Georges Cove Village

Modified Planning Proposal | 146 Newbridge Road, Moorebank

Prepared for Benedict Industries Pty Limited
May 2024

EMM Sydney
Ground floor, 20 Chandos Street
St Leonards NSW 2065

T 02 9493 9500
E info@emmconsulting.com.au

www.emmconsulting.com.au

Georges Cove Village

Modified Planning Proposal | 146 Newbridge Road, Moorebank

Report Number

J17103 RP2

Client

Benedict Industries Pty Limited

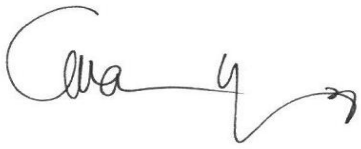
Date

1 May 2024

Version

v3 Final

Prepared by



Allan Young
National Technical Leader - Urban & Regional Planning
1 May 2024

Approved by



Phil Towler
Associate Director
1 May 2024

This report has been prepared in accordance with the brief provided by Benedict Industries Pty Limited and, in its preparation, EMM has relied upon the information collected at the times and under the conditions specified in this report. All findings, conclusions or recommendations contained in this report are based on those aforementioned circumstances. The contents of this report are private and confidential. This report is only for Benedict Industries Pty Limited's use in accordance with its agreement with EMM and is not to be relied on by or made available to any other party without EMM's prior written consent. Except as permitted by the *Copyright Act 1968* (Cth) and only to the extent incapable of exclusion, any other use (including use or reproduction of this report for resale or other commercial purposes) is prohibited without EMM's prior written consent. Except where expressly agreed to by EMM in writing, and to the extent permitted by law, EMM will have no liability (and assumes no duty of care) to any person in relation to this document, other than to Benedict Industries Pty Limited (and subject to the terms of EMM's agreement with Benedict Industries Pty Limited).
© EMM Consulting Pty Ltd, Ground Floor Suite 01, 20 Chandos Street, St Leonards NSW 2065. [2024]

Executive summary

This report has been prepared on behalf of Benedict Industries Pty Limited to propose an amendment to the *Liverpool Local Environmental Plan 2008* (LLEP).

The amendment relates to the land situated at 146 Newbridge Road, Moorebank (the subject site) and would result in the following:

- an additional site-specific Part 7 (Additional Local Provisions), Division 2 (Other Provisions) provision for a shop with a maximum gross floor area of 4,000 m^2.

This report has been prepared to assist Liverpool City Council to prepare a planning proposal for the LEP amendment of the site in accordance with section 3.33 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Further, this report has been prepared in accordance with the NSW Department of Planning and Environment's *Local environmental plan making guideline* (August 2023).

Table of contents

Executive summary ES.1

1 Introduction 1

1.1 Overview 1

1.2 Background 1

1.3 Employment zone reforms 2

1.4 Structure of the report 3

2 Site characteristics 4

2.1 The site and surrounds 4

2.2 Existing land use 4

3 Part 1 – Objectives and intended outcomes 7

4 Part 2 – Explanation of provisions that are to be included in the proposed LEP 8

5 Part 3 – Justification 9

5.1 Need for the planning proposal 9

5.1.1 Local strategic planning statement, strategic studies and reports 9

5.1.2 The best means of achieving the objectives or intended outcomes 10

5.2 Relationship to strategic planning framework 10

5.2.1 Applicable regional or district plans and strategies 10

5.2.2 Strategic merit 12

5.2.3 Liverpool Local Strategic Planning Statement 12

5.2.4 State and regional strategies and studies 13

5.2.5 State Environmental Planning Policies 14

5.2.6 Ministerial Directions 15

5.3 Section C - Environmental, social and economic impact 25

5.3.1 Critical habitat or threatened species, populations or ecological communities, and their habitats 25

5.3.2 Other resources 26

5.3.3 Other likely environmental effects as a result of the planning proposal and how are they proposed to be managed 26

5.3.4 Overshadowing 30

5.3.5 Social and economic effects 31

5.3.6 Effects on land in the vicinity of the site 33

5.3.7 Public infrastructure for the planning proposal 35
5.4 State and Commonwealth interests 35
5.4.1 Views of State and Commonwealth public authorities consulted in accordance with the Gateway determination 35
6 Part 4 – Maps 36
7 Part 5 – Community consultation 37
8 Part 6 – Project timeline 38
9 Closing 39

Appendices

Appendix A Georges Cove Village concept design and architectural statement A.1
Appendix B Ecological impact assessment B.1
Appendix C Detailed site investigation for DA 24/2017 at Lot 7 DP 1065574 C.1
Appendix D Remediation action plan for DA 24/2017 at Lot 7 DP 1065574 D.1
Appendix E Flood impact assessment E.1
Appendix F Bushfire constraints assessment F.1
Appendix G Traffic impact assessment G.1
Appendix H Social impact assessment H.1
Appendix I Economic impact assessment I.1

Tables

Table 4.1 Proposed amendments to Liverpool Local Environmental Plan 2008 8
Table 5.1 SEPPs and relevant deemed SEPPs 14
Table 5.2 Relevant local planning directions 16
Table 5.3 Existing approved and likely future uses 33
Table 8.1 Project timeline 38

Figures

Figure 1.1 Area A 2
Figure 2.1 Project location 5
Figure 2.2 Land zoning 6

1 Introduction

1.1 Overview

This planning proposal has been prepared by EMM Consulting Pty Limited (EMM) on behalf of Benedict Industries Pty Ltd (the proponent) to amend Division 2 (Other Provisions) of Part 7 (Additional Local Provisions) of the *Liverpool Local Environmental Plan 2008* (LLEP 2008) to provide for a shop with a maximum gross floor area of 4,000 m^2 on the subject site at 146 Newbridge Road, Moorebank.

Shops and other types of retail premises, including supermarkets, are a type of commercial premises (as defined under LLEP 2008).

The recent changes to land use zoning resulted in a change in zoning for the subject site from the previous zoning as B6 Enterprise Corridor to the new employment zone category of E3 Productivity Support.

Clause 35 of Schedule 1 of the LLEP 2008, provides for the use of certain land in Zone E3. Development for the purpose of 'commercial premises' - which includes shops, and more specifically a supermarket - is an already permissible land use on land identified as 'Area A' on the Land Zoning Map for LLEP 2008. The subject site is identified as Area A.

Notwithstanding the above provisions, subclause 7.23(2) of LLEP 2008 limits the gross floor area of retail premises in Zone E3 to a maximum of 1,600 m^2. Hence, an additional site-specific provision, pursuant to Part 7 (Additional Local Provisions), Division 2 (Other Provisions), is required in order to permit a shop with a maximum gross floor area of 4,000 m^2.

Concept designs prepared by Rothelowman Architects are provided at Appendix A. These include a supermarket and light industrial uses.

1.2 Background

An earlier planning proposal, prepared by the proponent, was referred to the Liverpool Local Planning Panel and was considered at a Council meeting in September 2020. Council subsequently forwarded the proposal to the Department of Planning and Environment (DPE) for Gateway determination. DPE returned the Gateway Request in December 2020 noting a need to further address issues regarding flooding and evacuation.

The proponent has since revised the design and function of the proposed development, this new planning proposal is being submitted.

Note that the earlier planning proposal sought:

- provision of a childcare centre, being prohibited development pursuant to the (then) land zoning of B6 Enterprise Corridor
- exceedance of the permissible 15 m building height control
- exceedance of the permissible floor space ratio of 0.75:1
- a gross floor area of 15,500 m^2 as per an existing Voluntary Planning Agreement (VPA).

These are no longer proposed.

In April 2023, Council was provided revised concept architectural plans and in June 2023 Council advised the proponent on the additional information required to progress this revised planning proposal.

This report is based on the revised design and addresses the matters required by Council.

1.3 Employment zone reforms

At the time of lodgement of the earlier planning proposal, the subject site was zoned B6 Enterprise Corridor which permitted the land use of 'commercial premises'.

Since lodgement of the earlier proposal, the Employment Zone reforms initiated by the DPE – specifically via the Standard Instrument (Local Environmental Plans) Amendment (Land Use Zones) Order 2022 – revised the zoning of the land to E3 Productivity Support. The new zonings took effect on 26 April 2023.

Clause 35 of Schedule 1 of the LLEP 2008 now provides for the use of certain land in Zone E3, and the migration of zoning maps to a digital format has included an overlay for the site which identifies it as 'Area A' (refer to Figure 1.1).

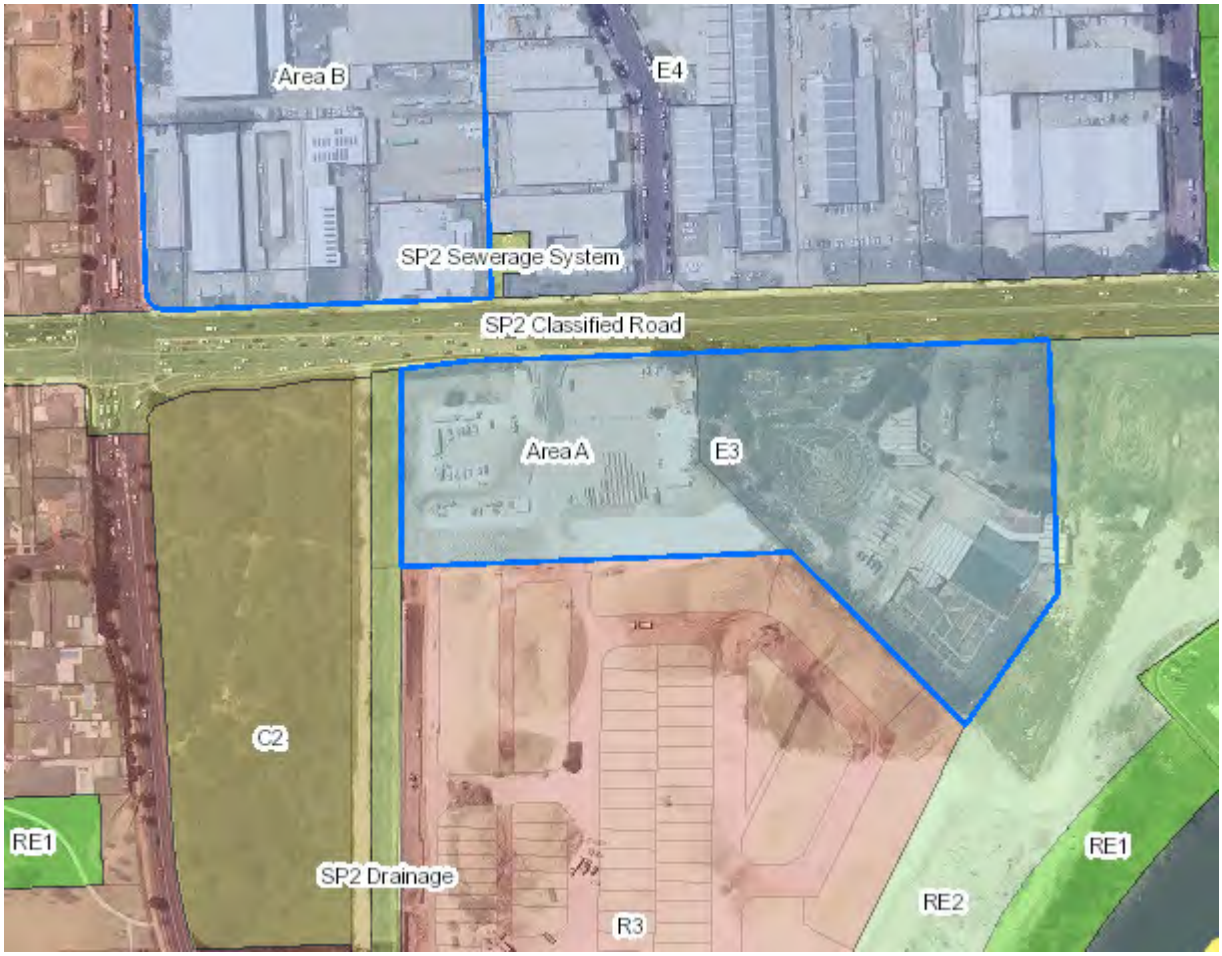


Figure 1.1 Area A

Development for the purpose of 'commercial premises' - which includes shops, and more specifically a supermarket is permissible land use on land identified as 'Area A' on the Land Zoning Map for LLEP 2008.

Notwithstanding the above provisions, subclause 7.23(2) of LLEP 2008 limits the gross floor area of retail premises in Zone E3 to a maximum of 1,600 m^2. Hence, an additional site-specific provision, pursuant to Part 7 (Additional Local Provisions), Division 2 (Other Provisions), is required in order to permit a shop with a maximum gross floor area of 4,000 m^2.

It is, therefore, necessary to prepare a planning proposal for an additional permitted use on this land.

1.4 Structure of the report

The planning proposal has been prepared in accordance with section 3.33 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Further, this report has been prepared in accordance with the NSW Department of Planning and Environment's *Local environmental plan making guideline* (August 2023). It includes the following:

- description of the site and its context
- an overview of the strategic context of the site
- a summary of the local planning controls
- an overview of the key elements of the planning proposal
- statement of the objectives and intended outcomes of the proposal
- explanation of the provision of the proposal
- justification of the proposal
- mapping to accompany the proposal
- description of the community consultation process expected to occur regarding the proposal
- an approximate project timeline.

The planning proposal is accompanied by a range of plans and reports to provide a comprehensive analysis of the site's opportunities and constraints. These include:

- Preliminary Concept Design prepared by Rothelowman Architects (Appendix A)
- Shadow Diagrams prepared by Rothelowman Architects (Appendix A)
- Ecological Impact Assessment by EMM Consulting (Appendix B)
- Detailed Site Investigation prepared by Douglas Partners (Appendix C)
- Remediation Action Plan prepared by Douglas Partners (Appendix D)
- Flood Study prepared by Mark Tooker and Associates (Appendix E)
- Bushfire Constraints Assessment prepared by ABPP Pty Ltd (Appendix F)
- Traffic Impact Assessment prepared by EMM Consulting (Appendix G)
- Social Impact Assessment (Appendix H)
- Economic Needs Assessment by LocationIQ (Appendix I).

2 Site characteristics

2.1 The site and surrounds

The site is located at 146 Newbridge Road, Moorebank, and is legally described as Lot 1 in DP 1246745 (herein referred to as 'the subject site') within the Liverpool Local Government Area (LGA) (refer to Figure 2.1). It is located in the eastern Moorebank precinct, 27 kilometres (km) south-west of Sydney CBD. The site area is approximately 17,220 m².

The site adjoins a classified road on its northern boundary, Newbridge Road (A34). To the west of the site is Georges Fair residential estate, to the east is the former Flower Power site and to the south Georges Cove residential estate. Further south is the approved (but not yet constructed) Georges Cove Marina.

Land further north and across Newbridge Road is zoned as industrial land within the suburb of Chipping Norton, largely characterised by wholesale, warehousing, transportation hubs and limited manufacturing.

Vehicular access to the site will be from Newbridge Road and a new local access road, which forms part of the Georges Cove residential subdivision as envisioned in Liverpool's Moorebank East Development Control Plan.

The site is owned by Tanlane Pty Ltd, a related entity of Benedict Industries Pty Ltd.

2.2 Existing land use

The site has been historically used as a recycling facility and contains some stockpiled soils and construction materials. Activities associated with the former extractive and waste management facilities on the site were undertaken by entities controlled by Tanlane Pty Ltd in accordance with all relevant regulatory requirements including development consents, environmental protection licences and other permits.

The site topography has been modified by the former extractive operations since development consent was granted for those activities in 1992. The site is substantially cleared of all vegetation, other than scattered patches of swamp oak and river flat eucalypt located along the northern periphery.





KEY

- Site boundary
- Cadastral boundary
- Named waterbody

INSET KEY

- Major road
- NPWS reserve
- State forest

Source: EMM (2023); ABS (2021); DCSSS (2023); GA (2009); MetroMap (2023)

0 100 200 m

GDA2020 MGA Zone 56

N

\\emmsvr1\EMM\Jobs\2017\J17103 - B6 Planning Proposal, Moorebank\GIS\02_Maps\PlanningProposal\PP001_SiteLocation_20231019_02.mxd 19/10/2023

Project location

Georges Cove Village
146 Newbridge Road, Moorebank
Modified Planning Proposal
Figure 2.1

EMM
creating opportunities



KEY

- Site boundary
- Cadastral boundary

Land zone

- C2 | Environmental conservation
- E3 | Productivity support
- IN2 | Light industrial
- IN3 | Heavy industrial
- R2 | Low density residential
- R3 | Medium density residential
- RE1 | Public recreation
- RE2 | Private recreation
- SP2 | Infrastructure
- W1 | Natural waterways

Source: EMM (2023); DCSSS (2023); DPIE (2022); MetroMap (2023)

0 100 200 m

GDA2020 MGA Zone 56

N

\\emmsvr1\EMM\Jobs\2017\17103 - B6 Planning Proposal, Moorebank\GIS\02_Maps\PlanningProposal\PP002_LandZoning_20231019_02.mxd 19/10/2023

Land zoning

Georges Cove Village
146 Newbridge Road, Moorebank
Modified Planning Proposal
Figure 2.2

EMM
creating opportunities

3 Part 1 – Objectives and intended outcomes

The objective of this planning proposal is to allow for provision of a supermarket within the development with a maximum gross floor area of 4,000 m^2.

The intended outcome of an increased gross floor area (GFA) for a shop on the site is to provide for the establishment of a supermarket which would service the everyday grocery needs of residents in the local catchment.

It is considered that the proposal will have substantial public benefits by enabling a suitably sized supermarket in the E3 zoned land - noting that the planning proposal does not seek a change in underlying zoning nor does it seek to allow for an entirely new class of development. The planning proposal simply seeks to change a development control to provide for a more market-based retail footprint. This is necessary to meet the day-to-day needs of an expanding local residential sector, and to meet the contemporary operational parameters for most major supermarkets.

The Georges Cove development precinct, within which the subject site is located, provides an entirely new precinct for Moorebank East which includes residential development, a marina and open space. This mixed-use precinct is delivering an uplift in local resident and visitor population, combined with other sites nearby, and will generate demand for local services including groceries.

Key objectives of the planning proposal are to allow for development which will:

- provide an appropriate mix of commercial and light industrial development in an underserviced locality where growth is anticipated
- reduce travel distances between residential development, retail and commercial facilities
- provide for compatible services for adjacent residential areas, including a full-line supermarket (which is generally considered to be over 3,200 m^2)
- contribute to a stronger neighbourhood character and vibrancy within Moorebank East.

More specifically, it will allow for the construction of a high-quality development to enhance the future Georges Cove Marina, complementing the adjoining land uses, particularly the Moorebank Cove and Georges Fair residential precincts, which are transitioning towards urban residential renewal with high design and environmental standards.

4 Part 2 – Explanation of provisions that are to be included in the proposed LEP

The proposed outcome will be achieved by including an additional site-specific provision, in Part 7 (Additional Local Provisions), Division 2 (Other Provisions), which provides for a shop with a maximum gross floor area of 4,000 m^2 (as per Table 4.1).

Table 4.1 Proposed amendments to Liverpool Local Environmental Plan 2008

LLEP 2008	Proposed amendment
Part 7, Division 2 Schedule 1 Additional permitted uses	Add a site-specific clause to allow a shop with a maximum gross floor area of 4,000 m^2

It is noted that LLEP 2008 does not typically refer to additional permitted uses via mapping amendments, instead referring to the legal description of land as 'use of certain land at…'.

The appropriate description for the additional permitted use is for application to certain land at 146 Newbridge Road, Moorebank, and the clause provisions should apply to Lot 1 in DP 1246745, or 'Area A'.

The amendment relates to the land situated at 146 Newbridge Road, Moorebank (the subject site) and would result in permissibility for a shop, within Area A, with a maximum gross floor area of 4,000 m^2.

5 Part 3 – Justification

The planning proposal has been assessed against the questions below (in shaded boxes) as set forth by the Department of Planning and Environment's *A guide to preparing planning proposal*s.

5.1 Need for the planning proposal

Is the planning proposal a result of an endorsed local strategic planning statement, strategic study or report?

5.1.1 Local strategic planning statement, strategic studies and reports

The planning proposal is not the direct result of a strategic study or report. However, it provides an improved alignment with the objectives of the following Council strategies for the local area as described below.

i Liverpool Local Strategic Planning Statement

Connected Liverpool 2040 is Council's Local Strategic Planning Statement (LSPS). It sets the long-term vision for the Liverpool local government area and guides the development of suburbs and balances the need for housing, jobs and services as well as parks, open spaces and the natural environment.

The LSPS gives effect to the Greater Sydney Region Plan and Western City District Plan.

Of particular relevance is LSPS Planning Priority 6 – to create high-quality, plentiful and accessible community facilities, open space and infrastructure aligned with growth.

The rationale states that Council is committed to the delivery of high-quality facilities and services that are attractive, flexible and address the needs of the general community. The planning proposal supports the policy intent of the LSPS by contemplating the future form and the growing residential component of the surrounding Georges Cove precinct and attending to the provision of suitable day-to-day services and facilities, such as local employment generating development and a local supermarket.

ii Liverpool Community Strategic Plan 2022-2032

The *Community Strategic Plan* (CSP) is a ten-year plan that defines the vision and priorities of the Liverpool community. The CSP is the overarching plan that sets the direction not only for Council but for all stakeholders, including government, business, the not-for-profit sector and residents. The directions from the CSP provide a guide for stakeholders to work together and to capitalise on the opportunities which will keep Liverpool moving forward.

Key strategies and goals for the CSP include:

- improve liveability and quality of life for the community by delivering vibrant parks, places and facilities
- deliver effective and efficient planning and high-quality design to provide best outcomes for a growing city.

This planning proposal aligns with the CSP by providing employment generating development and retail facilities which match the growth in the local residential population. Outcomes such as improved liveability and quality of life for the community are delivered by the planning proposal because it enables a walkable neighbourhood where shops, employment and residential areas are in close proximity.

Is the planning proposal the best means of achieving the objectives or intended outcomes, or is there a better way?

5.1.2 The best means of achieving the objectives or intended outcomes

A planning proposal is the best means of meeting the objectives articulated in Part 1 of the planning proposal, as the objectives require amendment to LLEP 2008 to provide for a larger gross floor area of a shop.

The alternative of a proposal to increase the permissible gross floor area of a shop in Area A would create a broader set of issues due to the likely change in permissible uses under the land use table of the LEP. Given the specific and limited need for a larger retail footprint to meet market needs, the current planning proposal for an increased permissible gross floor area provides the precision needed and limits the potential impacts that may be associated with a change in the underlying land use zone.

The availability of alternative locations is also highly constrained and the 'walkable neighbourhood' principles suggest that the emerging residential development on lands to the south of the site will benefit from a standard sized supermarket in the Georges Cove Village development.

5.2 Relationship to strategic planning framework

Will the planning proposal give effect to the objectives and actions of the applicable regional, or district plan or strategy (including any exhibited draft plans or strategies?

5.2.1 Applicable regional or district plans and strategies

The planning proposal has been assessed against the relevant adopted and draft regional and district plans for the Moorebank and Liverpool area, as discussed below.

i Greater Sydney Region Plan

In March 2018, the NSW Government released 'A Metropolis of Three Cities – The Greater Sydney Region Plan' which effectively replaces the previous strategic plan for Sydney which was 'A Plan for Growing Sydney'. The objective of A Metropolis of Three Cities is to balance growth and deliver the benefits of the Plan more equally and equitably to residents across Greater Sydney. The Greater Sydney Region Plan has been prepared concurrently with the Future Transport 2056 and the State Infrastructure Strategy, and aligns land use, transport and infrastructure planning to reshape Greater Sydney as three connected cities.

To meet the needs of a growing changing population, the vision seeks to transform Greater Sydney into a metropolis of three cities. These being:

- The Western Parkland City
- The Central River City
- The Eastern Harbour.

Liverpool LGA and is located within the Western Parkland City. Liverpool is identified as a metropolitan cluster.

There are 10 key directions for Greater Sydney in the Plan. Each key direction includes objectives relevant to that direction. The following directions are relevant to this Planning Proposal:

- **A city for people:**

  - The proposal will allow for the development of a local supermarket that provides a convenient focus for daily activities and which will be required by existing and future residents in the surrounding area.

- **A city of great places:**

  - A well-planned and well-designed development can improve the character of a place, its vitality and sense of community. It can make the local environment more attractive and improve services. The proposal will complement the desired future use of the immediate locality, including the adjacent Georges Cove residential area and the Georges Cove Marina. The proposed development will ensure that the Georges Cove precinct is a great place to live and work.

- **Jobs and skills for the city:**

  - The planning proposal is consistent with this direction, as it will allow for development of a mix of retail and light industrial development that will increase job opportunities in the area.

As demonstrated above, the planning proposal is consistent with the relevant directions of the A Metropolis of Three Cities.

ii Western City District Plan

The Western City District covers the Blue Mountains, Camden, Campbelltown, Fairfield, Hawkesbury, Liverpool, Penrith and Wollondilly local government areas.

The Western City District Plan is a 20-year plan to manage growth in the context of economic, social and environmental matters to achieve the 40-year vision for Greater Sydney. It is a guide for implementing the Greater Sydney Region Plan at a district level and is a bridge between regional and local planning.

This District Plan has been prepared to give effect to A Metropolis of Three Cities, the Region Plan that applies to the five districts that make up the Greater Sydney Region. It is the role of the Greater Sydney Commission to prepare and finalise the district plans.

The *Environmental Planning and Assessment Act 1979* (EP&A Act) requires district plans to:

- provide the basis for strategic planning in the District, having regard to economic, social and environmental matters

- establish planning priorities that are consistent with the objectives, strategies and actions of *A plan for growing Sydney*

- identify actions required to achieve those planning priorities.

The District Plan meets these requirements by:

- progressing the directions of *A plan for growing Sydney*

- identifying planning priorities for the District and the actions to achieve them.

District Plan Part 3 'Liveability' is about people's quality of life. Maintaining and improving liveability means housing, infrastructure and services that meet people's needs. This enables people to stay in their neighbourhoods, satisfy most daily requirements within a 15-minute travel distance, and participate in communities as they transition through life.

A place-based and collaborative approach is required to maintain and enhance the liveability of the Western City District. The Plan states that this can be achieved by adopting several Planning Priorities. Those relevant to this proposal include:

W3. Providing services and social infrastructure to meet people's changing needs

The planning proposal will enable development of an appropriate mix of services and development to complement the adjacent residential development.

W5. Providing housing supply, choice and affordability, with access to jobs, services and public transport

Access to services and jobs is the driver for this planning proposal. The supermarket will service the needs of residents, workers and visitors to Georges Cove.

W6. Creating and renewing great places and local centres and respecting the District's heritage.

The close proximity of the site to existing and future neighbouring residential developments, including Georges Cove residential development and Georges Cove Marina, will reduce the need for trips from those developments to shops and services by car.

W9 Growing and strengthening the metropolitan cluster

The urban structure to support the Metropolis of Three Cities needs to ensure people have access to a large number and range of jobs and services delivering a well-connected city. Liverpool is identified as one of the four centres in a cluster that is required to deliver the metropolitan functions of providing concentrations of higher order jobs and a wide range of goods and services.

5.2.2 Strategic merit

The planning proposal is considered to have strategic merit as it consistent with the relevant directions of the Western City District Plan and also the Local Strategic Planning Statement for Liverpool LGA.

The planning proposal achieves strong alignment with strategies for land use at regional, district and local scale.

Is the planning proposal consistent with a council LSPS that has been endorsed by the Planning Secretary or GCC, or another endorsed local strategy or strategic plan?

5.2.3 Liverpool Local Strategic Planning Statement

The Liverpool Local Strategic Planning Statement (LSPS), *Connected Liverpool 2040*, includes a number of planning priorities which align with the planning proposal.

i Planning Priority 5 - A vibrant, mixed-use and walkable 24-hour City Centre with the Georges River at its heart

This priority has a stated rationale for Liverpool to transform into a lively river city by 2040 with a strong 24-hour economy, providing ample space for jobs, homes, entertainment, recreation and education.

The provision of a supermarket and related retail within the site supports this vision and rationale by providing essential services in a walkable precinct at Moorebank.

ii Planning Priority 6 – High-quality, plentiful and accessible community facilities, open space and infrastructure aligned with growth

This priority is underpinned by Liverpool City Council's commitment to the delivery of high-quality facilities and services that are attractive, flexible and address the needs of the general community.

The Moorebank precinct is being transformed and there is growth already underway locally. The provision of suitable retail services in this precinct, close to emerging residential developments, will integrate several elements of the vision for the community, including high quality facilities and infrastructure.

Is the planning proposal consistent with any other applicable State and regional studies or strategies?

5.2.4 State and regional strategies and studies

The planning proposal is consistent with other relevant State and regional strategies and studies.

i Western Parkland City Blueprint and Economic Development Roadmap – Phase 1

The NSW Government released the draft reports and process guide for *Western Parkland City Blueprint and Economic Development Roadmap – Phase 1* in October 2022.

The roadmap for the Western Parkland City, which includes Liverpool LGA, sets a vision and strategic direction to maximise economic opportunities and attract investment and businesses to the district.

Key principles in the roadmap include:

- build for the long term
- unlock the economic potential of the Parkland City
- make community central to planning and delivery.

The planning proposal aligns with these principles.

ii Liverpool Economic Development Strategy 2022-2032

Liverpool's *Economic Development Strategy 2022-2032* outlines the key economic priorities, actions and targets that will guide the growth of Liverpool's economy.

The strategy identifies industries with the greatest growth (based on 2010/2011 data) and retail is ranked at number three with a 10% growth recorded to 2019/2020.

The group of industries which can be grouped as 'population-serving industries' (including retail, hospitality and construction) are boosted by the region's key competitive advantages in the health, education, freight and logistics. In other words, growth in sectors such as retail is driven by the multiplier effect of key regional industries such as freight and logistics which underpin the sustainable economic trajectory of Liverpool.

Is the planning proposal consistent with applicable State Environmental Planning Policies?

5.2.5 State Environmental Planning Policies

The planning proposal is consistent with applicable State Environmental Planning Policies (SEPPs) as shown in the Table 5.1.

Table 5.1 SEPPs and relevant deemed SEPPs

SEPP	Relevant matters	Consistency and comments
State Environmental Planning Policy (Planning Systems) 2021	Schedule 2 State significant development sites.	The subject land is not within a site identified pursuant to Schedule 2.
State Environmental Planning Policy (Industry and Employment) 2021	Chapter 2 Western Sydney Employment Area.	The site is not within the Western Sydney Employment Area.
State Environmental Planning Policy (Transport and Infrastructure) 2021	Schedule 3 Traffic generating development.	A referral to Transport for NSW may apply at the future development application stage.
State Environmental Planning Policy (Biodiversity and Conservation) 2021	Chapter 2 – Vegetation in non-rural areas Chapter 3 – Koala habitat protection 2020 Chapter 3 – Koala habitat protection 2021 Chapter 6 – Water catchments Chapter 13 – Strategic conservation planning	No clearing of vegetation is proposed. The land is not identified as koala habitat. No evidence of koala presence has been detected on the site. The land is within the Georges River catchment. The planning proposal does not adversely impact water quality, water flow, surface water or groundwater. The proposed uses are not water-dependent. The planning proposal will allow the well-ordered development of the site and will not preclude the establishment of appropriate stormwater and run off control measures for future development. This will likely result in an improved outcome for the Georges River catchment as required by this SEPP. The land is not within a mapped Strategic Conservation Area.
State Environmental Planning Policy (Resilience and Hazards) 2021	Chapter 2 – Coastal management Chapter 4 – Remediation of land	The land is not within the coastal zone. The SEPP aims to promote the remediation of contaminated land and sets out matters for a planning authority to consider when rezoning land that is or is potentially contaminated. The site is within land which has been identified to be contaminated by previous uses. (see detailed site investigation (Douglas Partners,2016)) (Appendix C). Remediation of the site will be undertaken in accordance with the *Remediation Action Plan* (Douglas Partners 2017) (Appendix D). As such, it has been demonstrated that the land will be suitable for the proposed uses after remediation. Development will not be permitted until that time.

Table 5.1 SEPPs and relevant deemed SEPPs

SEPP	Relevant matters	Consistency and comments
State Environmental Planning Policy (Precincts – Western Parkland City) 2021	Chapter 2 – State significant precincts Chapter 3 – Sydney region growth centres Chapter 4 – Western Sydney Aerotropolis Chapter 7 – Western Sydney Parklands	The land is not within a mapped State Significant Precinct. The land is not within a mapped Growth Centre. The land is not within the Aerotropolis application area. The land is not within the Noise Exposure Contours for the Western Sydney Airport. The land is not within the Obstacle Limitation Surface for the Western Sydney Airport. The land is not located on a Transport Corridor for the Western Sydney Airport. The land is not within the Western Sydney Parklands application map. The land is not within an area mapped as High Biodiversity Value.
State Environmental Planning Policy (Housing) 2021	Nil.	Residential development is not proposed pursuant to this (revised) planning proposal.
State Environmental Planning Policy (Sustainable Buildings) 2022	Chapter 3 – Standards for non-residential development.	The standards apply to the erection of a new building and, hence, will be applied at the development application stage. The proposed additional permitted use does not preclude future compliance with the standards for energy and water use.
State Environmental Planning Policy No. 65 – Design Quality of Residential Apartment Development	Nil	The planning proposal does not seek to provide residential apartments.

Is the planning proposal consistent with applicable Ministerial Directions (s.9.1 directions) or key government priority?

5.2.6 Ministerial Directions

The planning proposal has been assessed against each relevant Ministerial direction. These directions, issued pursuant to section 9.1(2) of the EP&A Act (previously section 117), apply to planning proposals lodged with the Department of Planning and Environment on or after the date the particular direction was issued and commenced. Consistency with relevant Local Planning Directions is discussed in Table 5.2.

Table 5.2 Relevant local planning directions

Direction	Relevant provisions	Response
1.1 Implementation of regional plans	1. Planning proposals must be consistent with a Regional Plan released by the Minister for Planning.	The relevant regional plan is the Greater Sydney Region Plan - A Metropolis of Three Cities. The Western City District Plan also applies to the site.
1.2 Development of Aboriginal Land Council land	This direction applies to all relevant planning proposal authorities when preparing a planning proposal for land shown on the Land Application Map of Chapter 3 of the State Environmental Planning Policy (Planning Systems) 2021.	Chapter 3 applies to land owned by an Aboriginal Land Council. The subject land is not owned by an Aboriginal Land Council.
1.3 Approval and Referral Requirements	1. A planning proposal to which this direction applies must: a) minimise the inclusion of provisions that require the concurrence, consultation or referral of development applications to a Minister or public authority, and b) not contain provisions requiring concurrence, consultation or referral of a Minister or public authority unless the relevant planning authority has obtained the approval of: i. the appropriate Minister or public authority, and ii. the Planning Secretary (or an officer of the Department nominated by the Secretary), prior to undertaking community consultation in satisfaction of Schedule 1 to the EP&A Act, and c) not identify development as designated development unless the relevant planning authority: i. can satisfy the Planning Secretary (or an officer of the Department nominated by the Secretary) that the class of development is likely to have a significant impact on the environment, and ii. has obtained the approval of the Planning Secretary (or an officer of the Department nominated by the Secretary) prior to undertaking community consultation in satisfaction of Schedule 1 to the EP&A Act.	This planning proposal has requested the minimum additional permitted uses to facilitate a supermarket in the Georges Cove Village development, and hence referrals are minimised. The provisions proposed do not stipulate concurrence, consultation or referral of a Minister or public authority. The development facilitated by the planning proposal is unlikely to be classified as designated development.

Table 5.2 Relevant local planning directions

Direction	Relevant provisions	Response
1.4 Site Specific Provisions	1. A planning proposal that will amend another environmental planning instrument in order to allow particular development to be carried out must either: a) allow that land use to be carried out in the zone the land is situated on, or b) rezone the site to an existing zone already in the environmental planning instrument that allows that land use without imposing any development standards or requirements in addition to those already contained in that zone, or c) allow that land use on the relevant land without imposing any development standards or requirements in addition to those already contained in the principal environmental planning instrument being amended. 2. A planning proposal must not contain or refer to drawings that show details of the proposed development.	This planning proposal seeks to allow additional retail floor space for the purpose of a supermarket to be carried out in the E3 zone the land is situated on. Drawings which detail the retail development are not provided within the planning proposal.
3.7 Public Bushland	1. When preparing a planning proposal, the planning proposal authority must be satisfied that the planning proposal: a) is consistent with the objectives of this direction, and b) gives priority to retaining public bushland, unless the planning proposal authority is satisfied that significant environmental, economic or social benefits will arise that outweigh the value of the public bushland. The objective of this direction is to protect bushland in urban areas, including rehabilitated areas, and ensure the ecological viability of the bushland, by: a) preserving: i. biodiversity and habitat corridors, ii. links between public bushland and other nearby bushland, iii. bushland as a natural stabiliser of the soil surface, iv. existing hydrological landforms, processes and functions, including natural drainage lines, watercourses, wetlands and foreshores, v. the recreational, educational, scientific, aesthetic, environmental, ecological and cultural values and potential of the land, and b) mitigating disturbance caused by development, c) giving priority to retaining public bushland.	The objective of this direction is to protect bushland in urban areas, including rehabilitated areas, and ensure the ecological viability of the bushland. The planning proposal does not adversely impact any biodiversity or habitat corridors; or links between bushland areas. The planning proposal also does not impact hydrological landforms or other values of the land. Disturbance which may be caused by the development is limited to the existing modified landscape and will not impact or reduce any adjoining bushland areas.

Table 5.2 Relevant local planning directions

Direction	Relevant provisions	Response
3.10 Water Catchment Protection	1. When preparing a planning proposal, the planning proposal authority must be satisfied that the planning proposal achieves the following: a) is consistent with the objectives of this direction, b) is consistent with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality, as published by Water Quality Australia, and any water quality management plan prepared in accordance with those guidelines, c) includes documentation, prepared by a suitably qualified person(s), indicating whether the planning proposal: i. is likely to have an adverse direct, indirect or cumulative impact on terrestrial, aquatic or migratory animals or vegetation, and any steps taken to minimise such impacts ii. is likely to have an impact on periodic flooding that may affect wetlands and other riverine ecosystems iii. is likely to have an adverse impact on recreational land uses within the regulated catchment. d) identifies and considers the cumulative impact of the planning proposal on water quality (including groundwater) and flows of natural waterbodies and on the environment more generally, including on land adjacent to or downstream of the area to which this direction applies, e) identifies how the planning proposal will: i. protect and improve environmental values, having regard to maintaining biodiversity, and protecting native vegetation, cultural heritage and water resources (including groundwater) ii. impact the scenic quality of the natural waterbodies and the social, economic and environmental interests of the community, iii. protect and rehabilitate land from current and future urban salinity, and prevent or restore land degradation, f) considers any feasible alternatives to the planning proposal. 2. When preparing a planning proposal, the planning proposal authority must: a) consult with the councils of adjacent or downstream local government areas where the planning proposal is likely to have an adverse environmental impact on land in that local government area, and b) as far as is practicable, give effect to any requests of the adjacent or downstream council.	

Table 5.2 Relevant local planning directions

Direction	Relevant provisions	Response
4.1 Flooding	1. A planning proposal must include provisions that give effect to and are consistent with: a) the NSW Flood Prone Land Policy, b) the principles of the Floodplain Development Manual 2005, c) the Considering flooding in land use planning guideline 2021, and d) any adopted flood study and/or floodplain risk management plan prepared in accordance with the principles of the Floodplain Development Manual 2005 and adopted by the relevant council. 2. A planning proposal must not rezone land within the flood planning area from Recreation, Rural, Special Purpose or Conservation Zones to a Residential, Employment, Mixed Use, W4 Working Waterfront or Special Purpose Zones. 3. A planning proposal must not contain provisions that apply to the flood planning area which: a) permit development in floodway areas, b) permit development that will result in significant flood impacts to other properties, c) permit development for the purposes of residential accommodation in high hazard areas, d) permit a significant increase in the development and/or dwelling density of that land, e) permit development for the purpose of centre-based childcare facilities, hostels, boarding houses, group homes, hospitals, residential care facilities, respite day care centres and seniors housing in areas where the occupants of the development cannot effectively evacuate, f) permit development to be carried out without development consent except for the purposes of exempt development or agriculture. Dams, drainage canals, levees, still require development consent, g) are likely to result in a significantly increased requirement for government spending on emergency management services, flood mitigation and emergency response measures, which can include but are not limited to the provision of road infrastructure, flood mitigation infrastructure and utilities, or h) permit hazardous industries or hazardous storage establishments where hazardous materials cannot be effectively contained during the occurrence of a flood event.	The Liverpool flood planning area maps show that a component of the site along the Newbridge Road frontage is in the flood planning area. A flood impact assessment (FIA) and Flood Emergency Response Plan (FERP) have been provided at Appendix E (Tooker and Associates, 2023). The FIA assesses the flood risk of the site and the performance concept design against this direction. The majority of the site in its Council designated benchmark pre-development state is above the flood planning level. Local Planning Direction 4.1 allows inconsistencies with this Direction if the inconsistency is of a minor significance. It is considered that the proposed inconsistency is of minor significance because it only involves a minor part of the site frontage along Newbridge Road which falls into the flood planning area. The majority of the site is not affected by, and does not affect, flood behaviour or flood impacts. The FIA has concluded that the concept design. would comply with the NSW government policy and the Council's LEP and DCP in terms of development of flood prone land. A Flood Emergency Response Plan prepared by Tooker and Associates (attached to Appendix E) demonstrates that the development will have an acceptable flood emergency response plan based on SES recommendations for evacuation and the proposed elevated pedestrian bridge.

Table 5.2 Relevant local planning directions

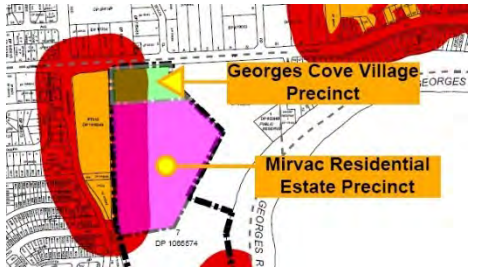
Direction	Relevant provisions	Response
4.3 Planning for Bushfire Protection	1. In the preparation of a planning proposal the relevant planning authority must consult with the Commissioner of the NSW Rural Fire Service following receipt of a gateway determination under section 3.34 of the Act, and prior to undertaking community consultation in satisfaction of clause 4, Schedule 1 to the EP&A Act, and take into account any comments so made. 2. A planning proposal must: a) have regard to *Planning for Bushfire Protection 2019*, b) introduce controls that avoid placing inappropriate developments in hazardous areas, and c) ensure that bushfire hazard reduction is not prohibited within the Asset Protection Zone (APZ). 3. A planning proposal must, where development is proposed, comply with the following provisions, as appropriate: a) provide an Asset Protection Zone (APZ) incorporating at a minimum: i. an Inner Protection Area bounded by a perimeter road or reserve which circumscribes the hazard side of the land intended for development and has a building line consistent with the incorporation of an APZ, within the property, and ii. an Outer Protection Area managed for hazard reduction and located on the bushland side of the perimeter road, b) for infill development (that is development within an already subdivided area), where an appropriate APZ cannot be achieved, provide for an appropriate performance standard, in consultation with the NSW Rural Fire Service. If the provisions of the planning proposal permit Special Fire Protection Purposes (as defined under section 100B of the Rural Fires Act 1997), the APZ provisions must be complied with, c) contain provisions for two-way access roads which links to perimeter roads and/or to fire trail networks, d) contain provisions for adequate water supply for firefighting purposes, e) minimise the perimeter of the area of land interfacing the hazard which may be developed, f) introduce controls on the placement of combustible materials in the Inner Protection Area.	The site is within the buffer area of Category 1 bushfire prone vegetation under the Liverpool Council Bushfire Prone Land Map. As such, the site is classified as bushfire prone land. The Category 1 vegetation is on land (a public reserve) to the west of the site.  Cumberland Ecology undertook an Ecological Constraints Assessment in 2009 and found that the vegetation within the public reserve to the west of the site contains Cooks River Castlereagh Iron Bark Forest. For retail and commercial development *Planning for Bushfire Protection* requires that these components of the development be located so that the buildings are not impacted by flame contact.

Table 5.2 Relevant local planning directions

Direction	Relevant provisions	Response
		In order to satisfy this requirement, the minimum separation distance to the Category 1 Bushfire Prone Vegetation in the public reserve is 19 metres (m). The Concept Plans provide a defendable space setback width of 21 m from the western boundary of the site. This setback includes the width of the drainage channel, maintenance track and retaining wall. The characteristics of the site, together with the fire protection measures recommended, provide that the rezoning and subsequent development of the land is suitable in terms of its intended retail/commercial/light industrial land use. Further, the concept design demonstrates how future development can feasibly access Newbridge Road and the future DCP Road, providing multiple access points for emergency egress and emergency vehicle access. As such, the planning proposal has taken the matters detailed in the direction into consideration. As stated in the direction, the relevant planning authority must consult with the RFS, following receipt of a gateway determination (e.g. post-gateway).

Table 5.2 Relevant local planning directions

Direction	Relevant provisions	Response
4.4 Remediation of Contaminated Land	1. A planning proposal authority must not include in a particular zone (within the meaning of the local environmental plan) any land to which this direction applies if the inclusion of the land in that zone would permit a change of use of the land, unless: a) the planning proposal authority has considered whether the land is contaminated, and b) if the land is contaminated, the planning proposal authority is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for all the purposes for which land in the zone concerned is permitted to be used, and c) if the land requires remediation to be made suitable for any purpose for which land in that zone is permitted to be used, the planning proposal authority is satisfied that the land will be so remediated before the land is used for that purpose. In order to satisfy itself as to paragraph 1(c), the planning proposal authority may need to include certain provisions in the local environmental plan. 2. Before including any land to which this direction applies in a particular zone, the planning proposal authority is to obtain and have regard to a report specifying the findings of a preliminary investigation of the land carried out in accordance with the contaminated land planning guidelines	A Detailed Site Investigation (DSI) was prepared by Douglas Partners in 2016 (refer to Appendix C) which considered the earlier planning proposal for this site which included a residential land use component. Douglas Partners also prepared a Remediation Action Plan (RAP) for the former planning proposal (refer to Appendix D). Noting the earlier use of the site for activities which included extractive activities, waste management and dredging, there have been a number of previous geotechnical and contamination investigations carried out at the subject site. The findings of the Douglas Partners investigation were generally consistent with previous investigations. The drilling program encountered uncontrolled filling with a component of construction and demolition waste to thicknesses of up to 9.2 m. The contaminant concentrations in soil were generally consistent with previous investigations with the exception of the polychlorinated biphenyls (PCB) hotspot encountered at one borehole. PCB has not previously been detected at the site, but this is most likely attributable to the heterogeneous nature of the waste filling. Ongoing landfill gas monitoring has confirmed a characteristic gas situation (CGS) of 3 and thus the need to incorporate gas mitigation systems into the building design.

Table 5.2 Relevant local planning directions

Direction	Relevant provisions	Response
		The Douglas Partners DSI conclude that the site can be made suitable for the (then) proposed residential development subject to the development of a suitable RAP. As residential development no longer proposed for the subject site, and the design for the future use of the site now includes retail and light industrial land uses, the findings of Douglas Partners remain valid and confirm the suitability of the site for the intended purpose.
4.5 Acid Sulfate Soils	1. The relevant planning authority must consider the Acid Sulfate Soils Planning Guidelines adopted by the Planning Secretary when preparing a planning proposal that applies to any land identified on the Acid Sulfate Soils Planning Maps as having a probability of acid sulfate soils being present. 2. When a relevant planning authority is preparing a planning proposal to introduce provisions to regulate works in acid sulfate soils, those provisions must be consistent with: (a) the Acid Sulfate Soils Model LEP in the Acid Sulfate Soils Planning Guidelines adopted by the Planning Secretary, or (b) other such provisions provided by the Planning Secretary that are consistent with the Acid Sulfate Soils Planning Guidelines. 3. A relevant planning authority must not prepare a planning proposal that proposes an intensification of land uses on land identified as having a probability of containing acid sulfate soils on the Acid Sulfate Soils Planning Maps unless the relevant planning authority has considered an acid sulfate soils study assessing the appropriateness of the change of land use given the presence of acid sulfate soils. The relevant planning authority must provide a copy of any such study to the Planning Secretary prior to undertaking community consultation in satisfaction of clause 4 of Schedule 1 to the Act. 4. Where provisions referred to under 2(a) and 2(b) above of this direction have not been introduced and the relevant planning authority is preparing a planning proposal that proposes an intensification of land uses on land identified as having a probability of acid sulfate soils on the Acid Sulfate Soils Planning Maps, the planning proposal must contain provisions consistent with 2(a) and 2(b).	The site is largely mapped on Council's Acid Sulfate Soils Map as Class 4 and Class 5. However, a portion of the site is mapped as Class 2. The planning proposal does not seek to introduce uses that are more intense than those currently permitted, other than an increase in floor area for retail use in the development. This type of change in permitted uses will not lead to any increase in required earthworks than would otherwise be required. A more detailed and site-specific acid sulfate study will be completed during the post-Gateway period.

Table 5.2 Relevant local planning directions

Direction	Relevant provisions	Response
5.1 Integrating Land Use and Transport	1. A planning proposal must locate zones for urban purposes and include provisions that give effect to and are consistent with the aims, objectives and principles of: a) Improving Transport Choice – Guidelines for planning and development (DUAP 2001), and b) The Right Place for Business and Services – Planning Policy (DUAP 2001).	The planning proposal will enable the development of retail and light industrial employment opportunities adjacent to public transport.
7.1 Employment Zones	1. A planning proposal must: a) give effect to the objectives of this direction, b) retain the areas and locations of Employment zones, c) not reduce the total potential floor space area for employment uses and related public services in Employment Zones. d) not reduce the total potential floor space area for industrial uses in E4, E5 and W4 zones, and e) ensure that proposed employment areas are in accordance with a strategy that is approved by the Planning Secretary. The objectives of this direction are to: a) encourage employment growth in suitable locations, b) protect employment land in employment zones, and c) support the viability of identified centres.	The objectives of this Direction are supported through the planning proposal. The retail sector is a major employer within the local government area (LGA) and the additional floor space available through this planning proposal enables a full-line supermarket, with the associated employment benefits, to be established in a suitable location (refer to the *Economic Impact Assessment* at Appendix I). This does not adversely impact employment zones within the LGA or regionally. The planning proposal also does not reduce the potential floor space for industrial uses and is within a E3 zone, not E4, E5 or W4.

5.3 Section C - Environmental, social and economic impact

Is there any likelihood that critical habitat or threatened species, populations or ecological communities, or their habitats, will be adversely affected because of the proposal?

5.3.1 Critical habitat or threatened species, populations or ecological communities, and their habitats

EMM has previously conducted an ecological assessment in relation to the entirety of the former Lot 7 DP 1065574 (i.e. the former Tanlane operational lands) for Mirvac Homes Pty Ltd as part of an Environmental Impact Statement (EIS) for works proposed on that lot. The Ecological Assessment (2016) from the EIS is provided at Appendix B.

The northern part of this previous ecological assessment is of most relevance to this planning proposal as the land assessed includes the relevant subject site for this planning proposal. Field surveys were undertaken, which included assessment of vegetation and flora and fauna habitat.

The ecological assessment included surveys aimed to identify the potential for threatened species, populations and/or communities listed under the (then) NSW *Threatened Species Conservation Act 1995* and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to occur within the project area. The study area for the ecology assessment included the northern portion of Lot 7 DP 1065574, which includes the subject site.

The ecological assessment identified Plant Community Type (PCT) 1232 Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion within the vegetated portion of the site, west of the road currently bisecting the site. The dominant Swamp Oak canopy and landscape position of this vegetation community were found to meet the scientific determination for the Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions Endangered Ecological Community (EEC) (Swamp Oak Floodplain forest) listing. However, exotic species were found to have dominated the ground strata.

A second vegetation type, PCT 836 Forest Red Gum - Rough-barked Apple open forest on poorly drained lowlands of the Central Coast, Sydney Basin Bioregion, was found on the eastern portion of the site.

This community was considered to meet the scientific determination for the River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC (River Flat Eucalypt forest), given the presence of characteristic Eucalypt and Angophora canopy.

No threatened species or threatened ecological communities listed under the EPBC Act were recorded, nor were any anticipated to occur across the whole of former Lot 7 DP 1065574, including the subject site. No hollow bearing trees were recorded as part of the assessment, with high levels of weed invasion noted across the study area, lowering the likelihood of arboreal mammals and nesting sites for hollow dependant birds.

No Koala population was detected or was predicted to occur on the site.

The ecological assessment considered the remnant vegetation areas to be highly isolated and disturbed with minimal potential for habitat for threatened fauna or flora species. The mid stratum and ground stratum of this plant community area are dominated by exotic species.

It is unlikely that the vegetation will provide habitat of importance to threatened fauna or flora species, given the high level of disturbance, small patch size and their isolation within a highly cleared landscape. In addition to the vegetation types described above, cleared areas and non-native vegetation are also likely to be present in project area.

As such, the previous ecological assessment provides a satisfactory level of detail to understand the likely natural environmental values on the site. However, it is recommended that a post-Gateway ecological assessment, informed by field surveys, and to the satisfaction of Council, is undertaken for the site to:

- verify the vegetation types and their extent within the site
- consider the fauna habitat, including any hollow bearing trees
- survey threatened flora and their habitat.

5.3.2 Other resources

The resources associated with this site, nominally sand and gravel, were extracted under a former land -use and are now depleted. The planning proposal therefore does not sterilise access to resources.

Are there any other likely environmental effects of the planning proposal and how are they proposed to be managed?

5.3.3 Other likely environmental effects as a result of the planning proposal and how are they proposed to be managed

i Contamination

The history of assessment and management of contamination at the site is summarised as follows:

- There have been a range of contamination assessments for the site beyond the Douglas Partners (May 2018) report that was Appendix 4 of the Planning Proposal, PP-2020-3520, prepared by Boston Planning (2020).
- These contamination assessments formed the basis for the site auditor concluding that, with remediation, the site can be made suitable for the proposed uses.
- These assessments met the requirements of NSW EPA guidelines and Chapter 4 of the Resilience and Hazards SEPP 2021 to the extent required for the site auditor to reach their conclusion.
- The Sydney Western City Planning Panel was satisfied with the level of contamination assessment as demonstrated by its approval of DA-611/2018 on 7 May 2021 and Modification 1 (DA-611/2018/A) on 30 November 2022 which included conditions requiring further contamination assessment that were drafted by Council.

We believe that the extensive contamination assessments for the site are suitable supporting documents for the planning proposal. Accordingly, preparation of another preliminary site investigation (PSI) for the site to specifically support this planning proposal is not justified as it is highly unlikely to provide any information that would change the conclusion that, with remediation, the site can be made suitable for the proposed uses.

ii Flood

A Flood Impact Assessment and Flood Emergency Response Plan has been prepared by Tooker and Associates (2023) and is provided in Appendix E.

The Georges Cove Village site is one of three development sites under the same land ownership in the Moorebank East precinct. The two other sites are the Georges Cove Residences - currently being developed by Mirvac - and the Georges Cove Marina site.

Cardno (now Stantec) have previously undertaken all the flood modelling for these three developments, and the sites are interrelated for wider flood modelling purposes. The benchmark pre-development land ground levels were formulated by Council and adopted in the earlier Cardno 2013 flood assessment as the base landform for the pre-development flood modelling of the three sites.

Liverpool Council subsequently required that there be no reduction in flood storage capacity over the combined area of the three developments for the 100-year average return interval (ARI) flood event. The Cardno flood report and the modelling and design results were then accepted by Liverpool Council.

The proposed development consists of a supermarket and retail specialty shops on Level 3 and commercial/light industrial on Level 4 and associated parking on Levels 2, 3 and 4. The dock loading area is on Level 1. Except for the Loading dock level, the rest of the site's proposed built form (including parking and commercial spaces) is above the 100-year ARI or probably maximum flood (PMF) levels. All the proposed habitable floor levels including the supermarket, retail shops and commercial/light industrial uses are flood free.

The proposed retail and light industrial/commercial development has been designed to exceed the State and local government requirements for flood management including due consideration of the recent recommendations in the *2022 Flood Inquiry Report* and revisions to the flood-related State and council planning requirements. It also complements the adjacent and recently approved development sites at Georges Cove Marina and Mirvac Georges Cove Residences. There is sufficient vehicular and pedestrian infrastructure to provide safe flood evacuation. There is also a fall-back emergency, the shelter-in-place option available above PMF flood levels (if required) and additionally, the same option is provided in the approved Georges Cove Marina and Mirvac Georges Cove Residences developments.

A copy of the Tooker and Associates report is provided at Appendix E.

iii Bushfire

A Bushfire Constraints Assessment has been prepared by Australia Bushfire Protection Planners Pty Ltd (2023) and is provided at Appendix F.

The Bushfire Constraints Assessment updates the previous report prepared in support of the previous planning proposal.

The Georges Cove Village site is identified on the Liverpool Council Bushfire Prone Land Map as containing the buffer zone to Category 1 Bushfire Prone Vegetation on the reserve land to the west.

Pursuant to Ministerial Direction No. 4.3 – Planning for Bushfire Protection under Section 9.1(2) of the *Environmental Planning and Assessment Act 1979*, Liverpool Council, in the preparation of a planning proposal that effects, or is in proximity to land mapped as bushfire prone land, must consult with the Commissioner of the NSW Rural Fire Service following receipt of a gateway determination under section 3.34 of the Act, and prior to undertaking community consultation in satisfaction of clause 4, Schedule 1 to the EP&A Act, and take into account any comments so made.

The only area at or adjacent to the site which contains bushfire prone vegetation is on the public reserve to the west. The vegetation within the public reserve to the west of the Georges Cove Village site contains Cooks River Castlereagh Iron Bark Forest, which is an endangered ecological community (EEC).

This vegetation has a width of approximately 90 m and therefore presents a high level of hazard to the proposed Georges Cove Village.

For retail and commercial development, the requirement under *Planning for Bushfire Protection 2019* is to position buildings so that they are not subject to flame contact.

In order to satisfy this requirement, the minimum separation distance to the Category 1 Bushfire Prone Vegetation on the land to the to the west of the site is 22 m.

The proposed development provides a defendable space width less than 22 m to the carpark floors, resulting in this part of the development being in the Flame Zone. The construction of the carpark will include non-combustible walls with an FRL of 240/240/240 therefore satisfying the construction requirements for a Flame Zone.

The floors containing the light Industrial and retail development are set back to achieve the defendable space width of 22 m. This setback includes the width of the drainage channel, maintenance track, retaining wall and setback to the building.

Warter supply for fire-fighting and access for fire-fighting operations is directly off Newbridge Road and the new road network within the Mirvac Estate to the south.

iv Traffic

On 14 June 2023, Council issued advice regarding the information required to progress the revised planning proposal. One traffic-related matter was stated to be:

> Due to the timeframe which has lapsed since the Traffic Impact Assessment Report was prepared being over 5 years and as the planning proposal concept architectural plans submitted in April 2023 have significantly changed since the preparation of the Traffic Impact Assessment Report, a revised Traffic Impact Assessment Report is to be submitted to Council.
>
> This may be in the form of an addendum as the development intensity of the subject site has been reduced as per the planning proposal concept architectural plans submitted in April 2023. It is required to include updated access and internal design comments (section 5), updated existing traffic and transport conditions/traffic studies (section 6), section 7 (Traffic Assessment), section 8 (summary) and appendix A (SIDRA Modelling outputs).

The previous traffic report, prepared by Ason Group, has been reviewed and a new traffic report (provided at Appendix G) has been prepared by EMM to address the above matters as required by Council.

a Key considerations and methodology

The key change, between the last traffic report (Ason Group) and the currently traffic report (EMM) is that the current planning proposal no longer includes residential accommodation, commercial offices or a medical centre. Instead, the planning proposal seeks to provide retail and light industrial units.

As part of this traffic report, traffic surveys were conducted on Thursday 22 June 2023 between 7 am–9 am and 4 pm–6 pm, during a non-school holiday period at nearby intersections.

Two scenarios have been assessed to determine the traffic impacts of the development of Georges Cove Village:

- Scenario A assumes that the DCP Road will not be connected to Davy Robinson Drive. It also assumes that Newbridge Road/Davy Robinson Drive intersection will not be signalised. Scenario A has been modelled based on the existing connection of the site to Brickmakers Drive via Promontory Way.

- Scenario B assumes that DCP Road will be connected to Davy Robinson Drive via the adjoining Flower Power site to the east. This scenario assumes that Newbridge Road/Davy Robinson Drive intersection will be signalised.

Currently, left-in movements are permitted from Newbridge Road (east) to the site, while left-out movements are permitted from the site to Newbridge Road (west) for both light and heavy vehicles. The existing egress – being left turn light vehicle movements from the site to Newbridge Road - will be restricted and the access will be limited to left turning ingress to the site from Newbridge Road. To calculate the baseline traffic volumes, the existing left turning egress movements from the site that will be restricted in the future have been redistributed to the other parts of the road network.

To assess the cumulative traffic for the planning proposal, the following components of the broader precinct have been considered:

- Georges Cove residences
- Georges Cove Marina (residential)
- Georges Cove Marina (commercial)
- Moorebank Recyclers land.

Intersection performance under the scenarios was modelled using SIDRA Intersection 9.1 software.

b Findings

The Traffic Impact Assessment Report (EMM) finds:

- Vehicles will be able to access the site via Promontory Way for all scenarios, while vehicles may access the site via Davy Robinson Drive in Scenario B. Scenario B is dependent on the development of the Flower Power site to connect the DCP Road to Davy Robinson Drive, as well as the signalisation of Newbridge Road/Davy Robinson Drive.
- Light vehicles will be able to enter the site from DCP Road on the south side of the site, as well as make a left turn from Newbridge Road (east) to the site access. For Scenario A, all light vehicle traffic will exit via Promontory Way, but will not exit via Davy Robinson Drive or from the site to Newbridge Road (west).

  For Scenario B, DCP Road will be connected to Davy Robinson Drive to the east of the site, so light vehicles will be able to exit via Davy Robinson Drive by a signalised intersection at Newbridge Road/Davy Robinson Drive.
- Heavy vehicles will be able to enter via a left turn from Newbridge Road east to the site, then proceed through an anti-clockwise circulation on the lower floor, exiting via a left turn to Newbridge Road (west) at the north-east of the site.
- The SIDRA traffic analysis shows the following:
  - Newbridge Road/Governor Macquarie Drive/Brickmakers Drive intersection is already operating over capacity, with LOS F and DOS >1, so additional traffic volumes from the development will have a minor impact on the intersection.
  - Efficiencies in the operation of the Newbridge Road/Governor Macquarie Drive/Brickmakers Drive intersection can reduce the delays in the PM peak compared to the existing scenario, even after the addition of the Georges Cove Village development and cumulative traffic volumes.

- The connection of DCP Road to Davy Robinson Drive and the signalisation of Newbridge Road/Davy Robinson Drive will improve the performance of Newbridge Road/Governor Macquarie Drive/Brickmakers Drive intersection in the AM and PM peak. Hence, due to the overall network benefits, TfNSW should consider signalisation of Newbridge Road/Davy Robinson Drive.

- The signalised Brickmakers Drive/Promontory Way intersection will operate satisfactorily at LOS A or B, with minimal delays. However, in the AM peak the queue may stretch back to the roundabout. This queuing will be alleviated by the connection of the DCP Road to Davy Robinson Drive.

  In addition, it should be noted that the existing traffic counts at this intersection also included construction related heavy vehicles. Hence, the SIDRA model is conservative.

- Newbridge Road/Site Access Road intersection will be impacted by traffic queues on Newbridge Road extending from Newbridge Road/Governors Macquarie Drive/Brickmakers Drive. While light and heavy vehicles will be queued while attempting to enter the site, no light vehicles will exit the site. Only heavy vehicles will exit the site onto Newbridge Road, which generally occurs outside of peak hours. Therefore, the additional impacts to this intersection will be negligible.

- In the existing scenario, Davy Robinson Drive (south approach) on the Newbridge Road/Davy Robinson Drive intersection experiences LOS F during the AM and PM peak hour. When the development traffic can exit via Davy Robinson Drive, signalisation of Newbridge Road/Davy Robinson Drive intersection will allow it to perform at LOS B.

- Until the DCP Road is constructed, as part of the Flower Power site development (Lot 2 DP 602988), and connection is established with Davy Robinson Drive, all traffic will be required to enter and exit the precinct via Promontory Way. In accordance with the Georges Cove Marina Consent (DA-611/2018), this intersection must be signalised prior to marina operations. It is expected that the precinct's traffic network will operate satisfactorily with the single connection via Promontory Way.

- The DCP Road connection to Davy Robinson Drive would further improve the operation of all roads in the precinct once constructed, and Newbridge Road/Davy Robinson Drive intersection is signalised by TfNSW. However, the DCP Road connection to Davy Robinson Drive and the signalisation of Newbridge Road/Davy Robinson Drive is not necessary for satisfactory traffic network performance in the precinct.

- Overall, this development either improves or maintains the existing levels of service surrounding the development. There will only be minor impacts on the existing community and users of the surrounding road network.

5.3.4 Overshadowing

Shadow diagrams have been prepared by Rothelowman to assess the proposed impact on solar access to future neighbouring properties between 9 am and 4 pm for the Winter Solstice (June 22). The shadow diagrams have been provided as part of Appendix A.

The site is bound by Newbridge Road to the north, a vegetated reserve to the west, the future Georges Cove residential subdivision to the south and a proposed mixed-use development to the east. The shadow diagrams take into account preliminary lot and dwelling layouts for the future residential subdivision to the south. The design of these dwellings has been modelled into the accompanying shadow study in order to accurately assess any impact on solar access to the dwellings primary private open space.

The built form of the proposal has been arranged such that all the housing sites to the south can comply with the minimum solar access requirements as set out in the DCP. A detail analysis of the urban context and the design considerations is included in the architectural design statement (refer Appendix A).

Has the planning proposal adequately addressed any social and economic effects?

5.3.5 Social and economic effects

i Social impacts

A Social Impact Assessment (SIA) was prepared by Cred Consulting Pty Limited (Cred) in 2017 for the former proposal and is attached as Appendix H. Cred Consulting has undertaken social impact assessments for multiple medium-to-large scale developments in the Moorebank area and is well informed on the needs for services and infrastructure in the area.

Council has requested that a SIA Addendum be provided in order to incorporate the reduced intensity of development and to consider updated and more contemporary policies, plans and data. A SIA Addendum has been prepared by EMM (2023) and is provided at Appendix H.

The Cred SIA only noted one negative social impact associated with the former planning proposal, being the possibility of increasing prices of housing in an area of increasing housing unaffordability. Cred attributed this impact to the provisions of large 3-bedroom apartments, which are no longer proposed as part of this development.

The revised (current) planning proposal relates only to additional permitted floor space for retail premises in order to accommodate a supermarket on terms which align with the market needs of supermarket operators.

The SIA Addendum makes a number of relevant findings as summarised below.

The policy and planning strategies, both at regional and local scale, point to:

- a growing population
- the need for retail and other services, at neighbourhood scale, in order to achieve place-making which is walkable and promotes liveability
- a shift from traditional industries to greater reliance on people-oriented jobs, including retail.

The population profile of Moorebank reveals a shift to slightly higher density, and a recent marked uplift in population within the suburb. The incoming population is characterised by a slightly increasing household size and slightly better employment and income metrics than the Liverpool LGA as a whole.

In order to meet these population characteristics and to deliver these strategic outcomes, retail space needs to be provided at a scale which is attractive and financially feasible for providers of supermarket or other retail services. The economic reality is that retailers make decisions based on location and available floor space. Planning controls need to adapt to these contemporary needs if future developments are to attract the type of retail businesses, and therefore the people-oriented jobs, which are envisioned under strategic planning instruments.

This suggests that the overall social impact of the proposed increase in floor area for retail premises at the site will be positive.

ii Economic impacts

Location IQ prepared an Economic Impact Assessment (July 2023), which presents an independent assessment of the need and demand for the proposed larger footprint retail facility. The report considers the likely economic impacts that would result from the proposed development. The assessment is provided at Appendix I.

Key findings of the research conducted for the Economic Impact Assessment are as follows:

- There are currently no major full-line supermarkets (over 3,200 m^2) within the main trade area.
- Supermarkets within the main trade area are quite small by modern supermarket standards, with the nearest major full-line supermarkets to the subject site provided at Westfield Liverpool, more than 5 km away.
- The major supermarket chains target a population of 8,000 to 10,000 persons in order to support one full-line supermarket. The main trade area population, at more than 24,500 persons, could support almost three full-line supermarkets, and up to four by 2041, based on a projected population of almost 32,000.

Retail related impacts identified include the following:

- With no full-line supermarkets currently provided within the main trade area, the proposed full-line supermarket at the subject site would retain a significant proportion of food and grocery expenditure that is currently escaping the area.
- A total impact of around -$14.4 million is projected to come from retail facilities within the main trade area in 2025/26, including -$7.1 million (or -17.5%) on Moorebank Shopping Centre and some -$5.8 million (-12.5%) on Chipping Norton Market Plaza. Other retail facilities within Moorebank (primarily along Newbridge Road), including Big Fresh are projected to be impacted by some -$0.4 million, or approximately -5%. Additionally, within the primary east sector, Milperra Shopping Centre impact is estimated at -$0.8 million (or -10%). These levels of impacts would not affect the viability of any retail facilities.
- The largest impact beyond the main trade area is projected to be on the Liverpool central business area (CBA), at a total of -$13.4 million, or some -1.7%. The various components of the CBA, including Westfield Liverpool (post development), Liverpool Plaza Shopping Centre and the balance or retail shopfront within the precinct are projected to be impacted by between -0.5% and -1% each.

  The next largest impact beyond the main trade area is likely to fall on Aldi at Bankstown Airport, at around -10% or some -$2.4 million dollars in 2025/26.
- The remaining impacts on other shopping centres within and beyond the main trade area are all lower than -5%.

Positive impacts identified by the Economic Impact Assessment include the following:

- Significant improvement in the range of retail facilities that would be available to the growing local population, particularly in terms of convenient supermarket retailing.
- The full-line supermarket would improve choice of location and allow for price competition. The inclusion of a full-line supermarket would represent the only such offer within the defined main trade area.

- The addition of a supermarket at the subject site would also result in the retention of spending currently being directed to other large supermarkets at major shopping centres situated beyond the main trade area, thereby reducing the need for local residents to travel further afield for their supermarket and convenience-based shopping needs.

- The creation of additional employment which would result from the project, both during the construction period, and more importantly, on an ongoing basis once the development is complete and operational. In total, some 993 jobs are likely to be created both directly and indirectly as a result of the retail and non-retail components of the proposed Georges Cove Village. This includes a number of youth employment opportunities with retail developments generally employing a large number of younger staff.

The Economic Impact Assessment concludes that the proposed development would offer a high degree of customer amenity and convenience by way of its high-profile site, easily accessible location, and quality design, and that a substantial net community benefit would result from the proposed Georges Cove Village development. These positive impacts are considered to sufficiently offset the trading impacts on some existing retailers.

5.3.6 Effects on land in the vicinity of the site

Existing, approved and likely future uses of the site and surrounding land is described in Table 5.3.

Table 5.3 Existing approved and likely future uses

Area	Existing use	Approved use	Likely future uses
The site	The site is currently vacant.	The site was zoned as B6 Enterprise Corridor under LLEP 2008. Since lodgement of the earlier proposal, the Employment Zone reforms initiated by the DPE revised the zoning of the land to E3 Productivity Support. The new zonings took effect on 26 April 2023. There is a savings provision provided under item 5 of Schedule 3 of the Standard Instrument (Local Environmental Plans) Amendment (Land Use Zones) Order 2022. This means any land use which was previously permissible on land under a former zone continues to be permitted with development consent until 26 April 2025. Pursuant to these savings provisions, a supermarket land use is permitted with consent on the subject site until 26 April 2025.	The planning proposal would allow for a supermarket, at a scale which is commercially feasible to likely operators, to service the needs of local residents and workers.
North of site	Immediately to the north of the site is Newbridge Road, a road that provides a regional connection to the Liverpool CBD, and Canterbury Bankstown Council, Sydney Airport and the Sydney CBD. Beyond Newbridge Road is the Chipping Norton industrial precinct, which	The Chipping Norton industrial precinct is zoned E4 General Industrial and E5 Heavy Industrial.	Given the close proximity of the Chipping Norton industrial precinct to existing receivers (e.g. the Georges River and bushland to the east and low density residential immediately to the west), it is likely that the current light industry and low impact general industry uses will continue unchanged into the future. While it is possible that a new heavy industry use could be established within the E5 Heavy Industrial area, this would

Table 5.3 Existing approved and likely future uses

Area	Existing use	Approved use	Likely future uses
	includes a variety of industrial uses and services, including warehousing, transport services and auto services. It does not appear that heavy industry (i.e. hazardous or offensive industry) exists in proximity to the site.		already be precluded from being in close proximity to the site due to existing receivers.
West of site	Immediately to the west of the site is a vegetation buffer of approximately 75 m. Beyond the vegetated area is a residential subdivision consisting primarily of low-density residential dwellings (e.g. separated dwellings).	The vegetated area west of the site is zoned C2 Environmental Conservation. This zone prohibits most development that is not for environmental protection or educational purposes. The residential area further to the west of the site is primarily zoned R3 Medium Density Residential, with a maximum height of building of 8.5 m. As such, low-rise medium density residential uses (e.g. townhouses/attached dwellings) and related uses are permitted, as per LLEP 2008.	It is likely that the vegetated area west of the site will remain vegetated and undeveloped, with the exception of environmental protection or flood mitigation works. It is possible that an educational trail/signage could be developed, though unlikely. It is likely that the residential area further to the west will remain low density residential in the near term, with slow densification associated with a transition to townhouse type development.
South of site	The south of the site is a residential development.	The south of the site is zoned R3 Medium Density Residential, with a maximum height of building of 8.5 m. As such, low-rise medium density residential uses (e.g. townhouses) and related uses are permitted, as per LLEP 2008.	A medium density townhouse subdivision on this site will be developed in the future. It is noted that the EIS also provides for recreation space and access to the foreshore of the Georges River, which would benefit and be accessible from the site via a pedestrian thru-site link.
East of site	The east of the site is formerly a nursery (Flower Power), with the Georges River and a limited amount of low density residential beyond.	The former Flower Power nursery land to the east of the site is zoned as E3 Productivity Support, with a mix of RE1 Public Recreation, RE2 Private Recreation, R2 Low Density Residential and W1 Natural Waterways (i.e. Georges River) further to the east.	It is understood that a planning proposal has been lodged for the neighbouring Flower Power land (Lot 2 DP 602988) to the east. This planning proposal would allow for residential development, similar to that being proposed to the south of the site. Commercial and limited retail uses are also proposed. Given the flood prone nature of the lands further to the east, it is likely that the current uses will continue in the short term, with medium to long term transitions to foreshore or other environmental or recreational uses. The Flower Power proposal is noted to include approximately 10,847 m^2 of public open space and approximately 5,400 m^2 of private open space.

As noted above, the planning proposal seeks to allow for an increased floor space for a supermarket within the future development, and that the resulting character and land use will be consistent with the existing, approved and likely future uses of land in the vicinity.

Section D – Infrastructure (Local, State and Commonwealth)

Is there adequate public infrastructure for the planning proposal?

5.3.7 Public infrastructure for the planning proposal

As noted elsewhere, the zoning of the site allows for commercial and retail uses, and the only change sought is with respect to the floor space available for retail use (i.e. a supermarket). Further, the site is in a developed area with a growing resident population and workforce who will benefit from access to daily provisions in close proximity.

The planning proposal will not require provision of additional types of infrastructure in order to accommodate a slightly larger footprint for retail use within the future development. However, consultation is anticipated with service and infrastructure providers as part of post-Gateway consultation.

As noted in the TIA, the site is adjacent to Newbridge Road, with the M90 Liverpool to Burwood bus service providing peak hour services every 10 minutes, and services outside of peak hour generally every 15–20 minutes. The bus service generally operates between 5:30 am and 9.30 pm, Monday to Friday and generally 7 am to 9 pm Saturdays, Sundays and public holidays.

5.4 State and Commonwealth interests

What are the views of State and Commonwealth public authorities consulted in accordance with the Gateway determination?

5.4.1 Views of State and Commonwealth public authorities consulted in accordance with the Gateway determination

The proponent has engaged in early consultation with Liverpool City Council and the Council has indicated in-principal support for this planning proposal to be prepared. Further consultation with LCC will be undertaken as the planning proposal progresses.

Initial consultation was commenced with Transport for NSW (TfNSW) regarding ingress and egress arrangements, and plans were amended in response to TfNSW suggestions.

It is expected that further consultation will be undertaken with the following public authorities:

- TfNSW, due to the adjacent classified road and regarding public transportation access
- Department of Primary Industries, due to the proximity of the Georges River.

No consultation has been undertaken with the Commonwealth Government. There are no Commonwealth land holdings in the vicinity (i.e. within 1 km) of the subject site.

6 Part 4 – Maps

The planning proposal seeks to amend the Key Sites Map (KYS_014) of the Liverpool Local Environmental Plan 2008 to identify the land the subject of the additional permitted use.

7 Part 5 – Community consultation

Public consultation will be undertaken in accordance with the requirements of the Gateway Determination and the Department of Planning and Environments *A guide to preparing local environmental plans*.

It is expected that the planning proposal will be exhibited for a period not less than 28 days and that this will include notification of the public exhibition:

- in relevant local newspapers
- in writing to the owners and occupiers of adjoining and nearby properties.

8 Part 6 – Project timeline

Estimates of timeframes for each key stage of the project are shown in Table 8.1.

Table 8.1 Project timeline

Step	Proposed date
Planning Proposal consideration by Council	April 2024
Planning Proposal submitted to Department of Planning and Environment (DPE) seeking Gateway Determination	May 2024
Anticipated commencement date (date of Gateway Determination)	May 2024
Anticipated timeframe for the completion of required technical information and peer review by Council	June 2024
Public exhibition and public authority consultation	June 2024
Timeframe for consideration of submissions	July 2024
Timeframe for the consideration of a proposal post exhibition (including reporting to Council)	August 2024
Drafting of instrument and finalisation of mapping	September 2024
Date of submission to DPE to finalise the LEP	October 2024
Anticipated date Relevant Planning Authority (RPA) will make the plan	October 2024
Anticipated date RPA will forward to DPE for notification	November 2024

9 Closing

This planning proposal seeks to amend Liverpool Local Environmental Plan 2008 to enable the development of a full-line supermarket at 146 Newbridge Road, Moorebank. It has been prepared in accordance with section 3.33 (previously section 55) of the EP&A Act and relevant guidelines from DPE, aligns with State and Council strategies and appropriately addresses the strategic merit and site-specific merit tests set out in the *Local environmental plan making guideline*.

The planning proposal demonstrates that the amendment is justified and will contribute to the provision of a high-quality development that will complement the emerging local development comprising housing, employment opportunities and essential services for current and future residents in the area.

The planning proposal is therefore suitable for Council consideration and forwarding to DPE for Gateway determination.

Appendix A

Georges Cove Village concept design and architectural statement

rothelowman

Brisbane, Melbourne, Sydney
rothelowman.com.au

Planning Proposal

Georges Cove Village

146 Newbridge Rd, Moorebank

April 2023



Project Contact

Ben Pomroy
Principal

T +61 2 8045 2600
BenP@rothelowman.com.au

© Rothe Lowman Property Pty. Ltd.
Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document. The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorised changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document.

Contents

1.0	**Architectural Statement**	**3**
	1.01 Project Summary	3
2.0	**Urban Context and Site Analysis**	**4**
	2.01 Site Location	4
	2.02 Existing Planning Controls	5
	2.03 Existing Site Photographs	6
3.0	**Design Evolution & Response**	**7**
	3.01 Road Network & Access	7
	3.02 Key Design Considerations	8
	3.03 Approved Subdivision Plan	9
	3.04 Massing Concept	10
	3.05 Site - Flooding	11
	3.06 50m Setback	12
	3.07 Existing Controls - Height	13
	3.08 Solar Analysis	14
	3.09 Solar Analysis	15
4.0	**Design Proposal**	**16**
	4.01 Perspective	16
	4.02 Perspective	17
	4.03 Perspective	18
	4.04 Perspective	19
	4.05 Perspective	20
	4.06 Perspective	21
	4.07 Perspective	22
	4.08 Perspective	23

Client
Benedict Industries
33-39 Riverside Road
Chipping Norton, NSW

Architecture
Rothelowman
Level 1, 241 Commonwealth St
Surry Hills, NSW, 2010

Traffic Consultant
Ason Group
Suite 1202, Level 12, 220 George Street
Sydney, NSW, 2000

Town Planning
Emmconsulting
Suite 01, Ground Floor, 20 Chandos Street, St Leonards,
NSW, 2065

1.0 Architectural Statement

1.01 Project Summary

Project Details

3 Storey Mixed Use Development comprising a total of 10 387.4m² of GFA

Project uses include:

- Light Industrial: 4903.0m² NLA
- Retail: 5326.7m² NLA including 3800m² Supermarket
- Associated carparking and driveway circulation spaces

The Site
146 Newbridge Road, Moorebank, NSW

The Opportunity
Create the Village Centre for the New Georges Cove Precinct. Located at the north end of the precinct, the development proposes a mixed use retail development to provide the services and retail required for the new community, equipped with a diversity of light industrial options to accompany the low density Mirvac estate.

The Proposed Development
The Georges Cove Village development comprises large format supermarket, and supporting specialty retail, along with commercial office space suitable for medical and other uses.

Above the retail level is proposed as Light industrial Units to provide a diverse arrangement of employment based uses suitable for the surrounding precinct.

Taking advantage of the sloping land towards Newbridge Road, the carparking and loading dock are located on the Newbridge Road level.

The design proposal seeks to amend the permitted uses to include provision for a Supermarket development, in order to serve the needs of the new residents in the precinct, and the broader Moorebank area.



2.0 Urban Context and Site Analysis / 2.01 Site Location

The site is located on Newbridge Road, Moorebank, at the north end of the New Georges Cove residential area.

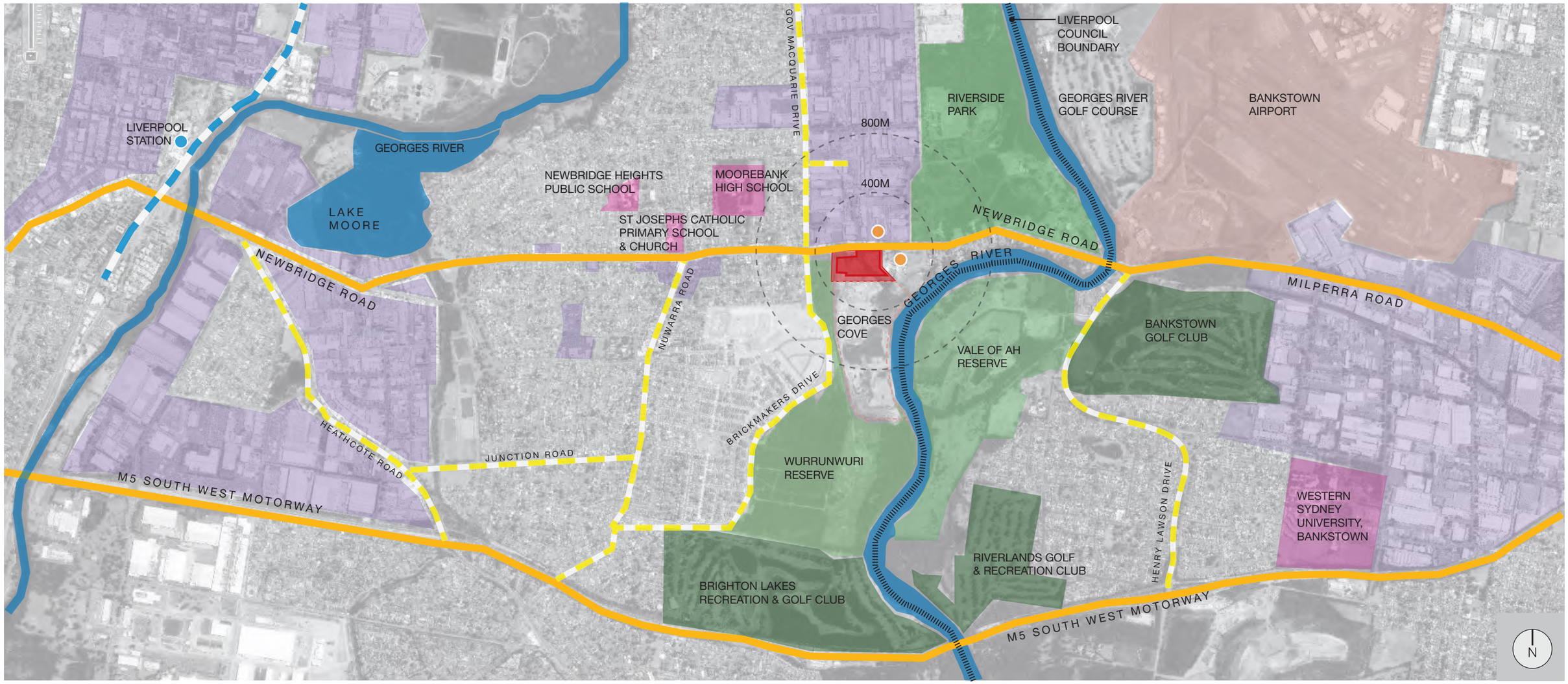
To the north across Newbridge Road is the Chipping Norton industrial estate. To the west landscape reserve and Brickmakers Drive. To the south is the Georges Cove residential development. And to the east is Flower Power Nursery.

Legend (Zones)

- Commercial Buildings
- Major Schools / Universities
- Golf Courses
- Parks & Open Spaces
- Bankstown Airport

Legend

- Subject Site
- Major Road
- Local Access Road
- Train Route
- Train Station
- Bus Stop
- Bike Path
- City Cycle Station



The existing planning controls permit small neighbourhood retail shops and shop top housing.
It is proposed to amend the planning controls on the site as follows

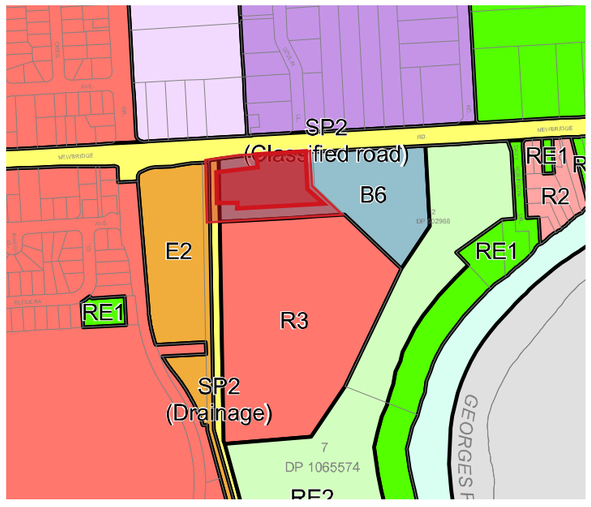
The Proposal:

- Schedule 1 Amendment to LEP to allow for supermarket uses above 1600m

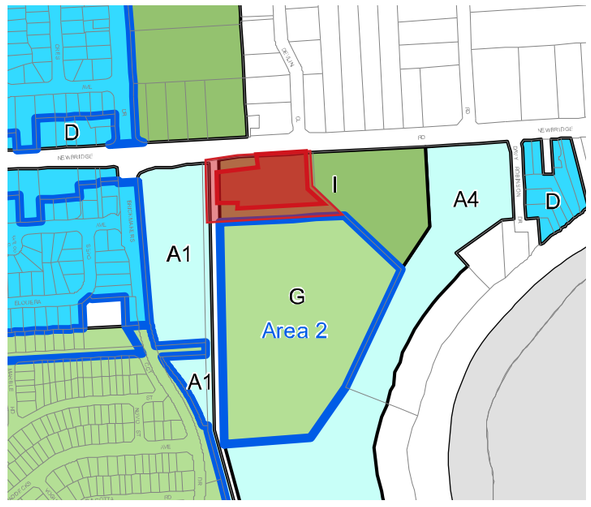
- Current site area: 17 184m^2
- FSR for site: 0.75:1
- GFA cap as per Voluntary Planning Agreement is 11 500m^2

- Proposed GFA at 10 387m^2 equates to an FSR of 0.60:1

Land Zoning



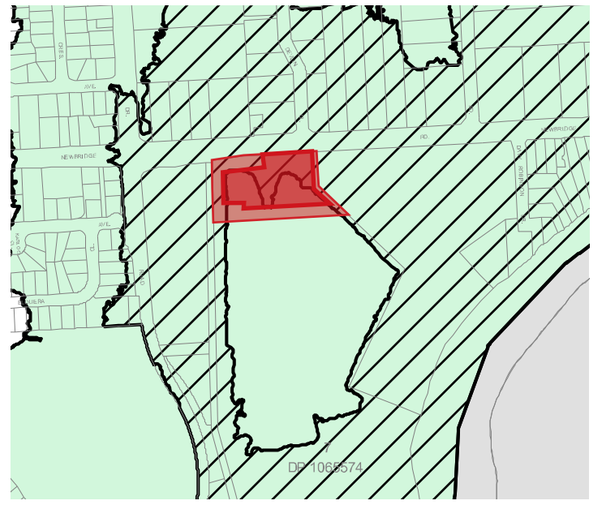
Floor Space Ratio



Height of Buildings



Flood Planning



Legend

	Subject Site
	B6 Enterprise Corridor
	E2 Environmental Conservation
	IN2 Light Industrial
	IN3 Heavy Industrial
	R2 Low Density Residential
	R3 Medium Density Residential
	RE1 Public Recreation
	RE2 Private Recreation
	SP2 Infrastructure
	W1 Natural Waterways

Legend (n:1)

	Subject Site
	A1 0.01
	A4 0.25
	D 0.5
	I 0.75
	G 0.65

Legend (m)

	Subject Site
	I 8.5M
	O 15M
	R 21M
	U 30M

Legend (m)

	Subject Site
	Flood Prone Land
	Flood Planning Area
*	Flood Design RL 5.60

N





View 1
Looking South from Eastern boundary on Newbridge Road



View 2
Looking South-West from Newbridge Road



View 3
Looking North-East from Entrance



View 4
Looking South from Entrance



View 5
Looking South-West from Entrance



View 6
Looking South from Western boundary on Newbridge Road

The site currently has a slip lane with left in, and left out from Newbridge Road.

The proposal encompasses:

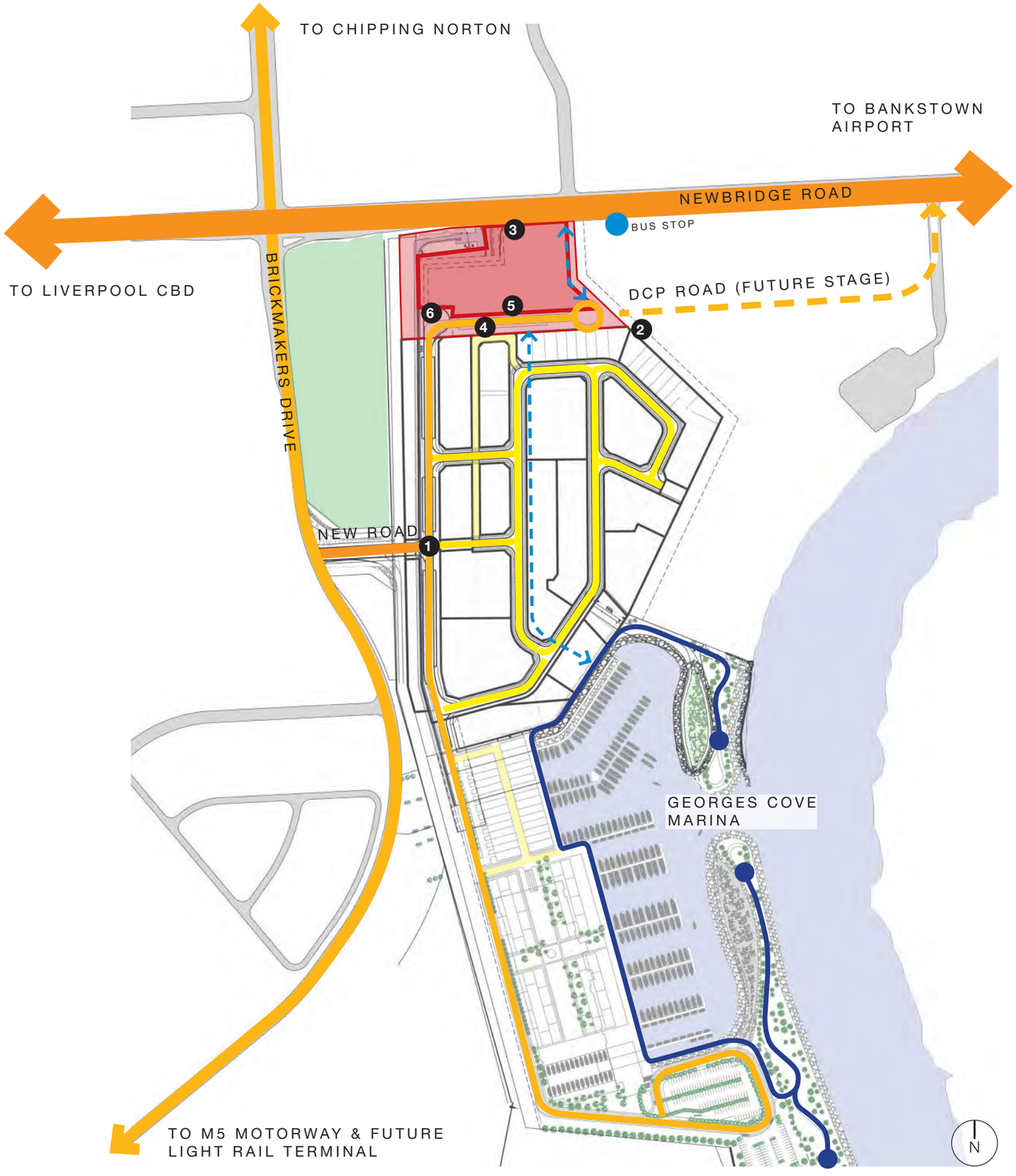
- Extension of existing slip lane to Newbridge Rd along frontage
- Entry + exit for heavy vehicles from Newbridge Rd
- Entry only for retail/commercial customer vehicles from Newbridge Rd
- All other traffic access from the new DCP road to the South

Legend

	Subject Site
	Collector Street 20m
	Main Access Street 15m
	Other Local Access Street
	Pedestrian Walkways
	Foreshore Walk

Vehicular Network

1	Site is connected to Brickmakers Drive through Mirvac Estate. This is flood free access
2	Future connection through development sites to the east
3	Existing driveway access to site proposed to provide entry + exit for trucks, and entry only for cars
4	DCP road provided on site (connection)
5	Access + exit for residential vehicles
6	Access + exit for retail vehicles



The following key opportunities and constraints on the site have been dealt with as part of the design response.

Opportunities

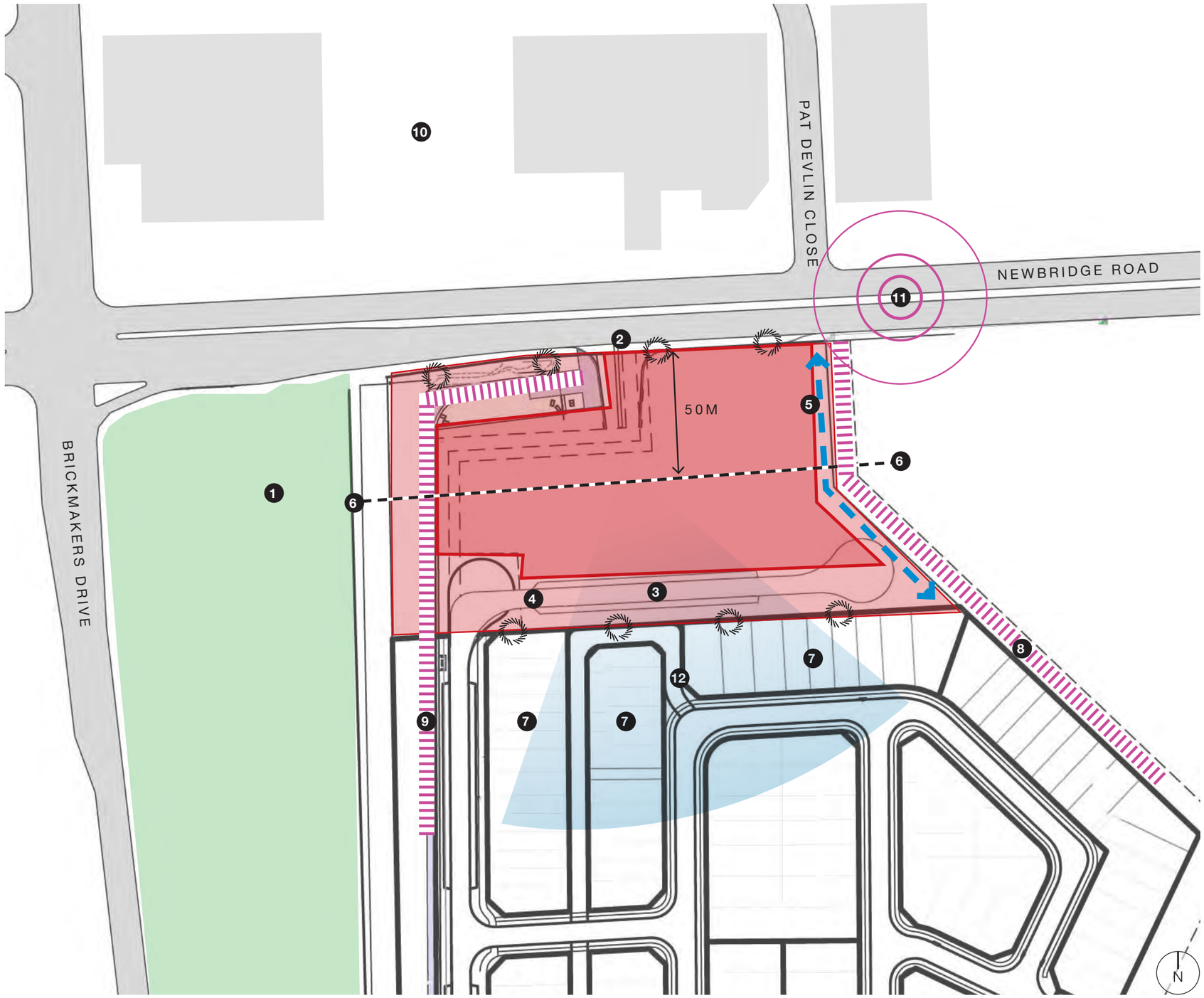
1. Landscape outlook
2. Vehicular access to Newbridge Road
3. New DCP road providing level address
4. Significant cross fall enables sleeving of carpark to residential area, and elevation of building above flood planning levels
5. Pedestrian Public Cross Link connecting Newbridge Rd to New Road and residential areas

Constraints

6. 50 metre setback for residential development
7. Future residential development to the South
8. Service easement to East
9. Drainage channel to West
10. Adjacent industrial estate
11. Noise + amenity constraints of Newbridge Rd lie to North of site
12. Significant local views exist due South of site

Legend

- Subject Site
- High Point
- Low Point
- Pedestrian Walkway
- Drainage Channel Easement



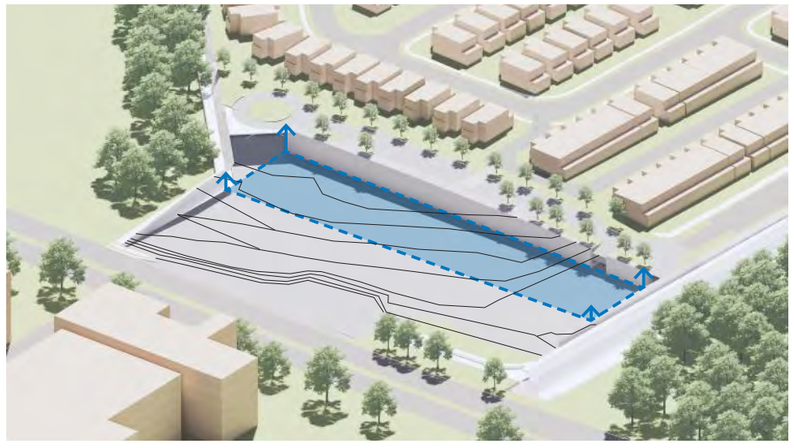
Approved subdivision of lots:



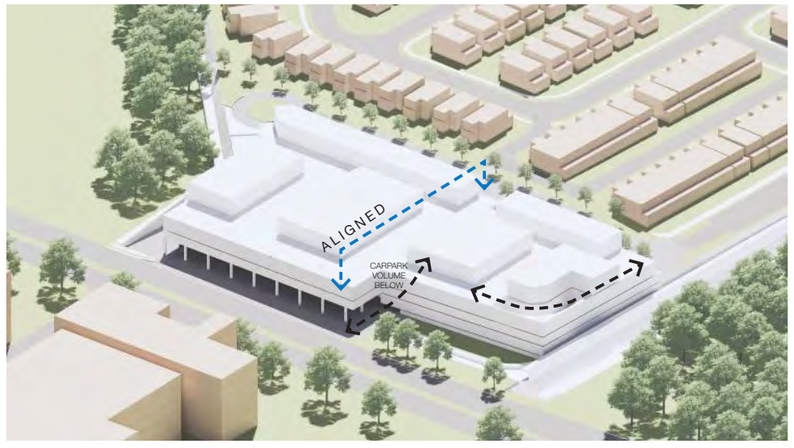
Concept diagrams outlining strategy behind massing and connection to the site. The design aims to work with the existing topography constraints to maximise yield without compromising space. The street network has defined the retail frontage, creating opportunity for communal street interactions and tucking away parking.

The pedestrian network has been enhanced with curated massing blocks that work with the existing height plane. These industrial areas are positioned above the retail to make the most of the views around the precinct.

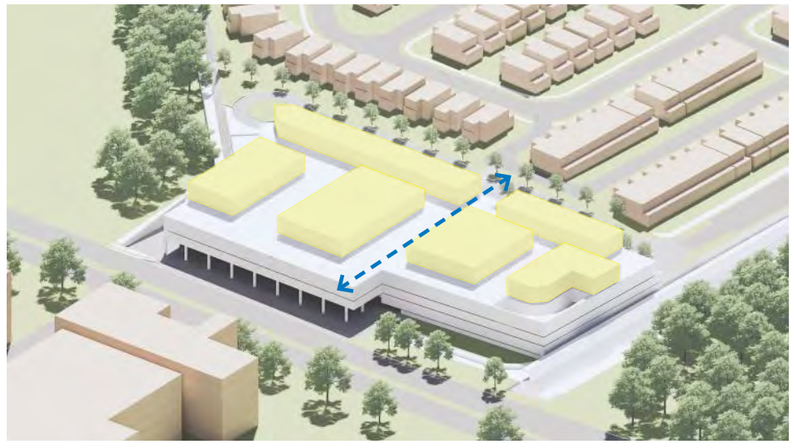
A buffer between Newbridge Road and pedestrian areas is created with the strategic positioning of the loading dock and ramp.



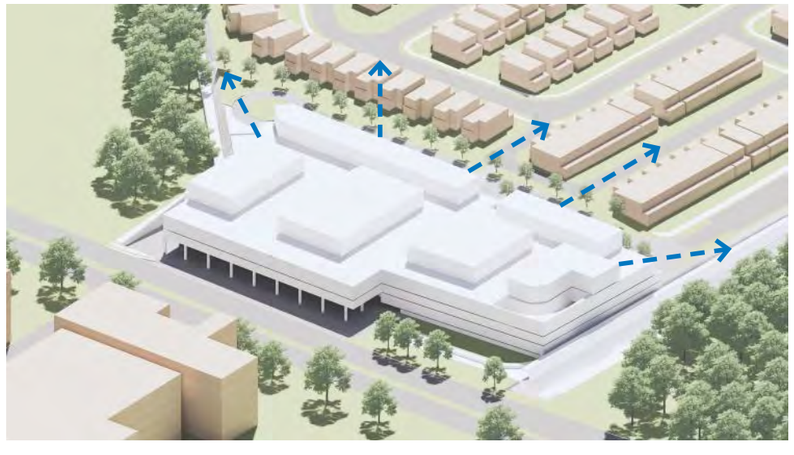
1:
Proposed site topography; Lift all carparking above Flood Planning Level



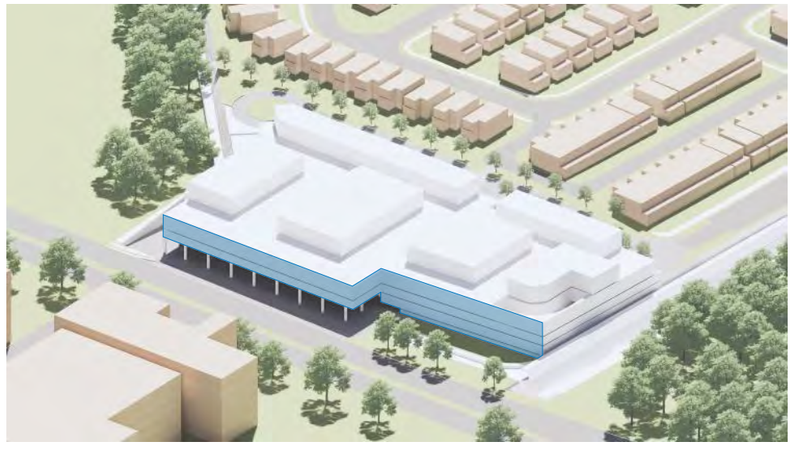
2:
Set main retail level to Georges Cove street network; creating carpark volume



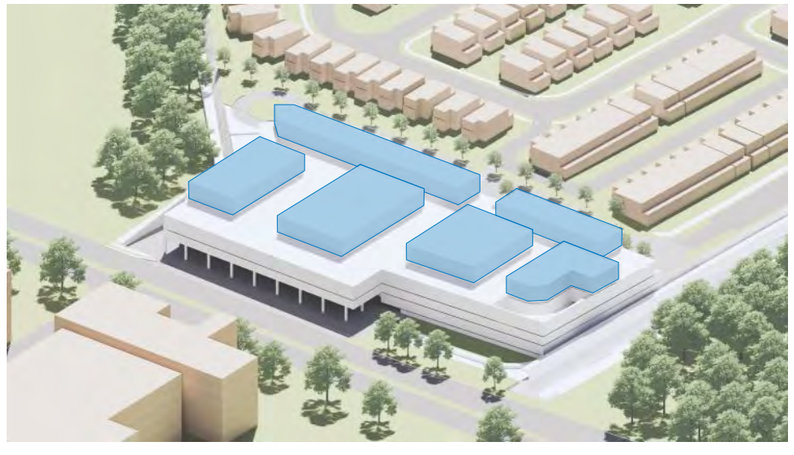
3:
Draw in the surrounding street and pedestrian network



4:
Industrial positioned above capturing views



5:
Loading dock and ramp positioned on Newbridge Road to create a buffer



6:
Articulate industrial forms to allow for views and solar access to South

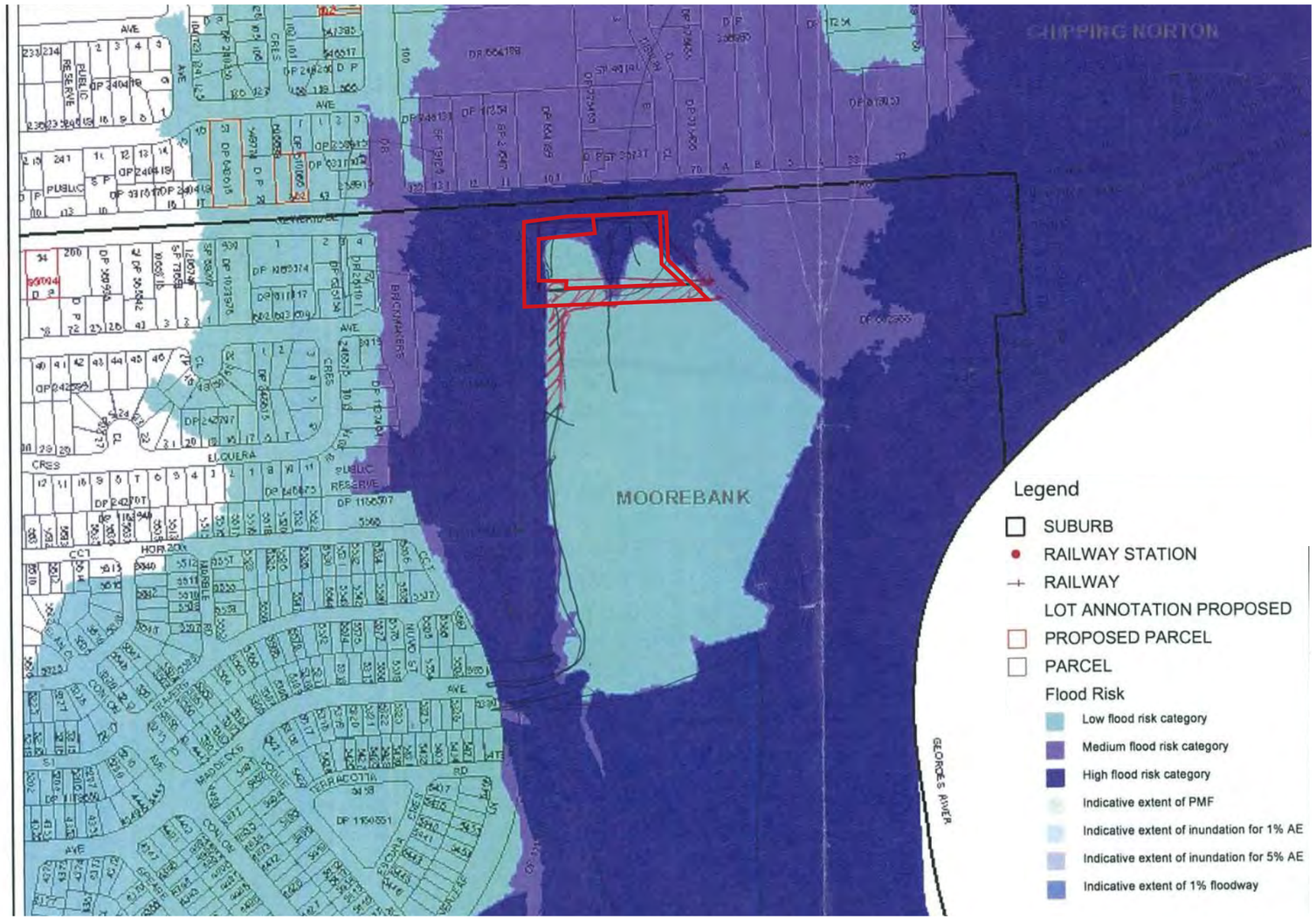
The subject site is flood affected according to Liverpool Council Modelling. The proposed development has been sited above the flood planning level throughout. The proposed critical levels are:

- Loading dock RL 3.0m
- Lower retail parking RL 4.6m
- Lowest residential parking RL 7.5m
- Retail parking RL 10.3m

All levels are above minimum RL flood planning levels.

The carpark is proposed as a suspended slab to allow for limited disruption to the current flood movement patterns. The loading dock apron will be below this level, matching current site level.

Refer to detailed flood study for additional information.

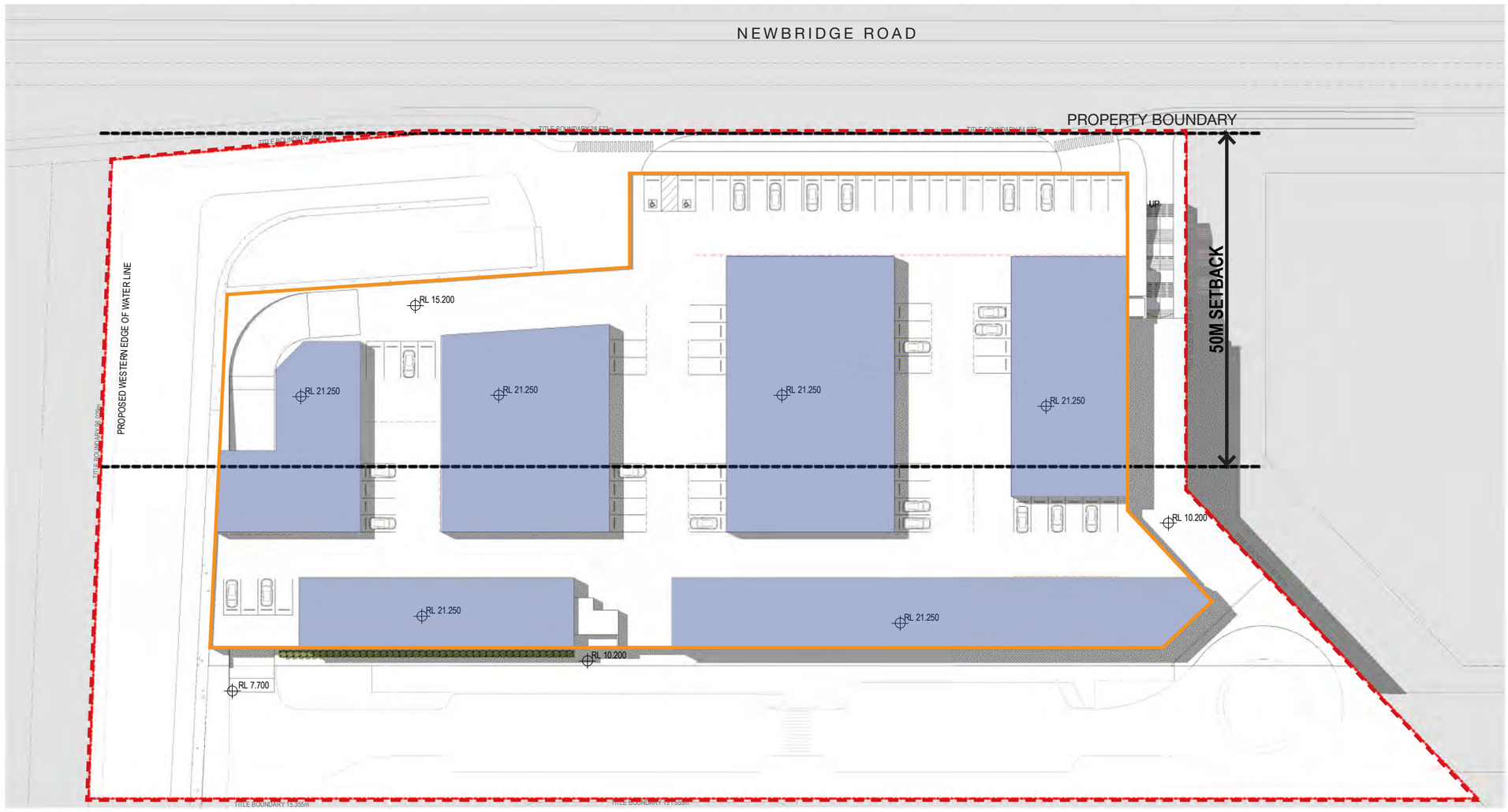


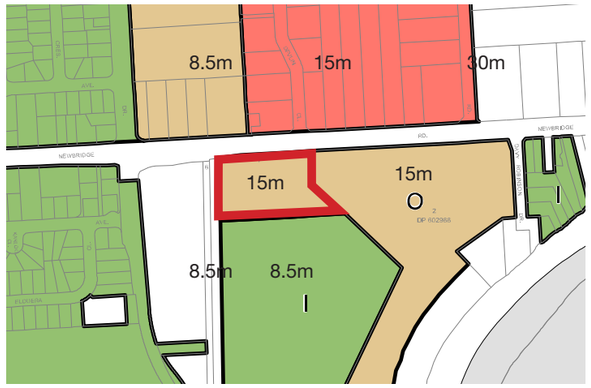
No residential uses are proposed within the existing 50m setback to Newbridge Rd. Non-residential uses are proposed within the setback, in accordance with the controls and to act as an additional buffer to traffic noise.

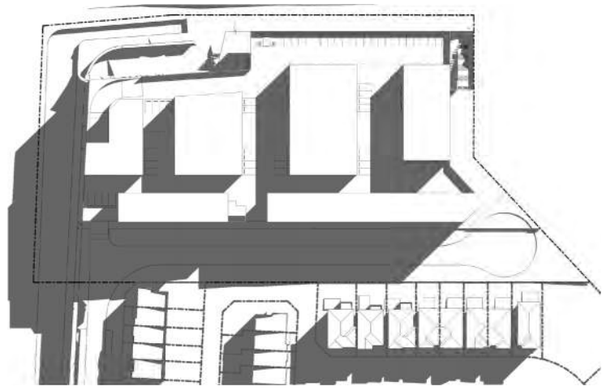
Legend

- Subject Site
- Retail Below
- Light Industrial

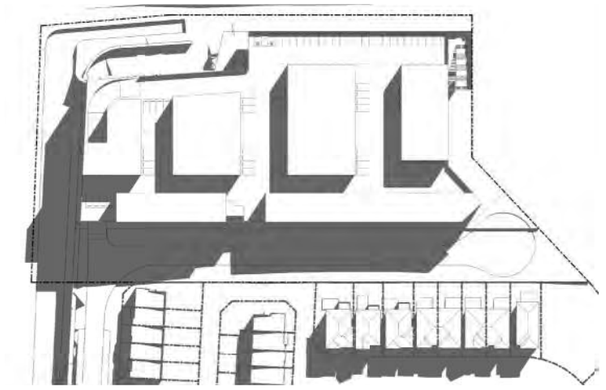
Top View



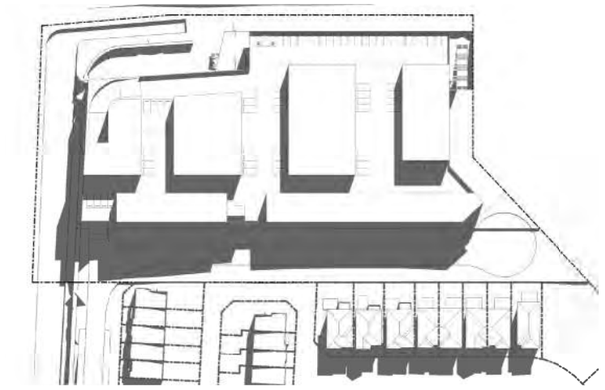

8.5m
15m
30m
15m
15m
8.5m
8.5m
NEWBRIDGE
AVE.
RD.
NEWBRIDGE
AVE.
RD.
NEWBRIDGE
AVE.
PLEASANTA
AVE.
RD.
NEWBRIDGE
AVE.
RD.
NEWBRIDGE
AVE.
RD.
NEWBRIDGE



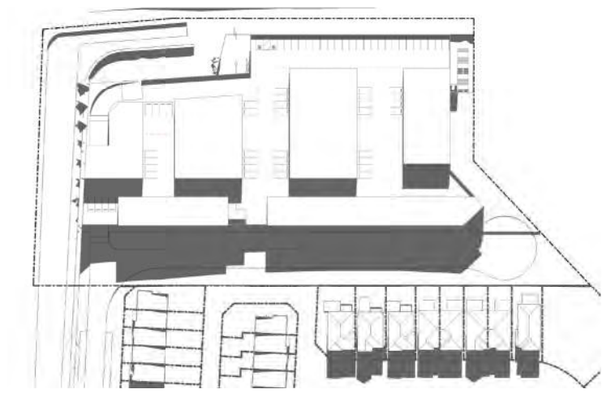
June 22nd
09 00



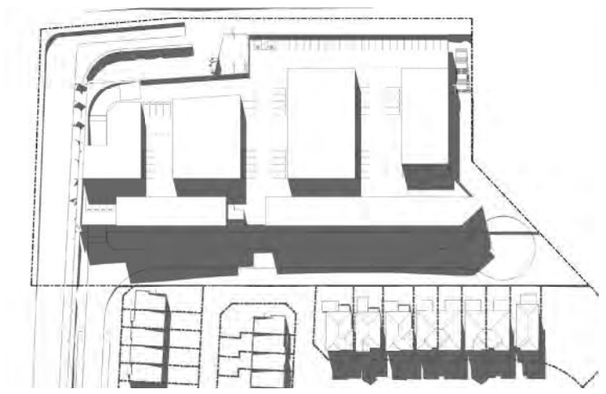
June 22nd
10 00



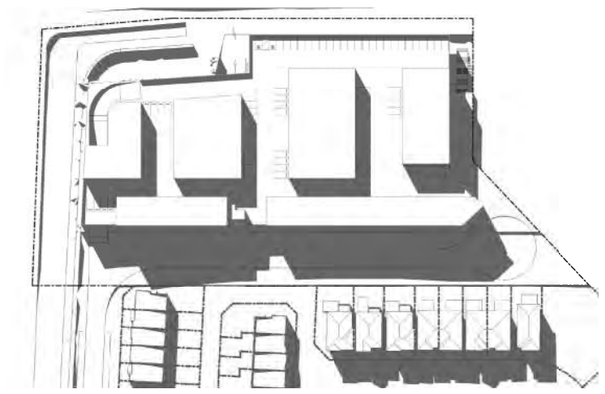
June 22nd
11 00



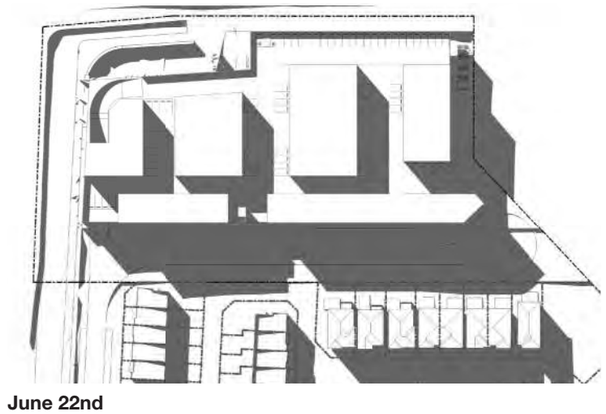
June 22nd
12 00



June 22nd
13 00



June 22nd
14 00



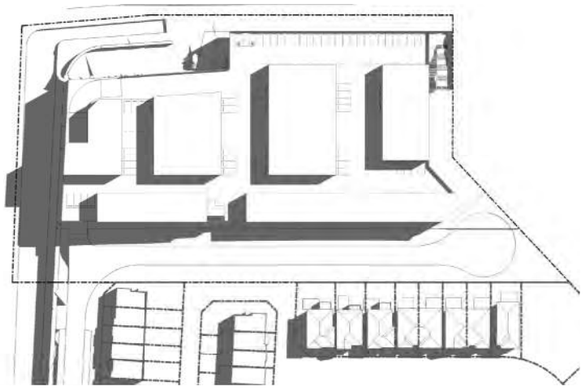
June 22nd
15 00

The proposed massing configuration has been attuned to maximise solar access to the residential housing to the south. The low rise industrial units are orientated to create these shadow profiles with the Southern linear blocks set to not create overshadowing to the neighbouring houses.

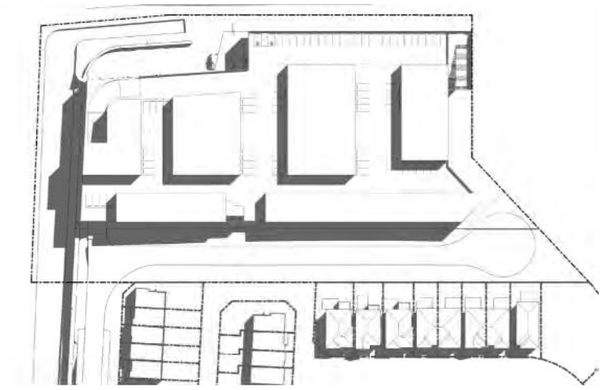
The majority of overshadowing generated by the development is cast onto the densely landscaped sites to the West/South-West.

The entirety of the development has a height that creates no additional shadow cast into the rear yards of the housing in the Mirvac Estate.

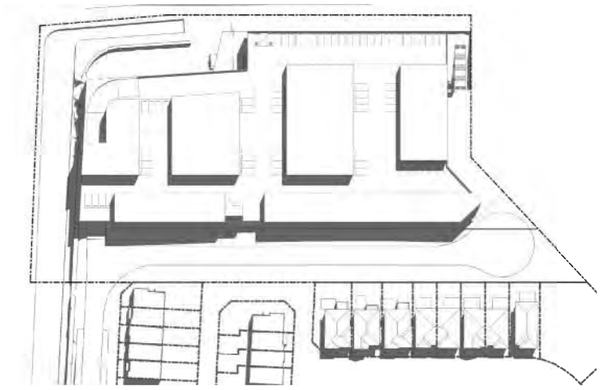
Detailed shadow studies for each dwelling is contained in Architectural Drawings.



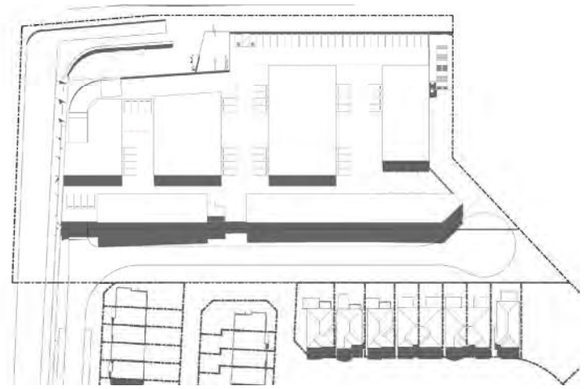
September 21st
09 00



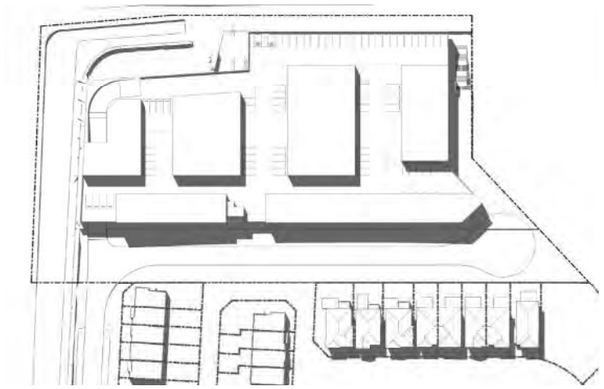
September 21st
10 00



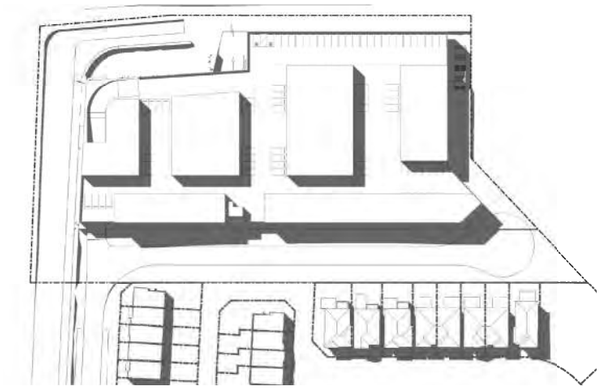
September 21st
11 00



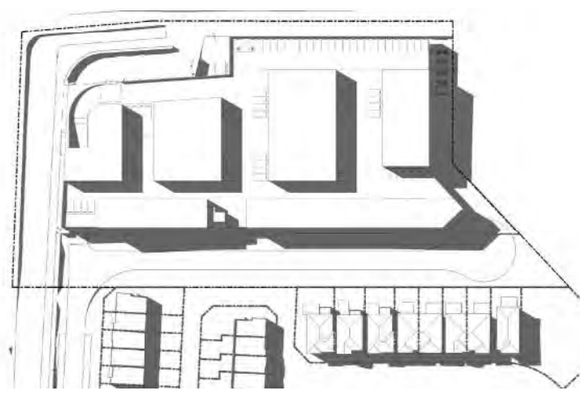
September 21st
12 00



September 21st
13 00



September 21st
14 00



September 21st
15 00

At the solar Equinox, no shadows cast from the proposed development will land on the primary private open spaces of the dwelling houses in the Mirvac Estate.

Overview 01
Perspective



Overview 02
Perspective



Overview 03
Perspective



Overview 04
Perspective



Street Interface
Perspective



Retail Entry
Elevation



Retail Entry
Perspective



Facade Detail
Elevation



Appendix B

Ecological impact assessment

Ecological Assessment

Moorebank Cove Residential Development

Prepared for Mirvac Homes (NSW) Pty Ltd | 14 December 2016



Ecological Assessment

Moorebank Cove Residential Development

Prepared for Mirvac Homes (NSW) Pty Ltd | 14 December 2016

Ground Floor, Suite 01, 20 Chandos Street
St Leonards, NSW, 2065

T +61 2 9493 9500
F +61 2 9493 9599
E info@emmconsulting.com.au

www.emmconsulting.com.au

Ecological Assessment

Final

Report J16050ARP3 | Prepared for Mirvac Homes (NSW) Pty Ltd | 14 December 2016

Prepared by	**Eugene Dodd**	Approved by	**Phil Towler**
Position	Senior Ecologist	Position	Associate Director - Executive Leader
Signature		Signature	
Date	14 December 2016	Date	14 December 2016

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

© Reproduction of this report for educational or other non-commercial purposes is authorised without prior written permission from EMM provided the source is fully acknowledged. Reproduction of this report for resale or other commercial purposes is prohibited without EMM's prior written permission.

Document Control

Version	Date	Prepared by	Reviewed by
1	3 August 2016	E. Dodd	P. Towler
2	14 December 2016	E. Dodd	P. Towler

T +61 (0)2 9493 9500 | F +61 (0)2 9493 9599

Ground Floor | Suite 01 | 20 Chandos Street | St Leonards | New South Wales | 2065 | Australia

www.emmconsulting.com.au

Table of contents

Chapter 1 Introduction 1

1.1 Background 1

1.2 Purpose of this report 1

1.3 Legislative framework 3

1.3.1 NSW Environmental Planning and Assessment Act 1979 3

1.3.2 State Environmental Planning Policy No. 44 – Koala Habitat Protection 3

1.3.3 Threatened Species Conservation Act 1995 4

1.3.4 NSW Native Vegetation Act 1997 4

1.3.5 NSW National Parks and Wildlife Act 1974 4

1.3.6 NSW Fisheries Management Act 1994 4

1.3.7 Noxious Weeds Act 1993 5

1.3.8 Commonwealth Environment Protection and Biodiversity Conservation Act 1999 5

Chapter 2 Methods 7

2.1 Desktop review 7

2.1.1 Previous local studies 7

2.1.2 Database searches 8

2.2 Field survey 8

2.2.1 Flora and Vegetation 8

2.2.2 Fauna 9

Chapter 3 Results 11

3.1 Desktop review 11

3.1.1 Previous studies 11

3.1.2 Database searches 11

3.2 Field survey 14

3.2.1 Vegetation 14

3.2.2 Flora 20

3.2.3 Fauna 21

Chapter 4 Impact assessment 25

4.1 Vegetation clearance 25

4.2 Endangered ecological communities, threatened ecological communities and native vegetation 25

4.3 Threatened flora 25

4.4 Threatened fauna 26

4.5 Migratory fauna 28

4.6 Indirect impacts 28

Table of contents *(Cont'd)*

Chapter 5	Recommendations	29
Chapter 6	Conclusion	31
References		33

Appendices

A Protected matters search results
B Threatened and migratory species recorded within the locality
C Flora species recorded within the study area
D Assessments of Significance - TSC Act

Tables

3.1	Noxious weeds within and adjacent to the study area	20
3.2	Fauna recorded incidentally during the field survey	23
4.1	Impact area for each vegetation community	25
4.2	Recently recorded threatened species within the locality	27
B.1	Threatened and migratory species recorded within the locality	B.1
C.1	Flora species recorded within the study area	C.5

Figures

1.1	The project location	2
3.1	Threatened flora recorded within the locality	12
3.2	Threatened fauna and migratory species recorded within the locality	13
3.3	Vegetation communities within the study area	19

Photographs

3.1	Swamp Oak Floodplain forest within the north east of the study area.	15
3.2	River Flat Eucalypt forest	16
3.3	Planted vegetation	17
3.4	Mangrove forest outside of the study area	18
3.5	Drainage line on the study area boundary	22

1 Introduction

Mirvac Homes (NSW) Pty Ltd have commissioned EMM Consulting Pty Limited (EMM) to assess the ecological impacts of the Moorebank Cove Residential Estate which is proposed to be developed on part of Lot 7 DP 1065574 at 146 Newbridge Road, Moorebank (Figure 1.1). The ecological assessment aims to build on and update previous studies conducted within the site.

1.1 Background

The site is currently used for extractive industry and recycling operations. Subject to development approval, both the Moorebank Cove Residential Estate, containing 179 dwellings, and a marina, south of the study area would be constructed within Lot 7 DP 1065574.

The study area is approximately 10 ha and is located in the Liverpool Local Government Area (LGA), operated by Benedict Industries.

1.2 Purpose of this report

The ecological assessment was undertaken by EMM to consider the impacts of the proposal residential development. The aims of this assessment are to:

- conduct new record searches for threatened species and communities;
- assess the characteristics and ecological condition of the vegetation communities and habitats within the study area, which may have altered since previous assessments;
- determine the occurrence, or likelihood of occurrence of threatened species, populations and endangered ecological communities listed under the NSW *Environmental Planning and Assessment Act 1995* (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 2000* (EPBC Act), including those species recently listed;
- describe and quantify impacts on biodiversity resulting from the proposal; and
- provide recommendations to avoid, minimise and mitigate potential impacts of the proposal on threatened biodiversity.



The project location

Moorebank Cove Residential Development Ecological Assessment,
Prepared for Mirvac Homes (NSW) Pty Ltd

Figure 1.1

1.3 Legislative framework

Legislation and planning policies relevant to the protection of biodiversity or their habitats and this ecological assessment are provided below. These statutory instruments provide conditions, matters for consideration, and requirements to seek authorisation (licences and approvals) to undertake various actions and activities. The State and Commonwealth legislation applicable to this assessment are:

- Environmental Planning and Assessment Act (1979);
- TSC Act;
- NSW *Native Vegetation Act 2003* (NV Act);
- NSW *National Parks and Wildlife Act 1974* (NPW Act);
- NSW *Noxious Weeds Act 1993* (NW Act);
- *State Environmental Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44); and
- EPBC Act.

1.3.1 NSW Environmental Planning and Assessment Act 1979

The relevant planning legislation for NSW is the EP&A Act. The EP&A Act institutes a system of environmental planning and assessment in NSW and is administered by the Department of Planning and Environment (DPE)

1.3.2 State Environmental Planning Policy No. 44 – Koala Habitat Protection

SEPP 44 aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reserve the current trend of koala population decline by:

- requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat;
- encouraging the identification of areas of core koala habitat; and
- encouraging the inclusion of areas of core koala habitat in environment protection zones.

This policy only applies to the LGAs listed in Schedule 1 of the policy but does not apply to land dedicated or reserved under the NPW Act or to land dedicated under the NSW *Forestry Act 1916* as a state forest or flora reserve. Liverpool LGA is listed within Schedule 1 and therefore SEPP 44 applies to the proposed development.

1.3.3 Threatened Species Conservation Act 1995

The TSC Act is administered by NSW Office of Environment and Heritage (OEH) and establishes mechanisms for:

- management and protection of listed threatened species of native flora and fauna (excluding fish and marine vegetation);
- listing of threatened species or key threatening processes;
- development and implementation of recovery and threat abatement plans;
- declaration of critical habitat;
- consideration and assessment of threatened species impacts in development assessment process; and
- management and regulation of actions that may damage critical or other habitat or otherwise significantly affect threatened species, populations and ecological communities.

The TSC Act lists threatened species, populations and ecological communities, which are priorities for conservation within NSW, under Schedules 1 and 2 of the Act. Schedule 3 of the Act lists key threatening processes for species, populations and ecological communities within NSW.

Section 5A of the EP&A Act sets out seven factors to be considered during assessments of significance (seven-part test) when determining whether a proposed action will, or is likely to, have a significant effect on a threatened species, endangered populations or Endangered Ecological Communities (EECs) listed under the schedules of the TSC Act. Potential impacts of the proposed development to threatened species, endangered populations or EECs are considered in Chapter 4. Seven-part tests are provided in Appendix D.

1.3.4 NSW Native Vegetation Act 1997

The NV Act provides for the management of native vegetation in NSW. Generally, approval to clear native vegetation in NSW is required under the NV Act. Potential impacts of the proposed development on native vegetation is considered in Chapter 4.

1.3.5 NSW National Parks and Wildlife Act 1974

The NPW Act is administered by OEH and contains provisions that relate to the protection of native terrestrial fauna, flora and EECs. Under the NPW Act, it is an offence to harm threatened species; buy, sell or possess threatened species; damage critical habitat; or damage the habitat of a threatened species without approval under the Act. Under section 171 of the Act, the Secretary may authorise the harming of threatened and protected flora and fauna species and habitats. It is a defence to prosecution under the Act if the offence is necessary for carrying out a project that has received development consent under the EP&A Act.

1.3.6 NSW Fisheries Management Act 1994

The FM Act provides management of marine and aquatic fish species, population communities and marine vegetation. Any impact to marine vegetation such as mangroves requires a permit under the Act.

1.3.7 Noxious Weeds Act 1993

The NW Act defines the roles of government, councils, private landholders and public authorities in the management of noxious weeds. The NW Act sets up categorisation and control actions for noxious weeds and imposes penalties for various offences. All private landowners, occupiers, public authorities and councils are required to control noxious weeds on their land under Part 3, Division 1 of the NW Act.

1.3.8 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, heritage places and water resources which are defined as MNES (Matters of National Environmental Significance), as defined under the EPBC Act as:

- world heritage properties;
- places listed on the National Heritage Register;
- Ramsar wetlands of international significance;
- threatened flora and fauna species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- nuclear actions (including uranium mining); and
- water resources, in relation to coal seam gas or large coal mining development.

Under the EPBC Act, an action that may have a significant impact on a MNES is deemed to be a 'controlled action' and can only proceed with the approval of the Commonwealth Minister for the Environment. An action that may potentially have an impact on a MNES is to be referred to Commonwealth Department of the Environment (DoE) for determination as to whether or not it is a controlled action. The proposed development will not have a significant impact on any MNES and, therefore, is not required to be referred to DoE and does not require approval from the Commonwealth Minister for the Environment.

2 Methods

2.1 Desktop review

2.1.1 Previous local studies

Two ecological studies have been previously completed at the site, which were reviewed prior to completing the field survey. These are described below.

i Total Earth Care (2006)

A flora and fauna assessment was completed to support a rezoning application (Total Earth Care 2006). The assessment included site surveys and classification of ecological constraints within an area which includes the current study area.

Desktop searches were completed for a 5 km radius of the project area in 2004, followed by two days of survey (23 August 2004 and 11 January 2005) including:

- identification of plant species;
- mapping and classification of plant communities;
- targeted searches for plant species of conservation significance;
- diurnal observation of fauna;
- searches for fauna evidence; and
- targeted searches for habitat types of threatened fauna.

ii Total Earth Care 2011

An updated flora and fauna assessment was completed to support the development application for the Georges Cove Marina (Total Earth Care 2011), which includes the current study area (refer to Figure 1.1). The assessment assessed the conservation significance of biodiversity values at the site and provided an indication of the potential constraints to the development of the marina.

Updated database searches (5 km) were completed prior to a field survey on 5 September 2011. The survey included:

- identification of plant species;
- mapping and classification of plant communities;
- targeted searches for plant species of conservation significance;
- diurnal observation of fauna including aural and visual detection of birds and frogs;
- searches for fauna evidence; and
- targeted searches for habitat types of threatened fauna.

Several studies have also been conducted in adjacent to the current study area including:

- A flora and fauna assessment for Boral, Moorebank, which included targeted threatened species surveys (ERM 2002);
- assessments of impacts for a proposed service road at Morebank for Boral (ERM 2003); and
- a flora and fauna assessment for the proposed rezoning of land south of the marina study area (AES 2002).

2.1.2 Database searches

Background literature reviews and database searches were conducted to obtain recent data on flora and fauna species, populations, communities and habitats. The search area included the study area and the locality (defined as within 5 km of the study area), prior to the field survey. Background information reviewed included:

- topographic map, aerial photograph and geographic information system (GIS) interpretations;
- the NSW OEH Atlas of NSW Wildlife database (Bionet 2016) to identify threatened and migratory species records, the search was limited to records within a 20 year period to exclude historical records; and
- the Commonwealth Department of the Environment's (DoE) online Protected Matters Search Tool (PMST) to identify species and ecological community habitat listed under the EPBC Act (refer to Appendix A for the full report).

The results of the literature review and database search informed survey effort and design through the identification of threatened species, populations and ecological communities as listed under the EPBC Act or the TSC Act that may occur in the study area.

2.2 Field survey

The field investigation was not designed to detect all resident and transitory species within the study area. Instead, it aimed to provide an overall assessment of the ecological features of the study area, building on and updating the previous ecological surveys completed. An EMM ecologist conducted a field survey on Friday 15 July 2016.

2.2.1 Flora and Vegetation

Details regarding the vegetation structure and dominant flora species were recorded within the study area. Notes were taken describing any disturbances (such as weed invasion, human disturbance) to assess the vegetation condition. Dominant species in each vegetation layer (ground, shrub and canopy) were recorded to identify vegetation communities, particularly those representative of EECs, and to identify potential habitat for threatened flora species. Meander searches were conducted through native vegetation to target threatened flora species.

Where possible, vegetation communities identified within the vegetation community were classified into PCTs described by OEH. The vegetation information system (VIS) classification database (OEH 2016) contains descriptions of all Plant Community Types (PCTs) identified. The database was established as the NSW standard community level vegetation classification for use in site based planning processes and standardised vegetation mapping.

2.2.2 Fauna

Targeted fauna surveys were not undertaken and fauna species were recorded opportunistically as they were encountered during the field survey. Any evidence of fauna such as tracks, scats, scratches on and around trees, and any potential fauna habitat features were also noted, including:

- the presence of nesting/sheltering/basking sites such as tree hollows, litter, fallen timber and logs and rocks;
- the cover/abundance of ground, shrub and canopy layers;
- drainage and the presence of freshwater habitats noting their permanency (ie permanent, semi-permanent or ephemeral);
- connectivity to adjacent areas of habitat;
- the extent and nature of previous disturbances, including the presence of fire scars and dieback;
- vegetation assemblage and structure;
- soil type and topography; and
- habitat surveys for Koala habitat and feed trees, including opportunistic surveys for individuals and scats (faeces).

3 Results

3.1 Desktop review

3.1.1 Previous studies

Two endangered ecological communities listed under the TSC Act, were identified within wider project area considered by TEC (2011): River Flat Eucalypt Forest and Swamp Oak Floodplain Forest. Both of these communities were described as almost entirely modified and highly disturbed.

Remnant Castlereagh Ironbark Forest and Cumberland Plain Woodland were identified on the adjacent Boral site during field investigations by ERM (2002) and Cooks River - Castlereagh Ironbark Forest was also identified within the Moorebank Recyclers site, to the south of the marina development (AES 2002).

A total of 87 flora species were recorded within the wider project area considered by TEC (2011) comprising 38 native species and 49 introduced species. Of the 49 introduced flora species, nine were listed noxious weeds for the Liverpool LGA. No threatened flora species were recorded by TEC during either of the 2006 or 2012 surveys or were considered likely to occur. One threatened plant species, *Acacia pubescens*, has been recorded on the sites adjacent to the study area (ERM 2002).

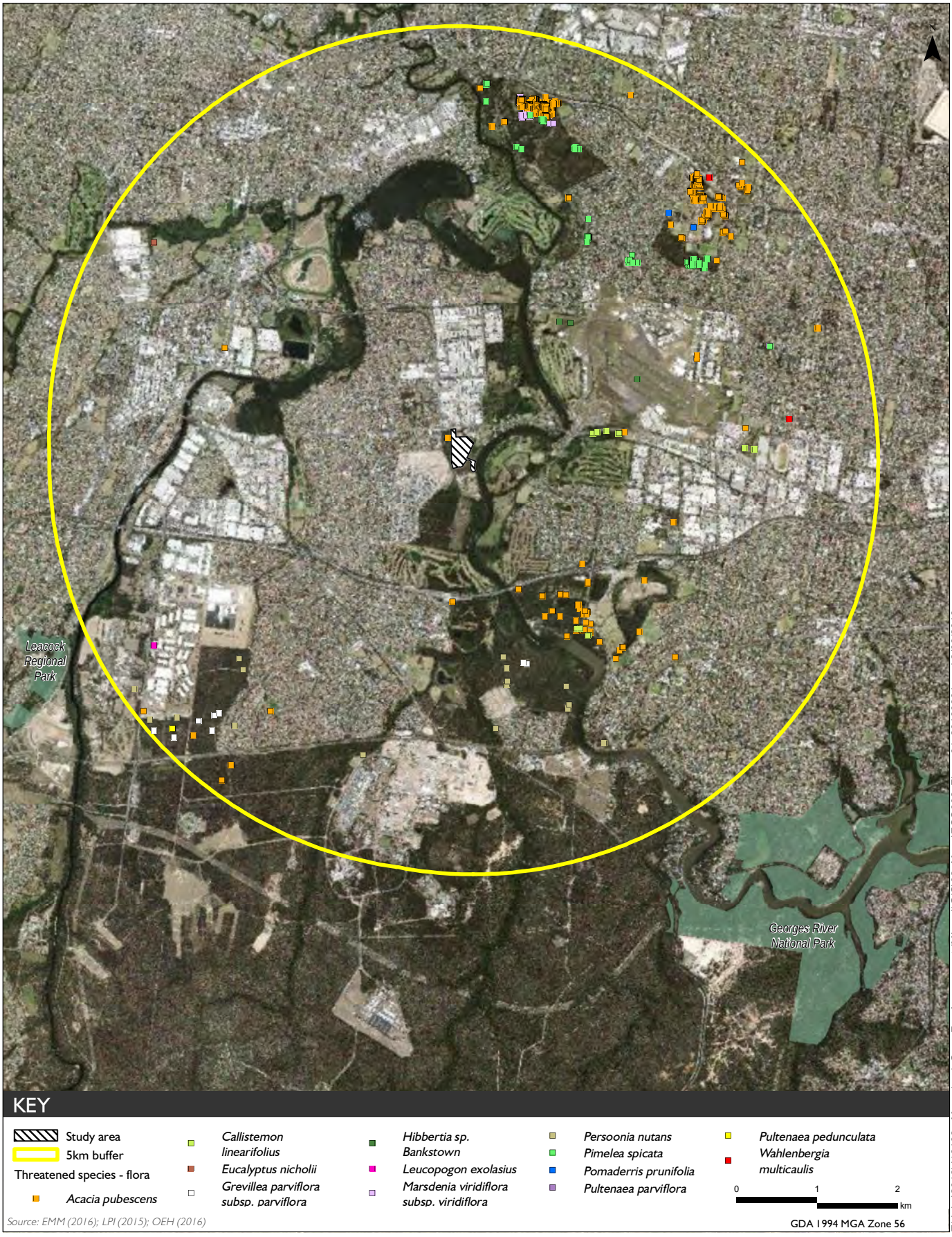
A total of 22 vertebrate fauna species were identified by TEC during 2011 field investigations, none of which were threatened. One EPBC listed migratory species was recorded, the White-bellied Sea Eagle (*Haliaeetus leucogaster*). A conservative approach was undertaken for two threatened microbat species, Eastern Freetail-bat (*Mormopterus norfolkensis*) and Yellow–bellied Sheathtail Bat (*Saccolaimus flaviventris*). They were considered as present within the site as they had been recorded at the adjacent Boral site. Other threatened species were considered unlikely to occur on the site, other than a transient basis in the case of mobile, wide ranging and nomadic species. For example some bat and bird species may occur on the site temporarily or transiently during foraging excursions. The Cumberland Land Snail (*Meridolum corneovirens*) was recorded at the adjacent Boral site (ERM 2002).

3.1.2 Database searches

The PMST tool identified the following ecological values which may occur within the area, or may have suitable habitat for the entity within the area (refer to Appendix A):

- 8 threatened ecological communities which may occur within the area;
- 60 listed threatened species which may occur within the area or have suitable habitat within the area; and
- 31 listed migratory species which may occur within the area

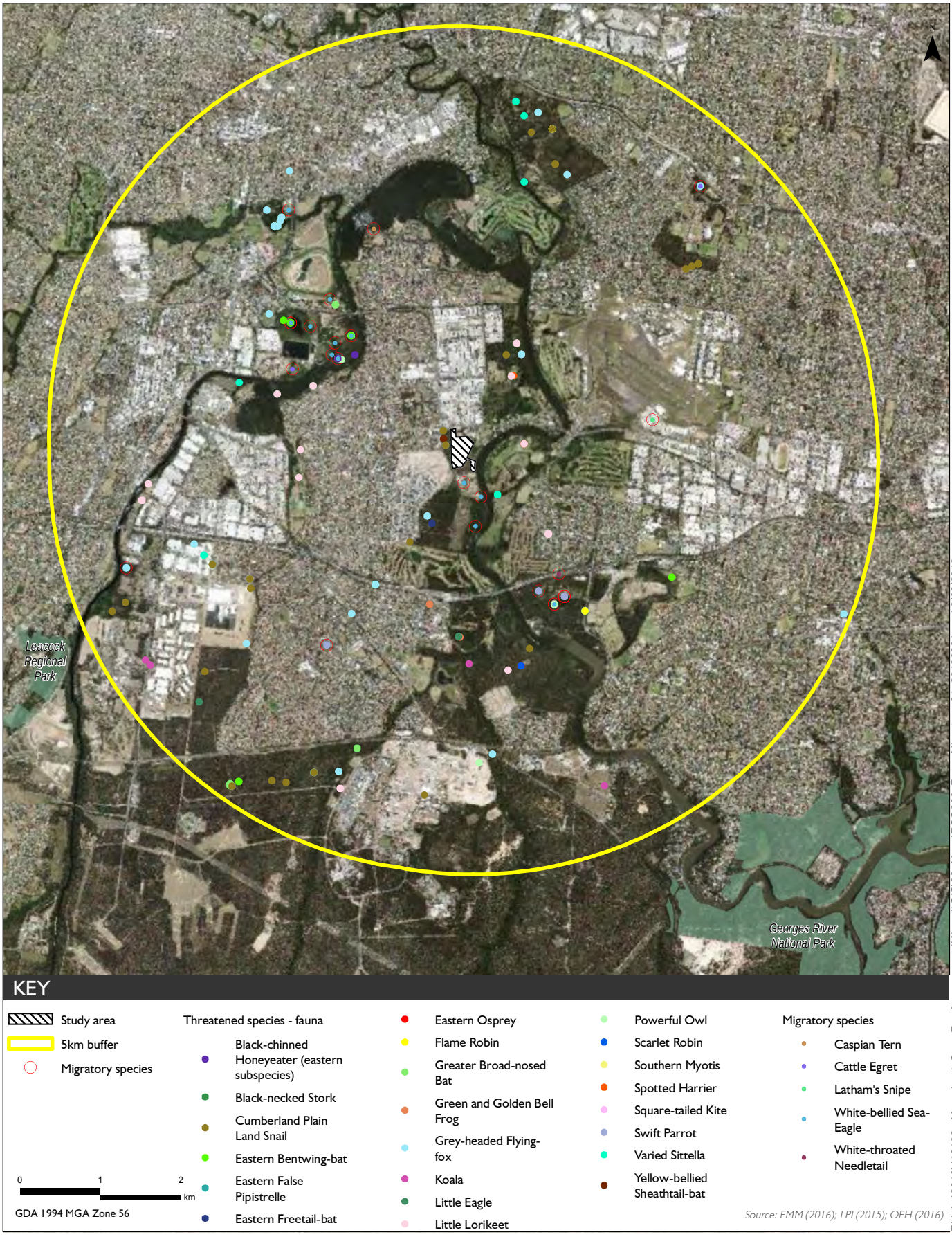
The Bionet search identified thirteen threatened plant species within the locality, none of which were located within the study area itself (Figure 3.1). A total of 22 threatened fauna species have been recorded within the locality, which consists of eight mammals, one gastropod, one amphibian and 12 birds (Figure 3.2). An additional five migratory species were also recorded. Refer to Appendix B for the list of species recorded within the locality and their listing status.



Threatend flora recorded within the locality

Moorebank Cove Residential Development Ecological Assessment,
Prepared for Mirvac Homes (NSW) Pty Ltd

Figure 3.1



Threatend fauna and migratory species recorded within the locality

Moorebank Cove Residential Development Ecological Assessment,
Prepared for Mirvac Homes (NSW) Pty Ltd

Figure 3.2

3.2 Field survey

3.2.1 Vegetation

The majority of the study area is cleared with bare sand and gravel, owing to its prior use for sand and gravel extraction and subsequent use as a recycling facility. Vegetation is largely limited to the northern and western peripheries of the study area and consists of disturbed regenerating communities. No remnant vegetation is present within the study area. Vegetation community classifications for the study area are described below.

i Swamp Oak Floodplain Forest

PCT 1232 Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion

This vegetation type primarily occurs in the north of the study area, with a very small patch also existing in the south-east adjacent to Georges River (refer to Figure 3.3 and Photograph 3.1). The total area of this community within the study area is 0.15 ha.

The dominant canopy species is Swamp Oak (*Casuarina glauca*), with scattered Forest Red Gum (*Eucalyptus tereticornis*) also present on the periphery of the community. The mid stratum is almost entirely absent, restricted to occasional Fringed Wattle (*Acacia fimbrata*). Native groundcover species are limited to Common Couch (*Cynodon dactylon*) and Scurvy Weed (*Commelina cyanea*), which occur at low densities. Exotic species dominate the ground strata with a high cover of Balloon Vine ((*Cardiospermum grandiflorum*), Panic Veldtgrass (*Ehrhatia erecta*), Cobbler's Pegs (*Bidens pilosa*), Caster Oil Plant (*Ricinus communis*) and Paddy's Lucerne (*Sida rhombifolia*).

This vegetation community is attributed to the PCT *1232 Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion.* In addition to the correct landscape position, the dominant canopy species of Swamp Oak is typical of this PCT. Forest Red Gum did not occur in sufficient quantities to consider placing this community in any of the Sclerophyll dominated PCTs. This PCT often has Melaluca species present in the mid story and canopy however the absence of Melaleuca may be due to disturbance or may be naturally absent. The two native groundcover species recorded are typically found within this PCT.

The dominant Swamp Oak canopy and landscape position of this vegetation community meets the scientific determination for the *Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC* listing. The almost entirely exotic understory does not preclude this community being listed as the EEC, with very few examples of Swamp Oak Floodplain Forest remaining unaffected by weeds.



Photograph 3.1 Swamp Oak Floodplain forest within the north east of the study area.

ii River Flat Eucalypt Forest

PCT 836 Forest Red Gum - Rough-barked Apple open forest on poorly drained lowlands of the Central Coast, Sydney Basin Bioregion

This vegetation type primarily occurs on the eastern perimeter of the study area, refer to Figure 3.3 and Photograph 3.2. The total area of this community within the study area is 0.41 ha.

The canopy species are mixed with Forest Red Gum, Sydney Blue Gum (*Eucalyptus saligna*), Swamp Mahogany (*Eucalyptus robusta*) and Rough-barked Apple (*Angophora floribunda*). Few native species are present in the mid stratum, limited to occasional Swamp Oak, Sweet Pittosporum (*Pittosporum undulatum*) and Willow Bottlebrush (*Callistemon salignus*). The mid stratum has a high coverage of weed species including Camphor Laurel (*Cinnamomum camphora*), Large-leaf Privet (*Ligustrum lucidum*), Small-leaf Privet (*Ligustrum sinense*), Green Cestrum (*Cestrum parqui*) and Lantana (*Lantana camera*). The ground stratais dominated by exotic herbs and grasses including Balloon Vine, Purpletop (*Cestrum parqui*), Paspalum (*Paspalum dilatatum*), Guinea grass (*Panicum maximum*) and Trad (*Tradescantia fluminensis*).

This vegetation community is attributed to the PCT *836 Forest Red Gum - Rough-barked Apple open forest on poorly drained lowlands of the Central Coast, Sydney Basin Bioregion.* The PCT lists five characteristic species within upper stratum of which four occur within the community within the study area: Forest Red Gum, Swamp Oak, Swamp Mahogany and Rough-barked Apple.

None of the mid stratum or ground stratum species listed for this PCT were recorded within the community, which is likely to be due to the highly disturbed nature of the community and the very high prevalence of weed species.

This community meets the scientific determination for the *River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC*, given the presence of characteristic Eucalypt and Angophora canopy. Whilst the largely exotic mid and ground stratum reduces the value of this community, it does not preclude the community from being part of the EEC.



Photograph 3.2 River Flat Eucalypt forest

iii Planted vegetation

Planted vegetation exists on the bank of the drainage line in the south eastern corner of the study area, refer to Figure 3.3 and Photograph 3.3. The total area of this community within the study area is 0.03 ha.

It comprises a mixture of small trees and shrubs which do not reflect any naturally occurring communities or PCTs. The most frequent species include are Coast Myall (*Acacia binervia*), Swamp Oak, River Oak (*Casuarina cunninghamiana*), Fringed Wattle and the invasive Golden Wreath Wattle (*Acacia saligna*). The ground cover is sparse and largely restricted to weeds including Fireweed (*Senecio madagascariensis*), Crofton Weed (*Ageratina adenophora*), Cobblers Pegs and Panic Veldtgrass.



Photograph 3.3 Planted vegetation

iv Mangrove forest

PCT 916 Mangrove - Grey Mangrove low closed forest of the NSW Coastal Bioregion

There is a narrow band of mangroves on the banks of the Georges River with co-dominant Grey Mangrove (*Avicennia marina*) and River Mangrove (*Aegiceras corniculatum*) (refer to Figure 3.3 and Photograph 3.4). Mangroves are considered marine vegetation and therefore listed under the FM Act. If these are to be cleared a permit is required. This community is outside of the study area and are not considered further in this terrestrial assessment.



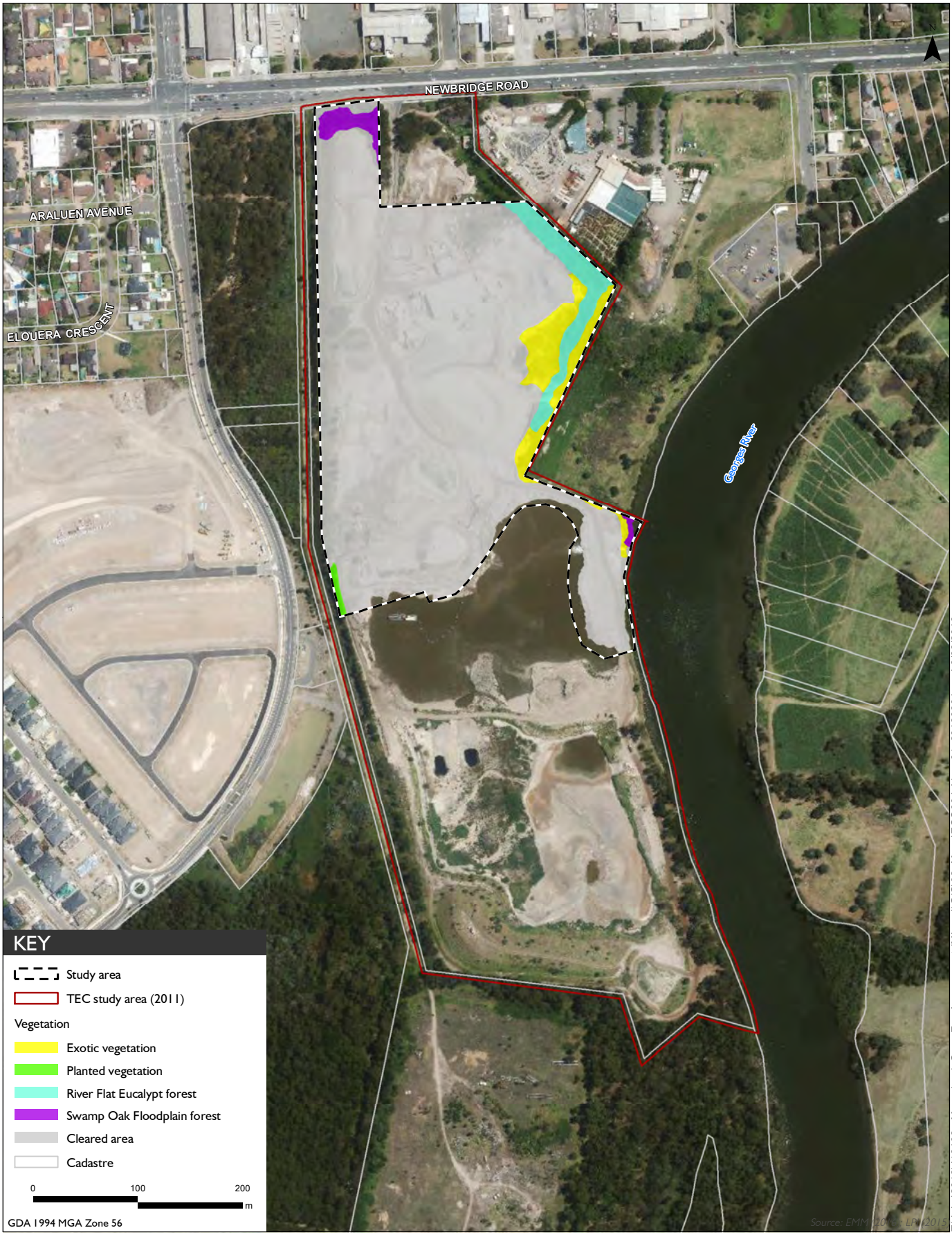
Photograph 3.4 Mangrove forest outside of the study area

v Exotic vegetation

Several patches of exotic vegetation occur within the study area. These have no native canopy species and a modified soils structure (Figure 3.3). These areas are dominated by variety of exotic forbs, grasses and small shrubs, including: Purpletop, Paspalum, Kikuyu and Paddy's Lucerne. The introduced Golden Wreath Wattle also occur as scattered shrubs.

vi Cleared areas

The cleared areas are unvegetated, consisting of unconsolidated soils, sand and gravels. There is evidence of recent clearance of small patches of vegetation within the study area; mostly along the drainage line and in the south of the site



Vegetation Communities within the study area

Moorebank Cove Residential Development Ecological Assessment,
Prepared for Mirvac Homes (NSW) Pty Ltd

Figure 3.3

3.2.2 Flora

A total of 39 flora species were recorded within the study area of which 18 are native species and 21 are weed species. No threatened flora species were recorded during the most recent field survey, nor have any other threatened flora been identified on site during previous investigations (TEC 2006 & 2012).

i Noxious Weeds

Eleven noxious weeds species, declared in the Local Control Authority area of Liverpool City Council, were recorded within the study area by EMM (2016). An additional five species have been recorded previously in the wider area surveyed by TEC (2011). These additional species have been included in Table 3.1 as there is a high potential for the species to spread into the site through natural dispersal or by anthropogenic means. Two of the species recorded by TEC are aquatic, associated with the drainage line on the western boundary of the study area. Immediately prior to the most recent field survey, the vegetation within and adjacent to the drainage line had been removed, therefore it is possible that the aquatic weed species had been removed. These species regenerate rapidly vegetatively and therefore, if these species were previously present, re-colonisation of the watercourse is highly likely.

Of the sixteen species recorded, six are Class 3 Regionally Controlled Weeds, meaning the plant must be 'fully and continuously suppressed and destroyed, the plant must not be sold, propagated or knowingly distributed'(DPI, 2016). Ten species are Class 4 Locally Controlled Weeds, meaning that 'the growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread, the plant must not be sold, propagated or knowingly distributed' (DPI 2016).

Table 3.1 Noxious weeds within and adjacent to the study area

Scientific Name	Common Name	TEC (2011)	EMM (2016)	Class
Alternanthera philoxeroides	Alligator Weed	x	-	3
Cortaderia selloana	Pampas Grass	x	x	3
Genista monspessulana	Montpellier Broom	x	-	3
Ludwigia peruviana	Peruvian Water Primrose	x	-	3
Cestrum parqui	Green Cestrum	x	x	3
Chrysanthemoides monilifera sp. rotundata	Bitou Bush	-	x	3
Arundo donax	Spanish Reed	x	-	4
Asparagus asparagoides	Bridal Creeper	x	x	4
Lantana camera	Lantana	x	x	4
Ligustrum lucidum	Large Leaved Privet	x	x	4
Ligustrum sinense	Small Leaved Privet	x	x	4
Opuntia monacantha	Drooping Pear	x	-	4
Ricinus communis	Castor Oil Plant	x	x	4

Table 3.1 Noxious weeds within and adjacent to the study area

Scientific Name	Common Name	TEC (2011)	EMM (2016)	Class
Senecio madagascariensis	Fireweed	x	x	4
Celtis sinensis	Chinese Celtis	-	x	4
Olea europaea subsp. cuspidata	African Olive	-	x	4

3.2.3 Fauna

i Fauna habitat

a. Forested areas

The forested areas within the study area consist of the River Flat Eucalypt forest, Swamp Oak Floodplain forest and planted vegetation. None of these areas contain remnant trees with no hollow bearing trees recorded. This lowers the suitability of the habitat to provide shelter for arboreal mammals and nesting sites for hollow dependant birds. Several of the eucalypt species within this habitat were in poor condition with canopy dieback evident and the high levels of weed invasion is likely to limit the diversity of fauna present. The species which utilise this habitat are likely to be common species with the ability to persist in disturbed habitats, such as Noisy Miner (*Manorina melanocephala*) and the Australian Raven (*Corvus coronoides*).

The River Flat Eucalypt forest includes tree species listed as Schedule 2 feed tree species under SEPP 44; River Red Gum and Swamp Mahogany (*Eucalyptus robusta*). The combined coverage of these feed tree species are approximately 15-20% in some patches therefore qualifying the habitat as potential Koala habitat. No Koala have been recorded within the study area or in any adjacent habitats. The study area has poor connectivity to areas of known Koala habitat and the small patch size within the study area would be unable to support the species in isolation. Core habitat under SEPP 44 refers to an area of land which has a resident population of Koalas, evidenced by attributes such as breeding females, recent sightings and historical records of a population. The study area and surrounding habitats have been well studied and the lack of any records historically or recently, indicate it is very unlikely that the species occurs (even transiently) and there is no evidence to suggest a resident population.

b. Aquatic Habitats

A large artificial pond exists south of the study area, which results from previous extraction of sand and gravels. This provides habitat for a wide range of waterbirds including Australasian Darter (*Anhinga novaehollandiae*), Little Black Cormorant (*Phalacrocorax sulcirostris*) and Pacific Black Duck (*Anas superciliosa*). The pond is devoid of marginal vegetation and are unlikely to provide important habitat for frogs, and is likely to support only the most disturbance tolerant species.

The tidal reaches of the Georges River, adjacent to the study area is likely to support a range of bird species including migratory species, euryhaline fish and marine vegetation such as mangrove. The Georges River is outside of the study area and is not considered further in this terrestrial impact assessment.

There is an earthen drainage line immediately outside of the study area, on the western boundary. This was constructed approximately 20 years ago. The Dusky Moorhen (*Gallinula tenebrosa*) and the White-faced Heron (*Egretta novaehollandiae*) were observed foraging within this habitat.

Recent mechanical clearing within the study area had removed vegetation on the banks of the drain; however the opposite bank was vegetated with Water Pepper (*Persicaria hydropiper*) and Cumbungi (*Typha sp*). No fish were observed within the drain, although have the potential to occur owing to connectivity to Georges River downstream. Frogs may also be present within the drain, although likely to be restricted to disturbance tolerant species such as the Common Eastern Froglet (*Crinia signifera*). Evidence of flood debris at high levels on adjacent vegetation indicated that that this drain experiences high flow events.



Photograph 3.5 Drainage line on the study area boundary

c. Exotic Vegetation

The exotic vegetation within the study area may provide habitat for cosmopolitan species, especially seed eating birds. However no species are likely to be reliant on this habitat type.

ii Fauna recorded within the study area

A total of 16 bird native bird species were noted during the field survey, all of which can be considered to be common (refer to Table 3.2). No threatened or migratory species were recorded. The majority of the Honeyeater species were observed on the western boundary of the study area associated with remnant forest habitat, which does not occur within the study area. The majority of the waterbird species was associated with the southern ponds, which is outside of the study area.

Table 3.2 Fauna recorded incidentally during the field survey

Common Name	Scientific Name	EPBC Act	TSC Act
Anas gracilis	Grey Teal	-	-
Anas superciliosa	Pacific Black Duck	-	-
Anhinga novaehollandiae	Australasian Darter	-	-
Aythya australis	Hardhead	-	-
Corvus coronoides	Australian Raven	-	-
Egretta novaehollandiae	White-faced Heron		
Fulica atra	Coot	-	-
Gallinula tenebrosa	Dusky Moorhen	-	-
Lichenostomus fuscus	Fuscous Honeyeater	-	-
Manorina melanocephala	Noisy Miner	-	-
Meliphaga lewinii	Lewin's Honeyeater	-	-
Phalacrocorax sulcirostris	Little Black Cormorant	-	-
Phalacrocorax varius	Little Pied Cormorant	-	-
Phylidonyris niger	White Cheeked Honeyeater	-	-
Rhipidura leucophrys	Willy Wagtail	-	-
Tachybaptus novaehollandiae	Australian Grebe	-	-

4 Impact assessment

4.1 Vegetation clearance

The direct impact of the proposed residential development is the clearance of vegetation within the study area. The impact assessment for this project assumes complete disturbance/removal of vegetation within the study area which occupies an area of 9.71 ha. The majority of this area is cleared, with the total vegetation loss (excluding exotic vegetation) restricted to 0.59 ha. A breakdown of the vegetation loss for each community is detailed in Table 4.1.

Table 4.1 Impact area for each vegetation community

Community type	Area to be cleared (ha)
Exotic vegetation	0.50
Planted vegetation	0.03
River Flat Eucalypt forest	0.41
Swamp Oak Floodplain forest	0.15
Non-vegetated area	8.62
Total study area	9.71

4.2 Endangered ecological communities, threatened ecological communities and native vegetation

Both the River Flat Eucalypt Forest and Swamp Oak Floodplain Forest meet the description of EECs under the TSC Act. An assessment of significance was undertaken for these communities (refer to Appendix D), which found that no significant impact would result from project, given the small area impacted, the poor condition of the communities present and the unlikelihood of the long term viability of the communities. There are no TECs listed under the EPBC Act within the study area and therefore no impacts will occur.

The other vegetation types requiring clearance include 0.03 ha of planted vegetation and 0.50 ha of exotic vegetation. These areas are unlikely to provide any important habitat for threatened flora or fauna. The removal of a small area of these vegetation types is not likely to cause any significant biodiversity loss.

The vegetation within the study area is highly fragmented and is unlikely to provide any important linkages for flora and fauna within the landscape. The removal of small patches of vegetation are unlikely to significantly chance connectively within the landscape.

4.3 Threatened flora

Previous assessments within the study area have concluded that there is a low likelihood of threatened flora occurring within the study area. Recent field surveys have supported this assertion, with no threatened species recorded.

One threatened flora species, the Downy Wattle (*Acacia pubescens*), has been recorded in the Boral site adjacent to study area. The vegetation within the Boral site includes remnant communities of Cumberland Plain Woodland and Castlereagh Ironbark Forest which is typical habitat for this species. Despite the close proximity of the species to the study area, the species is not anticipated to occur within the study area, owing to dominance of the weed species and the lack of any observed Downy Wattle individuals.

The recent Bionet search identified one threatened species and two endangered populations within the locality, which have not been previously assessed. These are considered below.

i Netted Bottle Brush (*Callistemon linearifolius*)

This species is listed Vulnerable under the TSC Act. This species grows in dry sclerophyll forest on the coast and adjacent ranges. Suitable habitat does not exist within the study area; furthermore the species is readily detectable and was not recorded during recent field surveys. It is therefore considered absent.

ii *Marsdenia viridiflora R. Br. subsp. viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas - endangered population

This endangered population typically grows in vine thickets and open shale woodland, which does not exist in the study area. The species was not recorded within the study area and is considered unlikely to occur.

iii Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield – Endangered population

This population is closely aligned with the Villawood soil series. The bluebell is found in disturbed sites and grows in a variety of habitats including forest, woodland, scrub, grassland and the edges of watercourses and wetlands. Suitable habitat is not considered to occur in the project area and the study area is within the Liverpool LGA which is outside of the extent of the endangered listing.

Considering the lack of threatened flora records, the history of ground disturbance within the study area and the dominance of exotic groundcover, it is unlikely that any threatened flora species will occur within the study area. As such there are not anticipated to be any impacts to threatened flora as a result of this project.

4.4 Threatened fauna

An additional four threatened species have been recorded within the locality, since previous assessments were undertaken in 2012. As these species have not been assessed to date, they have been considered in Table 4.2. None of the additional species are likely to be impacted by the project and any occurrence of the species is likely to be transient.

Table 4.2 Recently recorded threatened species within the locality

Species	Status		Habitat requirements present?	Potential for impacts from the proposal
	EPBC Act	TSC Act		
Eastern Osprey (*Pandion cristatus*)		V	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes.	Habitat for the species within the study area is absent although the species may fly over, given the close proximity to suitable foraging habitat.
Scarlet Robin (*Petroica boodang*)		V	Dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs..	Low potential to occur, given the absence of dry eucalypt forest, with no open grassy areas present, instead habitats are dominated by weedy groundcover.
Spotted Harrier (*Circus assimilis*)		V	Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe.	Low potential to occur given that the open areas of the site are cleared of vegetation, with an absence of prey species.
Black-necked Stork (*Ephippiorhynchus asiaticus*)		E	Floodplain wetlands of the major coastal rivers are the key habitat in NSW for the Black-necked Stork.	No suitable habitat exists within the study area considering the absence of shallow wetland areas. The ponds adjacent to the study area are too deep to be suitable habitat for this species.

No threatened fauna have been recorded within the study area to date. On a conservative basis, TEC (2001) assumed the presence of the Grey-headed Flying Fox (*Pteropus poliocephalus*), which is appropriate given its wide ranging habitat and numerous records within the locality. The foraging habitat for the Grey-headed Flying Fox is sub-optimal within the study area, restricted to small patches of eucalyptus and angophora species, most of which are small in size and in poor condition, with canopy dieback observed. These trees are unlikely to yield an abundance of nectar and are unlikely to be important to the species. No roosting sites are present within the study area and the project is not anticipated to adversely affect this species.

A suite of threatened microbat species listed under the TSC Act, were presumed present within the study area by TEC (2011): Eastern Bentwing Bat (*Miniopterus schreibersii oceansis*), Southern Myotis (*Myotis macropus*), Eastern Freetail-bat (*Mormopterus norfolkensis*), Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*) and Eastern False Pipistrelle (*Falsistrellus tasmaniensis*). These species have been assumed present owing to the presence of records within the adjacent Boral site, records existing within the wider locality and the lack of targeted survey effort required to indicate absence from the study area.

An updated assessment of significance has been undertaken for the above microbat species taking into account the loss of potential sub-optimal foraging habitat and roosting habitat where relevant. The assessment concluded that there would be no significant impact to any of the threatened microbat species, as a result of the project, due to the suboptimal nature of the habitat present and the small area to be cleared.

The Cumberland Land Snail is a species listed as critically endangered under the TSC Act and has been recorded adjacent to the study area in the Boral site, which is west of the study area, and separated by a drain. The Boral site contained Cumberland Plain Woodland and Castlereagh Ironbark Forest prior to its development into the Georges Fair residential estate. This community is not present within the study area. The Cumberland Land Snail typically inhabits Cumberland Plain Woodland, Shale Gravel Transition Forests, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest, preferring grassy open woodland with occasional patches of shrubs.

The species can be found under logs and other debris, persisting in degraded environments provided that ground cover of logs or rubbish is available. The species is known to burry in loose soil to escape periods of drought. Very little is known about the species specific foraging preferences although it is known to be a fungal specialist.

Searches for the species in the study area by TEC (2006 & 2011) did not identify the Cumberland Land Snail within the study area, although noted that the species may occur within the less disturbed parts of the riparian habitat, adjoining the Georges River, which is outside the study area of this assessment. The River Flat Eucalypt forest within the current study area is highly disturbed with an almost entirely modified ground cover, with evidence of historic earthworks and a very dense cover of weeds such as Balloon Vine. It considered unlikely that the Cumberland Land Snail occurs within the River Flat Eucalypt forest given that the ground stratum is no longer representative of the original community and functioning of the community is likely to be severely compromised.

4.5 Migratory fauna

A total of five migratory species listed under the EPBC act have been recorded within the locality (refer to Appendix A). None of these species have been recorded within the study area. However, a pair of White-bellied Sea Eagle (*Haliaeetus leucogaster*) have recorded immediately south of the current study area (TEC 2011). There is potential for this species to fly over the site given the proximity of suitable foraging habitat along Georges River. However, there is no potential nesting habitat given the absence of large trees within the study area. No foraging resources are present within the study area due to the lack of suitable water bodies, consisting of a predominately cleared terrestrial area.

The study area does not contain any restricted habitat or important habitat for any migratory species, nor are the migratory species likely to be dependent on the habitats present within the study area. There is no breeding habitat for any of the five migratory species recorded within the locality, furthermore there are no habitat attributes which would encourage large aggregations of a population to occur. The project will not substantially modify, destroy or isolate an area of important habitat for these species; result in harmful invasive species becoming established within the investigation area; or seriously disrupt the life cycle of an ecologically significant proportion of a population of the species. Whilst migratory species may fly over the site or occur transiently, no significant impacts are anticipated.

4.6 Indirect impacts

Without management, ground clearing and disturbance may result in the spread of weeds within the study area and off site. Given the existing occurrence of some noxious and invasive weeds, measures should be impacted to minimise the risk of further weed invasion into surrounding areas.

The study area is adjacent to three different waterbodies; the Georges River, a Pond and a drain. There is potential for construction works to cause indirect impacts to these habitats, due to increase sediment input and contaminated runoff. Sediment input is already likely to be high, due the presence of unconsolidated sediment on the banks of these waterbodies and controls should be implemented to reduce any impacts.

5 Recommendations

The following measures are recommended to reduce the potential for ecological impacts as a result of the proposed development:

- Implement erosion and sediment control measures in accordance with a Construction Environmental Management Plan (CEMP) to prevent inputs of sediment and contaminated runoff into the adjacent drainage line, Georges River and pond areas;
- manage clearance of areas of weed infestation, to allow for separate stockpiling and disposal of weed material. Vehicle hygiene protocols should also be included within the CEMP and will assist to control the movement of both pathogens and weeds;
- no hollow trees were recorded within the impact area, however an Ecologist should inspect trees prior to clearance, for signs of habitat (nest, hollow etc), or presence of fauna, and appropriate pre-clearance steps be taken if fauna if found to be present; and
- all workers will be made aware of the potential presence of threatened species on the site and the manner in which they should be treated.

Should any injured fauna be encountered, work in the immediate area should cease. For small native animals (lizards, birds, possums) throw a blanket or towel over it to immobilise it, then capture the animal and put it in a well ventilated box and cover it. Keep it warm, quiet and undisturbed to minimise shock. Large animals may be too dangerous to handle (Kangaroo, Koala). Keep an eye on the animal and protect it from further harm until assistance arrives. Injured animals should be immediately taken to the nearest appropriately qualified veterinary clinic or fauna rescue organisation contacted.

Given the design requirements of the proposed residential development and the low residual ecological impact, further avoidance is not required or recommended.

6 Conclusion

No threatened species listed under the TSC Act or EPBC act have been recorded in the study area to date. There is the potential for several listed threatened and migratory fauna species to fly over the study area or occur transiently. However the habitat present is not considered important for any of these species. The clearance of two EECs which occur within the study area is considered negligible, given the small area of proposed to be impacted and the poor condition of the communities affected..

The construction of the proposed residential development is not likely to cause any significant ecological impacts within the study area.

References

AES Environmental Consultancy 2002, *Flora and Fauna Assessment*, Proposed Rezoning of Lot 1 DP 336613 Newbridge Road, Moorebank

Bionet (2016) *NSW Bionet, the Website for the Atlas of NSW Wildlife.* NSW Office of Environment and Heritage

Department of Environment and Climate Change (DECC) 2007, *Threatened Species Assessment Guidelines: The Assessment of Significance,* Department of Environment and Climate Change NSW

Environmental Resource Management (ERM) 2002, *Boral Moorebank Flora and Fauna Assessment – Technical Report*, Environmental Resource Management Australia

NPWS (2000) *Cumberland Land Snail Environmental Impact Assessment Guidelines*, NSW National Parks and Wildlife Service.

Protected Matters Search Tool 2016, *Department of Environment online tool*, accessed 01/08/16

Total Earth Care 2006, *Flora and Fauna Assessment*: Proposed Rezoning of the Benedict Site No. 146 Newbridge Road, Moorebank, prepared for Benedict Industries Pty Ltd

Total Earth Care 2011, *Flora and Fauna Assessment*: No. 146 Newbridge Road, Moorebank, prepared for Benedict Industries Pty Ltd

OEH 2016, *Threatened Species Profiles*. Office of Environment and Heritage Online Species Profiles, accessed 02/08/2016

Appendix A

Protected matters search results

Australian Government

Department of the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 01/08/16 11:03:22

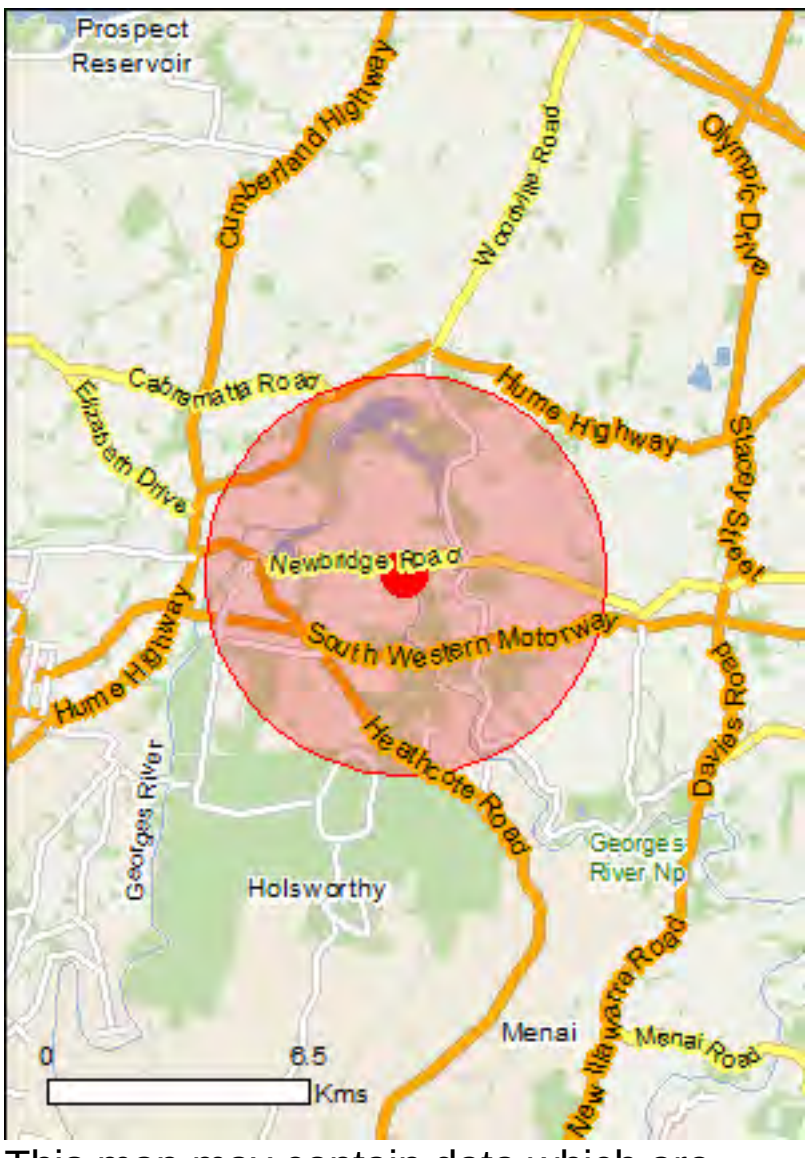
Summary

Details

- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat

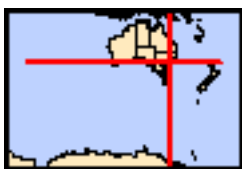
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 5.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	8
Listed Threatened Species:	60
Listed Migratory Species:	31

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	12
Commonwealth Heritage Places:	3
Listed Marine Species:	36
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	55
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	Endangered	Community likely to occur within area
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Critically Endangered	Community likely to occur within area
Shale Sandstone Transition Forest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area
Turpentine-Ironbark Forest in the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	Endangered	Community may occur within area
Western Sydney Dry Rainforest and Moist Woodland on Shale	Critically Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Species or species habitat likely to occur within area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Species or species habitat likely to occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable	Species or species habitat likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Diomedea sanfordi		
Northern Royal Albatross [64456]	Endangered	Species or species habitat likely to occur within area
Grantiella picta		
Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Lathamus discolor		
Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Macronectes giganteus		
Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli		
Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Pachyptila turtur subantarctica		
Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Thalassarche bulleri		
Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta cauta		
Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta steadi		
White-capped Albatross [82344]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche eremita		
Chatham Albatross [64457]	Endangered	Species or species habitat likely to occur within area
Thalassarche impavida		
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini		
Salvin's Albatross [64463]	Vulnerable	Species or species habitat likely to occur within area
Fish		
Epinephelus daemelii		
Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Frogs		
Heleioporus australiacus		
Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat likely to occur within area
Litoria aurea		
Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat known to occur within area
Litoria littlejohni		
Littlejohn's Tree Frog, Heath Frog [64733]	Vulnerable	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Litoria raniformis		
Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog [1828]	Vulnerable	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri		
Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population)		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area
Petauroides volans		
Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Petrogale penicillata		
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pseudomys novaehollandiae		
New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Other		
Pommerhelix duralensis		
Dural Land Snail [85268]	Endangered	Species or species habitat likely to occur within area
Plants		
Acacia bynoeana		
Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat may occur within area
Acacia pubescens		
Downy Wattle, Hairy Stemmed Wattle [18800]	Vulnerable	Species or species habitat likely to occur within area
Allocasuarina glareicola		
[21932]	Endangered	Migration route known to occur within area
Asterolasia elegans		
[56780]	Endangered	Species or species habitat may occur within area
Caladenia tessellata		
Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat likely to occur within area
Cryptostylis hunteriana		
Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat may occur within area
Genoplesium baueri		
Yellow Gnat-orchid [7528]	Endangered	Species or species habitat likely to occur within area
Grevillea parviflora subsp. parviflora		
Small-flower Grevillea [64910]	Vulnerable	Species or species habitat known to occur within area
Hibbertia puberula subsp. glabrescens		
[86645]	Critically Endangered	Species or species habitat likely to occur

Name	Status	Type of Presence within area
Leucopogon exolasius Woronora Beard-heath [14251]	Vulnerable	Species or species habitat likely to occur within area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat may occur within area
Melaleuca deanei Deane's Melaleuca [5818]	Vulnerable	Species or species habitat likely to occur within area
Pelargonium sp. Striatellum (G.W.Carr 10345) Omeo Stork's-bill [84065]	Endangered	Species or species habitat may occur within area
Persoonia nutans Nodding Geebung [18119]	Endangered	Species or species habitat likely to occur within area
Pimelea curviflora var. curviflora [4182]	Vulnerable	Species or species habitat may occur within area
Pimelea spicata Spiked Rice-flower [20834]	Endangered	Species or species habitat known to occur within area
Pterostylis gibbosa Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat known to occur within area
Pterostylis saxicola Sydney Plains Greenhood [64537]	Endangered	Species or species habitat known to occur within area
Thelymitra kangaloonica Kangaloon Sun Orchid [81861]	Critically Endangered	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat may occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Hoplocephalus bungaroides Broad-headed Snake [1182]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Species or species habitat likely to occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable	Species or species habitat likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Species or species habitat likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Species or species habitat likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Species or species habitat likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Species or species habitat likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Species or species habitat likely to occur within area
Migratory Marine Species		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat may occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur

Name	Threatened	Type of Presence within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Manta alfredi		
Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris		
Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Migratory Terrestrial Species		
Cuculus optatus		
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat known to occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat likely to occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat likely to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Australian Telecommunications Corporation
Commonwealth Land - Defence Housing Authority
Commonwealth Land - Defence Service Homes Corporation
Commonwealth Land - Director of War Service Homes

Name
Commonwealth Land - Telstra Corporation Limited
Defence - CAMP SAPPER-EAST HILLS (Lot 2) : CAMP SAPPER TRAINING AREA (Lot 1)
Defence - EAST HILLS BARRACKS - OP SAFE HAVEN
Defence - MOOREBANK AREA INC SME
Defence - Suite 8, Library Plaza

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Indigenous		
Cubbitch Barta National Estate Area	NSW	Listed place
Historic		
Bankstown Airport Air Traffic Control Tower	NSW	Listed place
Defence National Storage and Distribution Centre	NSW	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Cuculus saturatus Oriental Cuckoo, Himalayan Cuckoo [710]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Species or species habitat likely to occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable	Species or species habitat likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Species or species habitat likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Species or species habitat likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Species or species habitat likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Species or species habitat likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Reptiles		

Name	Threatened	Type of Presence
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat may occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area

Extra Information

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris European Greenfinch [404]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Asparagus scandens Asparagus Fern, Climbing Asparagus Fern [23255]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus densiflorus Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Voyager Point	NSW

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-33.93177 150.96493

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Parks and Wildlife Commission NT, Northern Territory Government
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

© Commonwealth of Australia
Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

Appendix B

Threatened and migratory species recorded within the locality

Table B.1 Threatened and migratory species recorded within the locality

Common Name	Scientific Name	EPBC Act	TSC Act
Flora			
Downy Wattle	*Acacia pubescens*	V	V
Netted Bottle Brush	*Callistemon linearifolius*		V
Narrow-leaved Black Peppermint	*Eucalyptus nicholii*	V	V
Small-flower Grevillea	*Grevillea parviflora subsp. parviflora*	V	V
	Hibbertia sp. Bankstown	CE	CE
Woronora Beard-heath	*Leucopogon exolasius*	V	V
Marsdenia viridiflora R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	*Marsdenia viridiflora R. Br. subsp. viridiflora*		E
Nodding Geebung	*Persoonia nutans*	E	E
Spiked Rice-flower	*Pimelea spicata*	E	E
Pomaderris prunifolia in the Parramatta, Auburn, Strathfield and Bankstown Local Government Areas	*Pomaderris prunifolia*		E
	Pultenaea parviflora	V	E
Matted Bush-pea	*Pultenaea pedunculata*		E
Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	*Wahlenbergia multicaulis*		E
Amphibians			
Green and Golden Bell Frog	*Litoria aurea*	V	E
Birds			
Cattle Egret	*Ardea ibis*	Mi	
Spotted Harrier	*Circus assimilis*		V
Varied Sittella	*Daphoenositta chrysoptera*		V
Black-necked Stork	*Ephippiorhynchus asiaticus*		E
Latham's Snipe	*Gallinago hardwickii*	Mi	
Little Lorikeet	*Glossopsitta pusilla*		V
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Mi	
Little Eagle	*Hieraaetus morphnoides*		V
White-throated Needletail	*Hirundapus caudacutus*	Mi	
Caspian Tern	*Hydroprogne caspia*	Mi	
Swift Parrot	*Lathamus discolor*	CE	E
Square-tailed Kite	*Lophoictinia isura*		V
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis gularis*		V
Powerful Owl	*Ninox strenua*		V
Eastern Osprey	*Pandion cristatus*		V

Table B.1 Threatened and migratory species recorded within the locality

Common Name	Scientific Name	EPBC Act	TSC Act
Scarlet Robin	*Petroica boodang*		V
Flame Robin	*Petroica phoenicea*		V
Invertebrates			
Cumberland Plain Land Snail	*Meridolum corneovirens*		E
Mammals			
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*		V
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*		V
Eastern Freetail-bat	*Mormopterus norfolkensis*		V
Southern Myotis	*Myotis macropus*		V
Koala	*Phascolarctos cinereus*	V	V
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*		V
Greater Broad-nosed Bat	*Scoteanax rueppellii*		V

Notes: 1. EPBC and TSC Act Status: V - vulnerable, E - Endangered, CE - critically endangered

Appendix C

Flora species recorded within the study area

Table C.1 Flora species recorded within the study area

Common Name	Scientific name	Weed Species
Coast Myall	*Acacia binervia*	
Fringed Wattle	*Acacia fimbrata*	
Coastal Wattle	*Acacia longifolia subsp. sophorae*	
Golden Wreath Wattle	*Acacia saligna*	*
River Mangrove	*Aegiceras corniculatum*	
Crofton Weed	*Ageratina adenophora*	*
Rough-barked Apple	*Angophora floribunda*	
Moth Vine	*Araujia sericifera*	*
Oats	*Avena sativa*	*
Grey Mangrove	*Avicennia marina*	
Willow Bottlebrush	*Callistemon salignus*	
Balloon Vine	*Cardiospermum grandiflorum*	*
River Oak	*Casuarina cunninghamiana*	
Swamp Oak	*Casuarina glauca*	
Chinese Celtis	*Celtis sinensis*	*
Green Cestrum	*Cestrum parqui*	*
Bitou Bush	*Chrysanthemoides monilifera ssp. rotundata*	*
Camphor Laurel	*Cinnamomum camphora*	*
Scurvy Weed	*Commelina cyanea*	
Couch	*Cynodon dactylon*	
Panic Veldt Grass	*Ehrhatia erecta*	*
African Love Grass	*Eragrostis curvula*	*
Grey Box	*Eucalyptus moluccana*	
Swamp Mahogany	*Eucalyptus robusta*	
Sydney Blue Gum	*Eucalyptus saligna*	
Forest Red Gum	*Eucalyptus tereticornis*	
Blue Morning Glory	*Ipomoea indica*	*
Lantana	*Lantana camera*	*
Variable Sword Sedge	*Lepidosperma laterale*	
Large Leaf Privet	*Ligustrum lucidum*	*
Small Leaf Privet	*Ligustrum sinense*	*
African Olive	*Olea europaea subsp. cuspidata*	*
Guinea Grass	*Panicum maximum*	*
Water Pepper	*Persicaria hydropiper*	
Common Reed	*Phragmites australis*	
Sweet Pittosporum	*Pittosporum undulatum*	
Castor Oil Plant	*Ricinus communis*	*
Fireweed	*Senecio madagascariensis*	*
	Senna pendula var glabrata	*
Trad	*Tradescantia fluminensis*	*

Appendix D

Assessments of Significance - TSC Act

D.1 Assessment of significance

Section 5A of the EP&A Act provides the criteria that must be considered in the assessment of the significance of potential impacts on threatened species listed under the TSC Act. The following assessment of significance has been undertaken in accordance with *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC 2007).

D.1.1 Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – Endangered Ecological Communities

1. *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;*

This question is not relevant as River-flat Eucalypt Forest and Swamp Oak Floodplain Forest are communities rather than individual species.

2. *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;*

This question is not relevant as River-flat Eucalypt Forest and Swamp Oak Floodplain Forest are communities.

3. *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

    a) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction;*

    b) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;*

The local occurrence of River-flat Eucalypt Forest (ie within a 5 km radius of the site) covers approximately 270 ha, while Swamp Oak Floodplain Forest covers approximately 95 ha (OEH 2013). The local occurrence contains some larger patches of the two floodplain communities, but mostly occurs in a highly fragmented state along the Georges River and its tributaries, surrounded by residential and industrial land.

The removal of 0.41 ha of River Flat Eucalypt forest and 0.15 ha of Swamp Oak Floodplain forest and represents a loss of 0.15% and 0.16% of each respective community within the locality (5 ha radius). This is a very small proportion of the community and will have a negligible impact on the extent of the community.

4. *In relation to the habitat of a threatened species, population or ecological community:*

    a) *the extent to which habitat is likely to be removed or modified as a result of the action proposed;*

    b) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action;*

    c) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;*

Only small areas of the EECs (up to 0.15% of River Flat Eucalypt Forest and 0.16% of Swamp Oak Floodplain Forest) will be removed. The existing vegetation currently occurs in a highly fragmented landscape and the removal of small areas of the EECs are unlikely to significantly change this.

The small areas of River Flat Eucalypt Forest and Swamp Oak Floodplain Forest to be removed are not considered important for the long-term survival of the communities in the locality. They are highly disturbed and very poor example of the community type, composed of an almost entirely exotic ground cover.

5. *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);*

Critical habitat has not been declared for River Flat Eucalypt Forest and Swamp Oak Floodplain Forest. Therefore, the proposed development will not have an adverse effect on critical habitat.

6. *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and*

River Flat Eucalypt Forest and Swamp Oak Floodplain Forest do not have recovery plans. Management objectives for the communities aim to maximise the extent of occurrence and condition across NSW. Any removal of small patches of EEC within the study area will not reduce the occurrence or condition of the ecological community in the locality.

7. *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

A key threatening process relevant to the removal of the trees is “the clearing of native vegetation”. The removal of the small areas of River Flat Eucalypt Forest and Swamp Oak Floodplain Forest classifies as the clearing of native vegetation, as the works will remove parts of one or more strata layers of vegetation in these areas.

Conclusion

The removal of up to 0.15% of River Flat Eucalypt Forest and 0.16% of Swamp Oak Floodplain Forest within the project area will not have a significant impact on the EECs in the locality as the proposed clearing is of low magnitude, and represent a small proportion of the EECs within the locality; and the remnant patch of floodplain EECs are not considered to be important and are highly disturbed.

D.1.2 Threatened microbat species

The following species are all listed as vulnerable under the TSC Act. They have the potential to occur within the study area given that they are highly mobile and records exist within the locality.

a. Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)

The Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*) is a very widespread species occurring over most of mainland Australia. It forages for insects over the forest canopy, but lower in more open country (OEH 2016). It occurs in most habitats types, with and without trees, and appears to defend an aerial territory. This species has been recorded approximately 150 m west of the study area. Tree hollows are the preferred roosting habitat for this species and there is a low likelihood that the species will roost in the study area as no suitable hollows were identified. The species may forage over vegetated areas of the study area and over adjacent water bodies.

b. Southern Myotis (*Myotis macropus*)

The Southern Myotis (*Myotis macropus*) is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100km inland, except along major rivers. The species generally roosts in groups of 10-15 close to water: in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage (OEH 2016). The species forages over streams and pools catching insects and small fish by raking their feet across the water surface. There are few records of this species within the locality (Bionet 2016), the closest record being 4.6 km to the south-east. Potential foraging habitat exists immediately adjacent to the study area within the drain; with less optimal foraging habitat over the Georges River and the artificial pond. This species may roost in dense foliage and therefore has the potential to roost within vegetated portions of the study area.

c. Eastern Bentwing Bat (Miniopterus schreibersii oceanensis)

The Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*) is listed as a vulnerable species under the TSC Act. The species typically forages above the canopy of forested areas and also in more open areas such as grasslands (OEH 2016). They roost in caves but will also use abandoned mines and road culverts as alternative roosting habitat. This closest record of this species to the study area is 2.5 km to the north-west. Given that there are no caves or other suitable man-made structures, the species is unlikely to roost within the study area. Potential foraging habitat exists within the vegetated areas of the study area.

d. Eastern Freetail-bat (Mormopterus norfolkensis)

The Eastern Freetail-bat (*Mormopterus norfolkensis*) typically occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. The species roosts in tree hollows preferentially; however it will also roost beneath bark or in man-made structures. The species is unlikely to roost within the study area but potential foraging habitat exists within the vegetated areas of the study area. The closest record of this species is 1 km south of the study area.

e. Greater Broad-nosed Bat (*Scoteanax rueppellii*)

The Greater Broad-nosed Bat (*Scoteanax rueppellii*) utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest (OEH 2016). Tree hollows are typically used for roosting, however exfoliating bark and building are occasionally used. This species may forage within the vegetated areas area of the study area, although is not expected to roost in the study area. The closest record of this species is 2 km to the south-west of the study area.

f. Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)

The Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) prefers mesic habitats with a canopy of tall Eucalypt forest. The species hunts flying insects just above or below the tree canopy and typically roosts in tree hollows. The species has also been recorded roosting in buildings and under loose bark. This species has been recorded approximately 1.9 km south of the study area and may forage within River Flat Eucalypt Forest within the study area.

1. *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;*

The project will not remove any potential breeding habitat for threatened microbats due to the absence of suitable structures and therefore is unlikely to impact on the lifecycle of these species. The proposal will remove 0.59 ha of potential foraging habitat for threatened microbats. These species are highly mobile and there are much larger higher quality areas of foraging habitat adjacent to the study area. The lifecycle of these species are unlikely to be threatened by the proposal.

2. *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;*

This question refers to endangered populations, therefore is not relevant to this assessment.

3. *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

    a) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction;*

    b) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;*

This question refers to EECs, therefore is not relevant to this assessment.

4. *In relation to the habitat of a threatened species, population or ecological community:*

    a) *the extent to which habitat is likely to be removed or modified as a result of the action proposed;*

    b) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action;*

    c) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;*

The project will remove 0.59 ha of potential foraging habitat for threatened microbats. No breeding habitat will be removed as these features are absent from the disturbance area. All of the waterbodies adjacent to the study area will remain after the project is completed and there will be no loss of water over which the bats can forage.

The vegetated foraging habitat within the study area occurs in small patches and is poorly linked to other vegetation. The removal of this sub-optimal habitat will not cause any significant increase in fragmentation considering the lack of linkages currently present. Any gaps between vegetation will be limited to distances in which the species can cross, given their highly mobile nature.

The vegetated habitat within the study area consists of regenerating forest with a lack of tree hollow or accumulations of exfoliating bark, which could be used as roosting sites for microbats. The communities present are highly disturbed with an exotic understory and mid stratum (where present), which is likely to reduce the amount and diversity of invertebrate prey available to microbats. The habitat to be removed has no significant importance to these species, as larger and more optimal foraging and roosting habitat is present in the locality.

5. *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);*

Critical habitat has not been declared for these threatened microbats, therefore, the proposed development will not have an adverse effect on critical habitat.

6. *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and*

There are currently no recovery or threat abatement plans for these threatened microbats. Priority actions for these species focus on monitoring the breeding success of maternity colonies to determine the viability of regional populations, identifying the types of winter roots used by species and regular censuses of maternity colonies and other key roosts. Given that only potential foraging habitat and suboptimal roosting habitat for the Southern Myotis, will be cleared, the project does not interfere with these actions.

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The KTP 'clearing of native vegetation' is most relevant to microbats and has been identified as a threat to the vulnerable species. Vegetation clearance within the study area is restricted to disturbed vegetation communities, with no remnant vegetation present within the study area. The total amount of native vegetation clearance is limited to 0.59 ha which is likely to have a negligible impact on microbats.

Conclusion:

The proposed development will not have a significant impact on threatened microbats as:

- no important roost sites will be impacted;
- a small area of potential foraging habitat will be removed, however there are larger areas of higher quality foraging habitat close to the study area which will not be impacted; and
- no breeding habitat will be removed.

SYDNEY
Ground floor, Suite 01, 20 Chandos Street
St Leonards, New South Wales, 2065
T 02 9493 9500 F 02 9493 9599

NEWCASTLE
Level 5, 21 Bolton Street
Newcastle, New South Wales, 2300
T 02 4927 0506 F 02 4926 1312

BRISBANE
Level 4, Suite 01, 87 Wickham Terrace
Spring Hill, Queensland, 4000
T 07 3839 1800 F 07 3839 1866



Appendix C

Detailed site investigation for DA 24/2017 at Lot 7 DP 1065574

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Detailed Site Investigation

Proposed Residential Development
146 Newbridge Road, Moorebank

Prepared for
Benedict Industries Pty Ltd

Project 71459.03
March 2016



Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	71459.03	Document No.	R.001.Rev1
Document title	Detailed Site Investigation Proposed Residential Development		
Site address	146 Newbridge Road, Moorebank		
Report prepared for	Benedict Industries Pty Ltd		
File name	71459.03.R.001.Rev1.DSI		

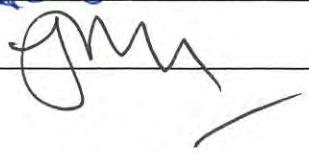
Document status and review

Status	Prepared by	Reviewed by	Date issued
Revision 0	John Russell	J M Nash	3 March 2016
Revision 1	John Russell	J M Nash	16 March 2016

Distribution of copies

Status	Electronic	Paper	Issued to
Revision 0	1	0	Ernest Dupere
Revision 1	1	0	Ernest Dupere

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author		16 March 2016
Reviewer		16 March 2016

bsi. ISO 9001 Quality Management

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666
Fax (02) 9809 4095

Executive Summary

This report presents the results of a Detailed Site Investigation (DSI) undertaken by Douglas Partners Pty Ltd (DP) for a proposed residential development at 146 Newbridge Road, Moorebank (the "site", refer to Drawing 1, Appendix A). The work was commissioned by Ernest Dupere of Benedict Industries Pty Ltd (Benedict) and was undertaken with reference to DP's proposal SYD150814 dated 10 August 2015. The following is understood:

- The DSI and a subsequent Remediation Action Plan (RAP) will be required for submission as part of a development application (DA) for a proposed residential development at the site;
- The proposed development will involve retaining wall construction, bulk earthworks followed by construction of internal roads, associated infrastructure, residential lots and approximately 200 houses; and
- The site is being audited by Dr Ian Swane, a NSW Environment Protection Authority (EPA) accredited site auditor, to facilitate the issue of a site audit statement (SAS) Part B confirming the land can be made suitable for the proposed development.

The objective of this DSI is to fill existing data gaps in relation to site contamination issues and to document the site characterisation methods utilised to assess potential site contamination. The findings of this DSI will inform a RAP for the site in the context of the proposed development.

The site comprises part (generally the northern half) Lot 7 in Deposited Plan 1065574. The street address is 146 Newbridge Road, Moorebank and the site has a total area of approximately 9 ha. Large scale filling and dredging activity occurred at the site between 1991 and 2000. The wider site currently operates under two EPA licences issued under the POEO Act. Based on a review of the EPA information undertaken by Environmental Investigation Services (EIS) (EIS (2013), the scheduled activities at the site included:

- Crushing, grinding or separating; land-based extractive activity; and water-based extractive activity;
- Storage/transfer/separation of various waste streams;
- Importation of VENM and potential acid sulphate soil (PASS) for backfilling sand quarry (according to the site owner, only minor quantities of PASS was ever accepted at the site);
- Dredging activities;
- Landfilling activities; and
- Recovery, storage and processing (non-thermal treatment) of general waste including VENM; general solid waste (non-putrescible); general or specific exempted waste; wood waste; waste; paper or cardboard; gyprock; glass; building and demolition waste; asphalt waste (including asphalt resulting from road construction and waterproofing works); and waste tyres.

A number of previous geotechnical and environmental (contamination) investigations have been carried out at the site. The investigations have generally confirmed the presence of fill containing a component of construction and demolition waste of varying thickness of up to 11.5 m at the southern central portion of the site.

The scope of works for the DSI covering the further characterisation of soil, soil gas / landfill gas, groundwater and surface water was outlined in a sampling and analysis quality plan (SAQP) (DP,

2015b) and comprised the drilling of 26 boreholes, including three which intersect the water table for groundwater / gas monitoring well installation and seven to the target gas interval for landfill gas monitoring well installation. Two of the seven gas wells were located outside the proposed development boundary with shallow or no fill to assess 'background' gas concentrations. Five shallow landfill gas wells were also drilled and installed adjacent to deeper landfill gas wells to evaluate the vertical profile of gas concentration / flow rate.

Soil, soil gas (trace non-methane organic compounds (NMOC)), groundwater and surface water samples were collected and selected samples were submitted for analysis at an analytical laboratory for the contaminants of concern. Landfill gas monitoring using a handheld gas analyser was also conducted on four separate occasions to augment the existing landfill gas monitoring dataset.

Advice on the geotechnical considerations for the project is currently being provided to Benedict by Jeffery and Katauskas Pty Ltd (J&K).

Conclusions

The findings of the current investigation were generally consistent with previous investigations insofar as the drilling programme encountered uncontrolled filling with a component of construction and demolition waste to thicknesses of up to 9.2 m. Many boreholes met refusal on buried obstructions in the filling.

The contaminant concentrations in soil were generally consistent with previous investigations with the exception of the polychlorinated biphenyls (PCB) hotspot encountered at BH220. PCB has not previously been detected at the site, but this is most likely attributable to the heterogeneous nature of the waste filling.

Ongoing landfill gas monitoring has confirmed a characteristic gas situation (CGS) of 3 and thus the need to incorporate gas mitigation systems into the building design for proposed residential dwellings.

Suitability of the Site for the Proposed Development

Based on the findings of the current investigation it is considered that the site can be made suitable for the proposed residential development subject to the development of a suitable RAP and the implementation of appropriate site remediation as per the recommendations outlined below.

Recommendations

Requirements for Site Remediation

A RAP should be prepared with reference to NSW OEH (2011) that outlines the requirements for site remediation necessary in order to render the site suitable for the proposed residential development.

Soil

There are several 'hotspots' of soil contamination that will require remediation. The RAP should determine which 'hotspots' (if any) will need to be remediated and this will be determined based on the proposed final site levels and the thickness of imported virgin excavated natural material (VENM) that will be used to cap the site.

Landfill Gas

Based on the ongoing landfill gas monitoring at the site, gas mitigation systems will need to be incorporated into the building design for proposed dwellings.

Additional landfill gas monitoring wells should be installed at locations where existing wells have been damaged or destroyed. They should also be installed at previously inaccessible areas of the site when stockpiles have been moved. The additional monitoring data should be used to finalise the levels of gas mitigation that will be required.

The recent monitoring conducted as part of this DSI suggests that a CGS of 3 is likely to be appropriate for this site as opposed to the previously recommended CGS of 4. The historical worst case CGS of 4 appears to be an outlier in the overall monitoring dataset. With reference to NSW EPA (2012), a CGS of 3 is typical of "old inert waste landfill" which is consistent with the filling at this site. Ongoing monitoring will be required to confirm the CGS.

The RAP will need to outline the relevant measure or system element to achieve a score consistent with what is required based on the CGS.

Groundwater and Surface Water

Given that surface water data suggests that groundwater is unlikely to be having an adverse impact on adjacent surface water, in particular, the Georges River, and impacts on other possible receptors of groundwater are unlikely or implausible (e.g. abstraction for drinking water) it is considered that no groundwater or surface water remediation is required.

Integration of Site Remediation and Geotechnical Site Improvements

The site remediation will need to be integrated with the geotechnical site improvements. Notably, the J&K summary (Appendix J) item 4 whereby "the entire site is to be excavated, as appropriate, to final terrace level –3m." Whilst it is understood that these details are still subject to detailed design, the excavated material may involve the disturbance of contaminated soil 'hotspots'. This aspect of the geotechnical site improvements will need to be clearly integrated into the RAP and site remediation when these earthworks occur.

Additional Investigations to Finalise Site Remediation Strategy

All or some of the following additional soil investigations are required when stockpiles have been removed from the site and a decision is finalised on the thickness of imported VENM that will be used to cap the site to achieve final design levels:

- Targeted near surface sampling at the diesel above ground storage tank (AST) and the drum storage area following their decommissioning;
- Delineation testing in the area of the PCB, PAH and lead 'hotspots' (if required); and
- Grid based sampling across the site with a focus on previously inaccessible areas (i.e. beneath existing stockpiles) in order to meet the EPA (1995) *Sampling Design Guidelines* recommended sampling density.

Ongoing landfill gas monitoring should be undertaken including the installation of additional monitoring wells.

Long Term Environmental Management Plan

A long term Environmental Management Plan (EMP) will be required for the ongoing management of contamination remaining on site and landfill gas mitigation systems. The EMP should include:

- Procedures for the management and maintenance of cap and landfill gas mitigation systems; and
- Procedures for scenarios where the capping or landfill gas mitigation systems need to be penetrated and reinstated.

The EMP will require establishment of appropriate public notification under Section 149(2) of the EP&A Act or a covenant registered on the title to land under Section 88B of the Conveyancing Act 1919. The EMP would be prepared prior to or during remediation and finalised following validation of the remedial activities.

Table of Contents

Page

1. Introduction 1
2. Site Identification 1
3. List of Previous Reports 1
4. Scope of Works 3
5. Regional Geology, Acid Sulfate Soil Risk and Hydrogeology 6
6. Summary of Site History 7
7. Summary of Relevant Previous Investigations 9
   - 7.1 DP (2002b) 9
   - 7.2 EIS (2013) 10
   - 7.3 EIS (2014a) 12
   - 7.4 EIS (2014b) 14
   - 7.5 EIS (2014c) 14
   - 7.6 EIS (2014d) 15
   - 7.7 EIS (2014e) 16
   - 7.8 DP (2014a) 19
   - 7.9 DP (2014b) 19
8. Conceptual Site Model 19
9. Data Quality Objectives 25
   - 9.1 Introduction 25
     - 9.1.1 State the Problem 25
     - 9.1.2 Identify the Decision / Goal of the Study 25
     - 9.1.3 Identify Inputs to the Decision 26
     - 9.1.4 Define the Study Boundaries 27
     - 9.1.5 Develop an Analytical Approach (or Decision Rule) 27
     - 9.1.6 Specify Limits on the Decision Error 28
     - 9.1.7 Optimise the Design for Obtaining Data 29
10. Rationale and Methodology 29
    - 10.1 Soil Sampling Rationale 29
    - 10.2 Landfill Gas Sampling Rationale 30
    - 10.3 Groundwater Sampling Rationale 30
    - 10.4 Surface Water Sampling Rationale 31
11. Site Assessment Criteria 31

11.1 Soil……31
11.1.1 Health Investigation and Screening Levels……31
11.1.2 Ecological Investigation and Screening Levels……33
11.1.3 Management Limits for Petroleum Hydrocarbons……35
11.2 Landfill Gas / Trace Non-Methane Organic Compounds……36
11.3 Groundwater……38
11.4 Surface Water……39
12. Fieldwork……40
12.1 Drilling and Soil Sampling……40
12.2 Drilling and Installation of Landfill Gas and Groundwater Monitoring Wells……40
12.3 Landfill Gas Sampling……41
12.3.1 Sampling Trace Non-Methane Organic Compounds……41
12.4 Groundwater Sampling……41
13. Results……42
13.1 Sub-Surface Conditions……42
13.2 Field Screening Results for Soil……43
13.3 Landfill Gas Sampling Results……43
13.4 Groundwater Levels……46
13.5 Analytical Laboratory Results……48
13.6 Data Quality Assurance and Quality Control……49
14. Discussion of Results……49
14.1 Soil Results……49
14.1.1 Leachability Results……51
14.2 Landfill Gas Results……51
14.2.1 Background Gas Wells……52
14.2.2 Relationship between Deep and Shallow Gas Well Data……52
14.2.3 Trace Non-Methane Organic Compounds……53
14.2.4 Trial Remediation Excavations……53
14.3 Groundwater Results……54
14.4 Surface Water Results……55
15. Conclusions……55
15.1 General……55
15.2 Relationship between Soil, Groundwater and Surface Water Results……55
15.3 Updated Conceptual Site Model……56
15.4 Suitability of the Site for the Proposed Development……56
15.5 Integration of the Development Application and Closure Plan……56
16. Geotechnical Considerations……56

17. Recommendations 57
17.1 Requirements for Site Remediation 57
17.1.1 Soil 57
17.1.2 Landfill Gas 57
17.1.3 Groundwater and Surface Water 57
17.2 Integration of Site Remediation and Geotechnical Site Improvements 57
17.3 Additional Investigations to Finalise Site Remediation Strategy 58
17.4 Long Term Environmental Management Plan 58
18. References 58
19. Limitations 60

Appendix A: About This Report
Drawings
Site Photographs
Appendix B: Summary of Soil Results
Appendix C: Summary of Non-Methane Organic Compound Results
Appendix D: Summary of Groundwater and Surface Water Results
Appendix E: Borehole Logs and Notes and Descriptive Terms
Appendix F: Calibration Certificates
Appendix G: Landfill Gas Field Sampling Sheets
Appendix H: Laboratory Certificates of Analysis and Chain of Custody Documentation
Appendix I: Data Quality Assurance and Quality Control Procedures and Results
Appendix J: Geotechnical Methodology for Remediating Benedict's Moorebank Site (J&K, 2016)

Detailed Site Investigation
Proposed Residential Development
146 Newbridge Road, Moorebank

1. Introduction

This report presents the results of a Detailed Site Investigation (DSI) undertaken by Douglas Partners Pty Ltd (DP) for a proposed residential development at 146 Newbridge Road, Moorebank (the "site", refer to Drawing 1, Appendix A). The work was commissioned by Ernest Dupere of Benedict Industries Pty Ltd (Benedict) and was undertaken with reference to DP's proposal SYD150814 dated 10 August 2015. The following is understood:

- The DSI and a subsequent Remediation Action Plan (RAP) will be required for submission as part of a development application (DA) for a proposed residential development at the site;
- The proposed development will involve retaining wall construction, bulk earthworks followed by construction of internal roads, associated infrastructure, residential lots and houses; and
- The site is being audited by Dr Ian Swane, a NSW Environment Protection Authority (EPA) accredited site auditor, to facilitate the issue of a site audit statement (SAS) Part B confirming the land can be made suitable for the proposed development.

The objective of this DSI is to fill existing data gaps in relation to site contamination issues and to document the site characterisation methods utilised to assess potential site contamination. The findings of this DSI will inform a RAP for the site in the context of the proposed development.

2. Site Identification

The site comprises part (generally the northern half) Lot 7 in Deposited Plan 1065574. The street address is 146 Newbridge Road, Moorebank and the site has a total area of approximately 9 ha.

The site boundary is shown on Drawing 1, Appendix A. The drawing also shows land to the south of the 'site' which is the remainder of Lot 7 in Deposited Plan 1065574. It is understood that this southern portion is also proposed to be developed as a marina and that this development is the subject of a separate DA.

3. List of Previous Reports

A number of previous investigations have been undertaken at the site by DP, Dames and Moore Pty Ltd (D&M), Environmental Investigation Services (EIS) and Jeffery and Katauskas Pty Ltd (J&K) (EIS is a division of J&K).

A summary of the relevant reports that are known to DP is provided in Table 1, below. The summary is not an exhaustive list, however, indicates the site has been subject to several investigations in the past.

Table 1: List of Previous Reports

Author	Year	Project No.	Report Title / Letter Report Title
D&M	1994	unknown	Report on Groundwater Sampling
DP	1999	27879	Proposed Environmental Monitoring Program, Sorting, Recovery and Transfer (SRT) Facility, 146 Newbridge Road, Moorebank
D&M	2000	unknown	Landfill Groundwater and Surface Water Monitoring and Assessment Program
DP	2002a	30410	Preliminary Geotechnical Assessment, 146 Newbridge Road, Moorebank
DP	2002b	30410	Report on Preliminary Contamination Assessment, Proposed Residential Development, 146 Newbridge Road, Moorebank
DP	2002c	30410	Geotechnical Assessment, 146 Newbridge Road, Moorebank
DP	2005	43479	Proposed Mixed Commercial / Residential Development, 146 Newbridge Road, Moorebank
DP	2008	45642.00	Preliminary Desktop Review, Benedict Sand and Gravel, Moorebank
DP	2009a	45642.01	Desktop Review, Benedict Sand and Gravel, Moorebank
DP	2009b	45642.02	Environmental and Geotechnical Advice, Benedict Sand and Gravel, 146 Newbridge Road, Moorebank
DP	2009c	45642.03	Review of Foundation Options, Proposed Residential Development, 146 Newbridge Road, Moorebank
DP	2009d	71459.00	Compaction and Grading, 146 Newbridge Road, Moorebank
EIS	2013	E26930KBrpt	Stage 1 Environmental Site Assessment for Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
J&K	2013	26930Zrpt	Geotechnical Investigation for Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
EIS	2014a	E26930KBrpt -HGG	Preliminary Hazardous Ground Gas Screening for the Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
EIS	2014b	E26930KBlet -HGGR2	Hazardous Ground Gas (HGG) Screening Results (Round 2), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
EIS	2014c	E26930KBlet -HGGR3	Hazardous Ground Gas (HGG) Screening Results (Round 3), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
EIS	2014d	E26930KBlet -HGGR4	Hazardous Ground Gas (HGG) Screening Results (Round 4), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

Author	Year	Project No.	Report Title / Letter Report Title
EIS	2014e	E26930KBlet -HGGR5	Hazardous Ground Gas (HGG) Screening Results (Round 5), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
DP	2014a	71459.01	Initial Comments on the Design of Landfill Gas Mitigation Measures 146 Newbridge Road, Moorebank Stage 1
DP	2014b	71459.01	Draft Concept Design for Landfill Gas Mitigation Measures 146 Newbridge Road, Moorebank Stage 1
DP	2015a	71459.02	Construction Environmental Management Plan, Proposed Retaining Wall, 146 Newbridge Road, Moorebank, NSW
DP	2015b	71459.02	Sampling and Analysis Quality Plan, Proposed Residential Subdivision, 146 Newbridge Road, Moorebank, NSW
DP	2015c	71459.04	Report on Geotechnical Investigation, Proposed Residential Subdivision, 146 Newbridge Road, Moorebank

4. Scope of Works

The scope of works for the DSI covering the further characterisation of soil, soil gas / landfill gas, groundwater and surface water was outlined in the SAQP (DP, 2015b) and comprised the following:

- Drilling of 26 boreholes (grid-based, where possible due to access constraints) to a depth of 0.5 m into natural soils (or prior refusal) including:
  - Three boreholes to depths intersecting the water table for soil sampling and groundwater / gas monitoring well installation including a replacement gas well for JK107 (replacement gas and groundwater well JKBH/MW107a);
  - Five boreholes to depths of 0.5 m into natural soils (or prior refusal), or to the target gas interval that was assessed whilst drilling for soil sampling and gas monitoring well installation including replacement wells for JK103 – partially damaged well (replacement well JK103a), and JK118 (replacement well JK118a);
- Drilling five shallow (~2.0 m) boreholes adjacent to five gas monitoring wells (including two within the initial remediation trial area of JK107) to establish five nested (paired) gas sampling locations to evaluate the vertical profile of gas concentration and flow rate;
- Collection of soil samples at regular intervals based on field observations, including from the near surface, from near the water table (if encountered) and upon any signs of obvious contamination such as odours or staining. Soil samples were collected using a standard penetration test (SPT) hammer where possible and from the auger spiral where the SPT was not feasible;
- Surveying of borehole coordinates and elevation using a differential GPS;
- Screening of all samples collected with a photoionisation detector (PID) to assess the likely presence or absence of volatile organic compounds (VOC);
- Submit 73 selected soil samples (including 10% QC samples) for analysis of a combination of the following common contaminants at a NATA accredited laboratory:
  - nine priority metals (arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, zinc);

  - total recoverable hydrocarbons (TRH);
  - monocyclic aromatic hydrocarbons (benzene, toluene, ethylbenzene and xylenes – BTEX);
  - polycyclic aromatic hydrocarbons (PAH);
  - organochlorine pesticides (OCP), organophosphorus pesticides (OPP);
  - polychlorinated biphenyls (PCB);
  - total phenols;
  - total cyanide (testing not actually requested by DP, however, results have been reported);
  - asbestos (up to 10 fragments, if encountered);
  - pH, cation exchange capacity (CEC);
- Installation of three groundwater monitoring wells;
- Developing the wells following installation;
- Allowing the well to stabilise for at least five days prior to sampling;
- Collection of groundwater samples from each monitoring well (including the two existing wells that were installed by J&K and remain serviceable);
- Submit six groundwater samples (including one QC sample plus one rinsate QC sample) to a NATA accredited laboratory for analysis of the following contaminants:
  - nine priority metals (arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, zinc);
  - TRH;
  - BTEX;
  - PAH;
  - total phenols;
  - OCP, OPP and PCB (trace level);
  - nutrients (nitrate, nitrite, ammonia and total phosphorous);
- Collection of a surface water sample from three locations – dredge ponds (south), Georges River (east) and drainage channel (west);
- Submitting four surface water samples (including one QC sample) to a NATA accredited laboratory for analysis of the following contaminants:
  - nine priority metals (arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, zinc);
  - TRH;
  - BTEX;
  - PAH;
  - OCP, OPP and PCB (trace level);
  - total phenols;
  - nutrients (nitrate, nitrite, ammonia and total phosphorous);
- Installation of seven landfill gas monitoring wells including two ‘background’ locations (BH224 and BH225) that were outside the proposed development area with shallow or no fill;

- Completion of four rounds of landfill gas testing using a GA 5000 landfill gas analyser to measure gas concentrations and flow rates at all landfill gas wells;
- Collection of three grab landfill gas samples (plus one intra-laboratory QC sample) using summa canisters and analysis at a NATA accredited laboratory for trace non-methane organic compounds (NMOC), including VOC, by USEPA TO-15 method;
- Field sampling and laboratory analysis in compliance with standard environmental protocols, including a Quality Assurance/Quality Control (QA/QC) plan consisting of 10% replicate sampling (intra and inter-laboratory replicate samples), trip spikes, trip blanks, rinsate, appropriate chain of custody procedures and in–house laboratory QA/QC testing; and
- Preparation of this DSI report detailing the methodology and results of the assessment with reference to EPA approved guidelines, including NEPC (2013).

The following table provides a summary of the purpose of each test location. Actual locations are shown on Drawing 2, Appendix A.

Table 2: Borehole Summary

Proposed Borehole ID	Soil Sampling	Landfill Gas Well [1]	Shallow Landfill Gas Well (Nested Pair)	Groundwater Monitoring Well
BH201	✓			
BH202	✓	✓		
BH203	✓			
BH204	✓			
BH205	✓			
BH206	✓			
BH207	✓			
BH208	✓			
BH209	✓			
BH210	✓			
BH211	✓	✓		
BH211b [2]			✓	
BH212	✓			
BH213	✓			
BH214	✓			
BH215	✓			
BH/MW216	✓	-		✓

Proposed Borehole ID	Soil Sampling	Landfill Gas Well [1]	Shallow Landfill Gas Well (Nested Pair)	Groundwater Monitoring Well
SS217*	✓			
BH/MW218	✓	-		✓
SS219*	✓			
BH220	✓			
BH221	✓			
BH222	✓			
BH223	✓	✓		
BH224		✓		
BH225		✓		
JK103a [3]	✓	✓		
JK103b [2,]			✓	
JKBH/MW107a [3, 4]	✓	-		✓
JK107b [2, 4]			✓	
JK114b [2]			✓	
JK118a [3]	✓	✓		
JK118b [2]			✓	

Notes to Table 2:

1. The three groundwater monitoring wells installed by DP were also utilised as landfill gas monitoring wells (denoted -).
2. 'b' denotes shallow gas well paired with deeper gas well.
3. 'a' denotes replacement gas well for destroyed wells JK103, JK107 and JK118.
4. Bore drilled in the footprint of the initial trial remediation excavation following backfilling.

* 'SS' denotes 'surface sample'. Excessive rubble in fill prevented drilling at this location.

5. Regional Geology, Acid Sulfate Soil Risk and Hydrogeology

A review summarised in EIS (2013) of the regional geological map of Penrith (1991) indicates that the site is underlain by the following formations:

- South and central sections – Quaternary aged deposits of medium grained sand and silty clay; and
- North, east and south-east sections – Tertiary aged deposits of clayey quartzose sand and clay.

Mapping and previous drilling indicates that the Tertiary and Quaternary deposits are underlain by shale bedrock.

A review summarised in EIS (2013) of the acid sulphate soil (ASS) risk map for Liverpool prepared by Department of Land and Water Conservation (1997) indicates that the site is located in the following ASS risk area:

- High Probability Risk Area – south and west sections of the site associated with low lying swamp areas. The depth of occurrence in this area is between 1 m and 3 m below ground level (bgl) associated with alluvial plains, alluvial swamps, alluvial levees and sand plains; and
- Disturbed Terrain – north, central and east sections of the site associated with the filled areas. The classification is adopted in large scale filled areas which often occur during reclamation of low lying swamps for urban development, in areas which may have been mined or dredged or have undergone heavy ground disturbance through general urban development or the construction of dams and levees.

A review summarised in EIS (2013) of groundwater bores registered with the NSW Office of Water (NOW) was undertaken. The search was limited to registered bores located within approximately 1 km radius of the site. The search indicated that two registered bores were located within this radius. The boreholes were registered for irrigation (GW024357) and domestic (GW023146) purposes. The irrigation bore is located approximately 800 m to the east of the site beyond Georges River. The domestic bore is located approximately 1.2 km to the north-east of the site. Both the bores are in close proximity of Georges River and the associated flood plain. Based on the distance of the bores and the regional topography, these bores were not considered to be potential receptors of any contamination that may be present at the site.

EIS (2013) noted that the stratigraphy of the site is expected to consist of relatively high permeability alluvial soils overlying deep shale bedrock. Based on these conditions and the results of the groundwater bore search, groundwater may be a potential resource in the vicinity of the site.

6. Summary of Site History

The detailed site history information is provided in DP (2002b) and EIS (2013). A summary of the site history information extracted from the EIS (2013) report is provided in Table 3, below.

Table 3: Summary of Site History (EIS, 2013)

Timeline	Details / Summary	Source of Information
1884 to 1924	The site was owned by private citizens and The Church of England Property Trust Diocese of Sydney. A portion of the land was owned by Perpetual Trustee Company Limited between 1920 and 1923. Based on a review of the 1930 aerial photograph, it is assumed that the site was predominantly vacant prior to 1930.	Land Title Records & Aerial Photos
1923 to 1947	The site was owned by New Bankstown Limited and The Greenacre Park Limited. A section of the site was also owned by private citizens between 1924 and 1965. A review of the 1943 historical aerial photograph indicates that cattle raising and grazing activity had commenced at the site after 1930. Sections of the site had been cleared of vegetation during this period.	Land Title Records & Aerial Photos

Timeline	Details / Summary	Source of Information
1947 to 1997	The site was owned by Echo Dairies Pty Ltd and a few private individuals including Anthony Francis Brady (a dairyman). A review of the historical aerial photographs indicates that large sections of the site were cleared during this period for cattle grazing. Warehouses were constructed at the site and low lying areas in some sections were filled to achieve level ground. A dam was created in the north section of the site which was subsequently filled. A storm water channel/drain was created along the west site boundary. The aerial photos indicate that the dairy activity at the site appeared to have ceased some time prior to 1982. Large sections of the site were filled between 1982 and 1991. Stockpiles were visible at the site in the 1991 aerial photograph which indicates the commencement of waste processing/dredging activity at the wider site (i.e. to the south of the proposed development area).	Land Title Records & Aerial Photos
1997 to present	The site as at 2013 was owned by Tanlane Pty Ltd. Large scale filling and dredging activity has occurred between 1991 and 2000. The site Land Title Records started to appear similar to the present layout from at least 2005. Council records indicate that a DA was submitted for the construction of a new road bridge at the subject site. A statement of environmental effects was prepared and submitted to council for the proposed development. The EPA has issued two licences (No. 4612, dated 2000 and 10490, dated 2001) under the POEO Act for the wider site. A number of variation notices were subsequently issued under s.58 of the Act between 2002 and 2013. Based on a review of the EPA information, the scheduled activities at the site included: • Crushing, grinding or separating; land-based extractive activity; and water-based extractive activity; • Storage/transfer/separation of various waste streams; • Importation of VENM and potential acid sulphate soil (PASS) for backfilling sand quarry (according to the site owner, only minor quantities of PASS was ever accepted at the site); • Dredging activities; • Landfilling activities; • Recovery, storage and processing (non-thermal treatment) of general waste including VENM; general solid waste (non-putrescible); general or specific exempted waste; wood waste; waste; paper or cardboard; gyprock; glass; building and demolition waste; asphalt waste (including asphalt resulting from road construction and waterproofing works); and waste tyres. A clean up notice (No. 1051596) was issued under s.91 of the Act to Benedict Reclamations in October 2005. The notice was for the clean-up of bonded asbestos containing material (bonded ACM) – fibro encountered in some stockpiles at the site.	Historical Aerial Photos, Council and NSW EPA records

7. Summary of Relevant Previous Investigations

The following subsections provide a brief summary of the conclusions and/or recommendations of those reports most relevant to the known site contamination issues.

7.1 DP (2002b)

DP was commissioned to undertake a Preliminary Contamination Assessment (PCA) for the proposed residential development at the site in 2002. The PCA was confined to the subject site which was formerly identified as Lot 1 in DP515738. The PCA was undertaken in conjunction with a geotechnical investigation commissioned for the proposed development. The objectives of the PCA were to:

- Determine the general level of potential contamination;
- Identify the potential for off-site migration of contamination; and
- Provide a preliminary view of the suitability of the site for the proposed development.

The investigation included:

- Drilling 12 boreholes in selected areas across the site; and
- Sampling the fill and natural soil profiles; and analysis of selected samples for a range of organic and inorganic contaminants.

The results of the investigation are summarised below:

- The boreholes encountered fill material ranging in depth from approximately 3.7 m to 8.7 m bgl. The fill contained inclusions of gravel and sand with some concrete, bricks, wood and clay;
- Natural alluvial soil comprising clay and sand was encountered beneath the fill;
- Groundwater seepage was encountered in the boreholes at depths of approximately 3.5m to 5.8m bgl;
- The majority of the analytical results were below the adopted site assessment criteria (SAC) which included the former Health Investigation Levels (HILs) Category A 'Residential Sites with Gardens and Accessible Soil' and the threshold concentrations for sensitive sites outlined in the NEPC (1999) *National Environment Protection (Assessment of Site Contamination) Measure 1999*, which has recently been superseded by NEPC (2013) *National Environment Protection (Assessment of Site Contamination) Measure 1999* as amended 2013;
- Elevations of lead above the SAC were encountered in four samples. However, the statistical analysis undertaken on the lead results indicated that the results were below the SAC;
- An elevated concentration of benzo(a)pyrene (B(a)P) above the SAC was encountered in one sample. However, the statistical analysis undertaken on the B(a)P results indicated that the results were below the SAC;
- The exceedances were not considered to pose a significant risk to human health; and
- Elevations above the provisional phyto-toxicity based guidelines levels (PPILs) (now superseded by EILs in NEPC (2013)) were encountered for cadmium and zinc in two samples. These samples were obtained from depths of approximately 2 m and 4 m below ground level and were

not considered to pose a risk to the shallow plant root zone (particularly in the context of a proposed cap at the site).

Based on the findings of the PCA, DP concluded that the site may be suitable for the proposed residential development provided further testing is undertaken to adequately characterise the groundwater and soil gas quality at the site.

7.2 EIS (2013)

The EIS (2013) investigation was limited to the subsurface soil profile, with the stockpile located on site at the time not being subject to the investigation. The objectives of the Stage 1 Environmental Site Assessment (ESA) were to identify the key areas of environmental concern (AEC) and to prepare a preliminary conceptual site model (PCSM) for the site. The objectives also included identifying widespread soil and groundwater contamination issues and the potential for the occurrence of acid sulfate soil (ASS) and hazardous ground gases (HGG) at the site.

The results of laboratory chemical analysis on the selected soil samples indicated the following:

- Monocyclic aromatic hydrocarbons (benzene, toluene, ethylbenzene and xylenes – BTEX), volatile organic compounds (VOC), organochlorine pesticides (OCP), organophosphorus pesticides (OPP) and polychlorinated biphenyls (PCB) were below the adopted SAC;
- The majority of the results for metals were below the HIL-A SAC. One fill sample JK16/0.0-0.2 had an elevated concentration of lead of 350 mg/kg above the SAC of 300 mg/kg. The elevated lead result was less than 250% of the SAC and the 95% upper confidence limit (UCL) of the arithmetic mean was calculated using the lead data from the fill soil samples. The 95% UCL for lead was 107 mg/kg which was below the HIL-A of 300 mg/kg. The Standard Deviation (SD) was less than 50% of the SAC;
- One fill sample JK7/2.7-3.0 recorded a total chromium concentration of 2800 mg/kg which was above the adopted Environmental Investigation Level (EIL) of 413 mg/kg;
- The majority of the results were below the Health Screening Level (HSL) A SAC. One surficial fill sample JK13/0.0-0.2 encountered an elevated concentration of total recoverable hydrocarbons (TRH) >C_{10}-C_{16} (TRH F2) of 190 mg/kg above the SAC of 110 mg/kg. The elevated TRH F2 result was less than 250% of the SAC and within the acceptance criteria outlined in Section 3. The 95% UCL was calculated using the TRH F2 data from the fill soil samples. The 95% UCL for TRH F2 was 43.94 mg/kg which is below the HSL-A of 110 mg/kg. The SD was less than 50% of the SAC. Seven individual fill samples encountered mid to heavy fraction TRH concentrations which were above the adopted Environmental Screening Levels (ESLs);
- The majority of the results for polycyclic aromatic hydrocarbons (PAH) were below the HIL-A SAC. One fill sample JK12/1.3-1.5 encountered an elevated concentration of B(a)P toxicity equivalency quotient (TEQ) of 13 mg/kg above the SAC of 3 mg/kg. The elevated B(a)P TEQ result was greater than 250% of the SAC (i.e. is a 'hotspot'). Twelve fill samples had elevated B(a)P concentrations which were above the adopted ESL criteria;
- Asbestos was encountered in JK10/7.3-7.5, no other asbestos was detected in any of the other boreholes. Seven fibre cement fragments from the surface of the site were tested for asbestos with six pieces confirmed to be bonded asbestos containing materials (ACM); and

- Acid sulphate soil results indicated that the majority of the results (eight samples only, five of fill, three of natural) were within the acidic to very acidic range. The adopted S_{POS} criterion of 0.03% was exceeded for samples of both fill and natural soils, suggesting that some potential acid sulphate soils may have been used to fill the site. The calculated preliminary liming rate required for neutralisation ranged from 2 kg Ca_3/tonne to 15 kg Ca_3/tonne.

The results of laboratory chemical analysis on the groundwater samples collected from the four groundwater monitoring wells by EIS indicated the following:

- TRH, BTEX, OCP, VOC and PCB were all below the adopted groundwater investigation levels (GILs);
- Detectable concentrations of OCP (DDE, DDT and dieldrin) were recorded at some monitoring wells, however, at concentrations below the GIL;
- Elevated concentrations of individual metals were recorded above the ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* GILs as follows:
    - Arsenic at MW9 recorded a concentration of 33 µg/L which exceeded the GIL of 24 µg/L;
    - Copper at MW9 and MW16 recorded a concentration of 12 µg/L and 2 µg/L, respectively, which exceeded the GIL of 1.4 µg/L;
    - Lead at MW9 recorded a concentration of 4 µg/L which exceeded the GIL of 3.4 µg/L;
    - Nickel at MW9 and MW16 recorded a concentration of 120 µg/L and 26 µg/L, respectively, which exceeded the GIL of 11 µg/L;
    - Zinc at MW9 and MW12 recorded a concentration of 200 µg/L and 39 µg/L, respectively, which exceeded the GIL of 8 µg/L;
- The majority of results for PAH were below the GILs. MW16 recorded a detectable concentration of naphthalene at 0.2 µg/L, which exceeded the USEPA criterion for tap water of 0.14 µg/L but below the ANZECC 2000 GIL; and
- Detectable concentrations of chlorpyrifos were recorded in the majority of the groundwater samples. The concentrations were above ANZECC 2000 GIL of 0.01µg/L. However, all of the results were below the NHMRC (2011) *Australian Drinking Water Guidelines* GILs.

The main areas of environmental concern (AEC) identified by EIS are summarised as follows:

- Uncontrolled large scale filling activity has been historically undertaken at the site associated with the commercial land uses. This has occurred since at least the 1950s and was not regulated during the initial years;
- The preliminary screening has indicated the presence of HGG at the site. The main source of HGG is considered to be the organic inclusions in the deeper filled areas. However, there may also be a potential for HGG generation to be associated with the swampy alluvial soils;
- The site has formerly been used as a dairy and for cattle grazing purposes. Some sections of the site were filled during this land use;
- Commercial activities associated with the current use of the site for resource recovery and waste processing could have a potential impact on the site; and
- Hazardous building material associated with the demolition of built structures can result in site contamination.

Data gaps identified by EIS include:

- Specific point sources of potential contamination associated with the AEC have not been adequately investigated;
- Deep fill at the site has not been adequately charactered;
- Large sections of the site have not been investigated (the EPA sampling design guidelines recommend 107 evenly spaced sampling points);
- The occurrence of HGG has not been adequately characterised; and
- Inaccessible areas (buildings and densely vegetated areas along the east west site boundaries) have not been investigated.

Based on the scope of works undertaken, EIS were of the opinion that the AEC at the site pose a risk to the identified receptors. EIS considered that the site can be made suitable for the proposed residential land use provided that suitable measures are untaken to address the data gaps and risks identified at the site. EIS recommended undertaking the following additional work:

- A preliminary HGG assessment should be undertaken to better characterise the risk associated with HGG. The assessment should include a PCSM for HGG; and
- A Stage 2 ESA should be undertaken to meet the EPA recommended sampling density. The Stage 2 ESA should target the data gaps identified in their report.

Based on the findings of the above investigations, EIS noted that consideration should be made to address the following:

- A remediation strategy to render the site suitable for the proposed residential land use;
- Assess the requirement for a Quantitative Health Risk Assessment (in accordance with enHealth and Appendix VII of the Guidelines for the NSW Site Auditor Scheme, 2006) for HGG and other remnant contamination that may remain on site; and
- Assess the requirements for an Environmental Management Plan (EMP) for the ongoing management of contamination remaining on site.

7.3 EIS (2014a)

The EIS (2014a) investigation involved the design and implementation of a field sampling program which included installation of monitoring wells to assess HGG. The initial sampling plan proposed 19 HGG sampling locations, but due to site access constraints, only 13 locations were drilled with four existing groundwater monitoring wells utilised as HGG sampling locations. The spacing of the wells varies and is generally in the order of 30 m to >60 m apart.

The HGG monitoring data in EIS (2014a) is summarised as follows:

- Methane concentrations ranged from 0.01 %v/v to 30 %v/v. The majority of the higher CH_4 concentrations were associated with the deep fill areas;
- Carbon dioxide concentrations ranged from 0.05 %v/v to 31.2 %v/v. The higher CO_2 concentrations were generally associated with the higher CH_4;

- Oxygen concentrations ranged from 0 %v/v to 30.6 %v/v. The O_2 concentrations generally decreased with higher CH_4 concentrations in the deeper fill areas;
- Carbon monoxide[1] concentrations ranged from 0 ppm to 117 ppm. There was no major trend observed in the CO concentrations;
- Hydrogen sulphide concentrations ranged from 0 ppm to 40 ppm. Higher values of H_2S were recorded in the boreholes during drilling when compared to readings obtained from monitoring wells on completion of drilling; and
- Atmospheric pressure readings ranged from 1013 hPa to 1024 hPa.

Based on the scope of works undertaken, EIS were of the opinion that the HGG encountered at the subject site poses a risk to the receptors and future development of the site. Prior to remediation/management of the site, EIS recommended undertaking the following additional work to better characterise the risks:

- "Long term monitoring of HGG should be undertaken at the site. Considering the end land use for residential with gardens, the CIRIA (2007) *C665 Assessing Risks Posed by Hazardous Ground Gases to Buildings* recommends a minimum monitoring period of 24 months;
- Additional HGG monitoring wells should be installed when site access becomes available to better assess the source and generation of HGG. The CIRIA C665 guideline recommends a grid spacing of <25 m for sensitive sites such as residential houses with gardens;
- A Stage 2 ESA should be undertaken to meet the EPA (1995) *Sampling Design Guidelines* recommended sampling density;
- A Quantitative Health Risk Assessment (in accordance with enHealth guidelines and Appendix VII of the DEC (2006) *Guidelines for the NSW Site Auditor Scheme*) should be undertaken by a suitability qualified risk assessor for the contamination remaining on site;
- In the event site remediation is chosen (either excavation and removal of fill or capping and passive / active gas venting), a Remediation Action Plan (RAP) should be prepared for the site;
- In the event the capping / management options are chosen, a Construction Management Plan (CMP) should be prepared to document the gas mitigation / management measures required to be implemented during construction;
- A Validation Assessment (VA) report should be prepared to document the remediation action undertaken at the site;
- An Environmental Management Plan (EMP) should be prepared for the ongoing management of contamination remaining on site. The EMP will require establishment of appropriate public notification under Section 149(2) of the *Environmental Planning and Assessment Act* NSW 1979 or a covenant registered on the title to land under Section 88B of the *Conveyancing Act* NSW 1919;
- Prepare an appropriate work, health and safety plan (WHS) for the contaminants encountered at this site; and

[1] Carbon monoxide and hydrogen sulphide are both reported in EIS reports as percent, however, DP assumes that this unit should be in parts per million (ppm) which is the common unit on landfill gas analysers and we have changed it accordingly.

- Inspections during demolition and excavation work to assess any unexpected conditions or subsurface facilities that may be discovered between investigation locations. This should facilitate appropriate adjustment of the works program and schedule in relation to the changed site conditions. Inspections should be undertaken by experienced environmental personnel."

7.4 EIS (2014b)

The EIS (2014b) investigation involved a continuation (Round 2) of the monitoring to assess HGG. The monitoring was undertaken on 21 February 2014.

The HGG monitoring data in EIS (2014b) was summarised by EIS as follows:

- The CH_4 concentrations ranged from 0 %v/v to 28.4 %v/v. The majority of the higher concentrations were associated with the deep fill areas;
- The CO_2 concentrations ranged from 0.5 %v/v to 31.3 %v/v. The high CO_2 concentrations were generally associated with the high CH_4 concentrations in the deeper fill areas of the site;
- The O_2 concentrations ranged from 0 %v/v to 18.7 %v/v. The O_2 concentrations generally decreased with higher CH_4 concentrations in the deeper fill areas of the site;
- The CO concentrations ranged from 0 ppm to 2 ppm. There was no major trend observed by EIS in the CO concentrations;
- The H_2S concentrations ranged from 0 ppm to 4 ppm. Higher values of H_2S were noted in the boreholes during drilling (see (EIS, 2014a) report) when compared to readings obtained during this screening;
- The atmospheric pressure reading during the screening ranged from 1016 hPa to 1019 hPa. A difference of 3 hPa was recorded; and
- The peak flow ranged from 0 L/hr to 4.7 L/hr over the monitoring duration of three minutes at each location.

A preliminary qualitative risk assessment (PQRA) was presented in EIS (2014a). The report recommended reviewing the PQRA based on the results of subsequent monitoring. EIS used the additional flow data obtained during the second round of screening to calculate the Gas Screening Value (GSV) and the Characteristic Gas Situation (CGS) in order to comment on the level of protection required for future development of the site.

The GSV for the site was calculated by EIS to be 2.82 L/hr. The GSV was used to calculate a CGS of 3 using the modified Wilson and Card classification which is in the moderate risk category. EIS concluded that for the proposed low density residential development with a CGS3, protection measures should be adopted to achieve a protection score of four or higher.

7.5 EIS (2014c)

The EIS (2014c) investigation involved a continuation (Round 3) of the monitoring to assess HGG. The monitoring was undertaken on 7 March 2014.

The HGG monitoring data in EIS (2014c) was summarised by EIS as follows:

- The CH_4 concentrations ranged from 0 %v/v to 35 %v/v. The majority of the higher concentrations were associated with the deep fill areas;
- The CO_2 concentrations ranged from 0.1 %v/v to 33.1 %v/v. The high CO_2 concentrations were generally associated with the high CH_4 concentrations in the deeper fill areas of the site;
- The O_2 concentrations ranged from 0 %v/v to 20.2 %v/v. The O_2 concentrations generally decreased with higher CH_4 concentrations in the deeper fill areas of the site;
- The CO concentrations ranged from 0 ppm to 2 ppm. There was no major trend observed by EIS in the CO concentrations;
- The H_2S concentrations ranged from 0 ppm to 18 ppm. Higher values of H_2S were noted in the boreholes during drilling (see EIS HGG (2014a) report) when compared to readings obtained during this screening;
- The atmospheric pressure reading during the screening ranged from 1018 hPa to 1021 hPa. A difference of 3 hPa was recorded; and
- The peak flow ranged from -0.1 L/hr to 7.3 L/hr over the monitoring duration of three minutes at each location.

The GSV for the site was calculated by EIS to be 5.11 L/hr (with EIS noting the uncertainty relating to the sampling device). The GSV was used to calculate a CGS of 4 using the modified Wilson and Card classification which is in the moderate to high risk category.

EIS concluded that for the proposed low density residential development with a CGS4, protection measures should be adopted to achieve a protection score of six or higher. EIS also noted that NSW EPA guidelines recommend adopting pathway intervention and a high level of management for residential development at CGS4 and above and that consideration should also be made to undertaking a Level 2 risk assessment.

7.6 EIS (2014d)

The EIS (2014d) investigation involved a continuation (Round 4) of the monitoring to assess HGG. The monitoring was undertaken on 1 April 2014.

The HGG monitoring data in EIS (2014d) was summarised by EIS as follows:

- The CH_4 concentrations ranged from 0.1 %v/v to 37.2 %v/v. The majority of the higher concentrations were associated with the deep fill areas. There was a general increase in the concentrations when compared to the previous rounds;
- The CO_2 concentrations ranged from 0.3 %v/v to 35.2 %v/v. The high CO_2 concentrations were generally associated with the high CH_4 concentrations in the deeper fill areas of the site. There was a general increase in the concentrations when compared to the previous rounds;
- The O_2 concentrations ranged from 0 %v/v to 5 %v/v. The O_2 concentrations generally decreased with higher CH_4 concentrations in the deeper fill areas of the site. There was a general decrease in the concentrations when compared to the previous rounds;

- The CO concentrations ranged from 0 ppm to 1 ppm. There was no major trend observed by EIS in the CO concentrations;
- The H_2S concentrations ranged from 0 ppm to 177 ppm. Higher values of H_2S were noted in the boreholes during drilling (see EIS HGG 2014a report) when compared to readings obtained during this screening. Monitoring well JK118 encountered a very high concentration of H2S of 177 ppm. The previous maximum concentration encountered in this monitoring well was 21 ppm during drilling on 28 January 2014;
- The atmospheric pressure reading during the screening was 1020 hPa; and
- The peak flow recorded using the GA5000 ranged from 0.1 L/hr to 4.5 L/hr over the monitoring duration of 3 minutes at each location. The peak flow recorded using the GFM unit ranged from 0 L/hr to 3.6 L/hr at selected locations. The peak flow recorded using the Risiteck unit ranged from 0.13 L/hr to 1.65 L/hr at selected locations.

The comparison of the flow rates in monitoring wells JK104, JK107 and JK119 indicated that the readings recorded by the GA5000 and the GFM units were generally within the same range. The results obtained from the Risiteck unit were not considered to be sufficiently accurate for further consideration.

The GSV for the site was calculated by EIS to be 2.72 L/hr. The GSV was used to calculate a CGS of 3 using the modified Wilson and Card classification which is in the moderate risk category. EIS concluded that for the proposed low density residential development with a CGS of 3, protection measures should be adopted to achieve a protection score of four or higher.

7.7 EIS (2014e)

The EIS (2014e) investigation involved a continuation (Round 5) of the monitoring to assess HGG. The monitoring was undertaken on 11 April 2014.

The HGG monitoring data in EIS (2014e) was summarised by EIS as follows:

- The CH_4 concentrations ranged from 0 %v/v to 65.4 %v/v. Monitoring well JK103 encountered a very high reading of 65.4 %v/v. The concentrations were rechecked at separate intervals during the monitoring event to validate the reading. The repeat monitoring results from JK103 were 58 %v/v and 63.6 %v/v. The majority of the higher concentrations were associated with the deep fill areas;
- The CO_2 concentrations ranged from 0.4 %v/v to 21.2 %v/v;
- The O_2 concentrations ranged from 0 %v/v to 21.2 %v/v. The O_2 concentrations generally decreased with higher CH_4 concentrations in the deeper fill areas of the site;
- The CO concentrations ranged from 0 ppm to 6 ppm. There was no major trend observed by EIS in the CO concentrations;
- The H_2S concentrations ranged from 0 ppm to 206 ppm. Higher values of H_2S were noted in the boreholes during drilling (see EIS HGG 2014a report) when compared to readings obtained during this screening. Monitoring well JK118 encountered a very high concentration of H_2S of 206 ppm. The previous maximum concentration encountered in this monitoring well was 177 ppm during the fourth round;

- The atmospheric pressure reading during the screening was 1003 hPa. The atmospheric pressure had been falling steadily from a high of 1025 hPa recorded at the BOM weather station at Bankstown Airport on Monday 7 April 2014; and
- The peak flow ranged from -5.4 L/hr to 2.3 L/hr over the monitoring duration of 3 minutes at each location.

The GSV for the site was calculated by EIS to be 4.77 L/hr. The GSV was used to calculate a CGS of 4 using the modified Wilson and Card classification which is in the moderate to high risk category. EIS concluded that for the proposed low density residential development with a CGS4, protection measures should be adopted to achieve a protection score of six or higher.

A summary of the five HGG monitoring rounds extracted from EIS (2014e) is shown on Figure 1, below.

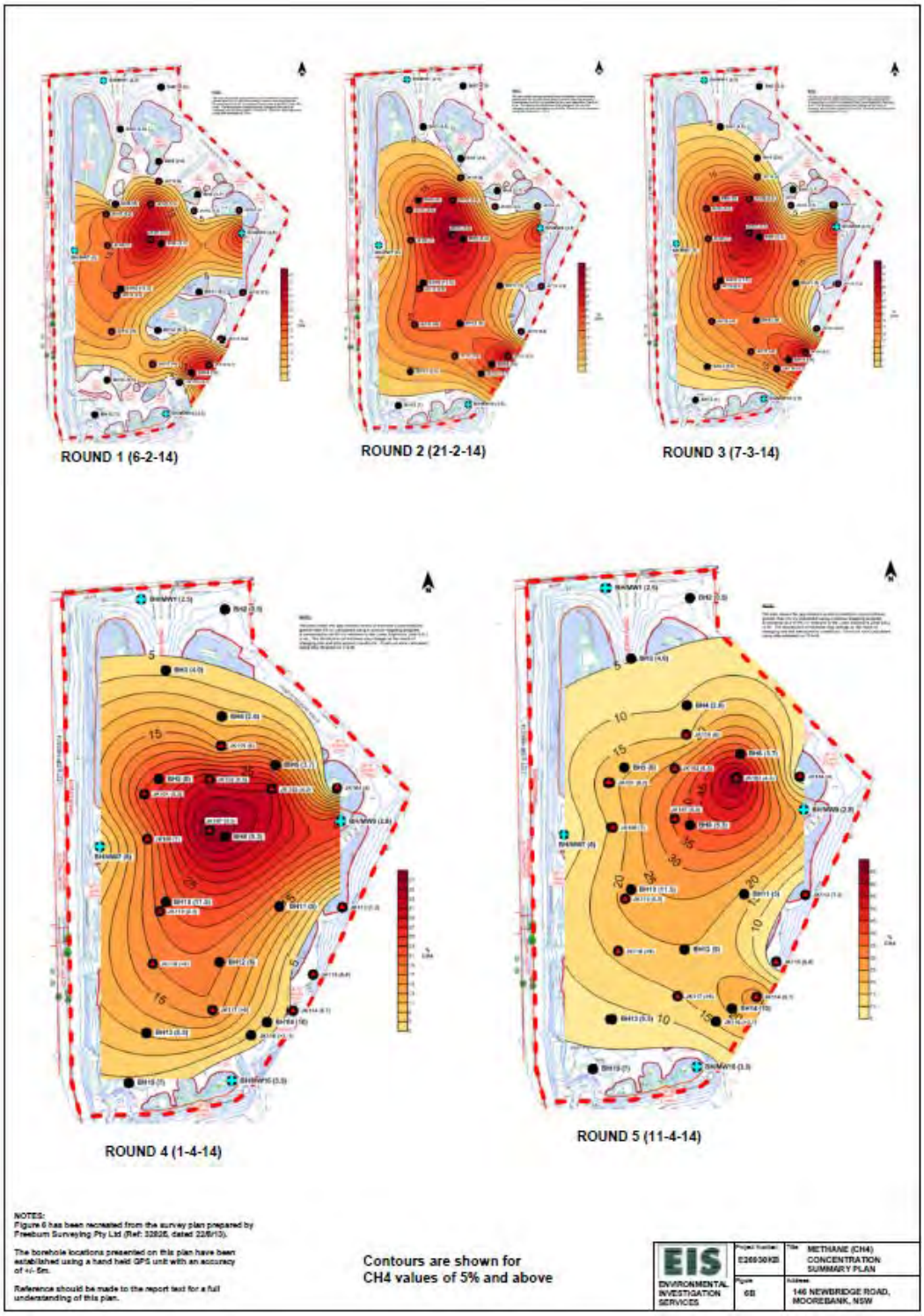


Figure 1: Methane Concentration Summary Plan (EIS, 2014e)

7.8 DP (2014a)

DP initially proposed four tasks namely:

- Review of the site investigation reports by EIS particularly the EIS (2014a);
- Provision of concept landfill gas mitigation design for low - medium density residential development including the likely development scenarios (e.g. residential house with slab, external services and public open space);
- Preliminary discussions with the builder (Mirvac Group) to discuss the build-ability of the concept landfill gas mitigation system(s) and initial discussions with the site auditor (yet to be confirmed at the time) to confirm in principal agreement; and
- Provision of a Stage 1 report for auditor review.

The DP (2014a) review concluded that, given the data to date it should be assumed that a minimum of three levels of gas mitigation is required. DP recommended that further monitoring works are undertaken to avoid overly conservative design requirements. In this regard, it was also recommended that a review of the earthworks requirements are undertaken with a view to establishing if the earthworks can be incorporated into the mitigation design (e.g. low permeable capping layer).

7.9 DP (2014b)

The scope of DP (2014b) was to provide the concept landfill gas mitigation design as discussed in Section 7.8 above.

The DP (2014b) draft concept design concluded that monitoring by EIS has indicated a CGS of 4 requiring a gas mitigation system design with a score of at least six. A passive landfill gas mitigation system design comprising at least three (and likely four) levels of protection was therefore required. The proposed concept design comprised several main elements as outlined in the report including: a clay cap, a gas drainage (collection and dispersal system) layer, a gas protective membrane and sealed concrete slab.

DP concluded that combined these should afford a score of >6 points as required by NSW EPA (2012) *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases*.

The report also noted that final design, specifications and suppliers can be provided once the initial concept design is reviewed and agreed by the site auditor and is demonstrably buildable.

8. Conceptual Site Model

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors (linkages). The CSM provides the framework for identifying how the site became contaminated and how potential receptors may be exposed to contamination either in the present or the future i.e. it enables an assessment of the potential source – pathway – receptor linkages. A preliminary CSM was developed

by EIS in EIS, 2013 and several investigations have been undertaken since that time. The refined CSM based on those investigations (i.e. prior to the current DSI) is reproduced herein.

The potential sources of contamination and contaminants of concern within the site have been identified and summarised in the Table 4, below.

Table 4: Potential Contamination Sources and Contaminants of Concern

Potential Source	Description of Potential Contaminating Activity	Contaminants of Concern
1. Large scale filling	Filling activity has occurred at the site since the use of the site for agricultural/commercial purposes (from at least 1950s). During the early years, due to lack of regulation, uncontrolled filling could have occurred. Filling of low lying swamps/vegetation could result in the generation of ground gasses. The site drainage has been significantly altered and artificial drainage including dams, channels/drains etc. have been created. Large scale filling at the site appeared to have occurred between 1982 and 1991 associated with the commercial use for waste processing / dredging and recycling activities. A review of the EPA records indicate that various waste streams including wood, tyres, general solid waste (non-putrescible) etc. were permitted to be imported onto the site. The boreholes drilled for previous investigations encountered deep fill in the central and south sections of the site where the majority of the filling has occurred. The batters along the subject site boundary provide an indication of the level of filling.	Metals, TRH, BTEX, VOC, PAH, OCP, OPP, PCB, asbestos, nutrients (nitrate, nitrite and phosphorous) and HGG including methane, carbon dioxide, carbon monoxide and hydrogen sulphide, trace NMOC
2. Past agricultural activities	Prior to commercial operations the site was used for dairy and cattle grazing. Potential contamination during this period could have occurred with the use of pesticides and herbicides.	Metals, OCP and OPP
3. Current site use for Resource Recovery and Processing	The site is licenced to receive various waste streams, including general solid waste (non-putrescible), wood, tyres, asphaltic gravel etc. The site is also licenced to carry out extractive activities, with various metals used in the extraction process. Petroleum hydrocarbons including oil, diesel etc. are used and kept on site along with car batteries. Asbestos (typically bonded ACM) has previously been found in stockpiles, in fill and at the ground surface within the site.	Metals, TRH/BTEX, PAH, OCP, OPP, PCB, oil and grease, sulphuric acid (associated with batteries) and asbestos

Potential Source	Description of Potential Contaminating Activity	Contaminants of Concern
4. Hazardous building materials	Former buildings within the site may have contained hazardous building materials (e.g. bonded ACM). A single storey cottage located within the site may contain hazardous building materials.	Asbestos, SMF, lead and PCB

Notes to Table 4:
TRH – Total recoverable hydrocarbons including light, mid and heavy fractions
BTEX – Monocyclic aromatic hydrocarbons – benzene, toluene, ethylbenzene and xylenes
VOC – Volatile organic compounds includes BTEX compounds
PAHs – Polycyclic aromatic hydrocarbons
OCPs – Organochlorine pesticides
OPPs – Organophosphorus pesticides
PCBs – Polychlorinated Biphenyls
SMF – Synthetic mineral fibres

The potential contamination sources (S) on the site are therefore:

- S1 – Large scale filling;
- S2 – Past agricultural activities which may have used pesticides or herbicides;
- S3 – Current site activities which may contribute to contaminants entering the soil; and
- S4 – Buildings that could have been constructed using asbestos, or other hazardous building materials.

The following potential human receptors (R) have been identified:

- R1 – Current site users;
- R2 – Construction workers (during site redevelopment);
- R3 – Future site users (including occupants) following construction of the proposed residential development; and
- R4 – Residents and users of surrounding lands.

The following potential ecological receptors (ER) have been identified:

- ER1 – Local ecology (upper 2.0 m of the proposed final landform);
- ER2 – Open drainage channel located on along the western boundary of the site;
- ER3 – Dredge ponds and associated aquatic ecosystem located to the south of the site; and
- ER4 – Georges River located approximately 120 m to the east of the site.

Potentially complete exposure pathways (P) for contamination to impact on the identified receptors include the following:

Primarily relevant to human receptors:

- P1 – Ingestion and dermal contact;
- P2 – Inhalation of dust and/or vapours including HGG;

- P3 – Explosion and/or asphyxiation due to the accumulation of HGG in structures (existing or proposed); and
- P4 – Abstraction and use (e.g. for drinking or irrigation) of contaminated groundwater.

Primarily relevant to ecological receptors:

- P5 – Direct contact with local ecology (upper 2.0 m of the proposed final landform);
- P6 – Surface water run-off;
- P7 – Leaching of contaminants from soil / fill and vertical migration to groundwater; and
- P8 – Lateral migration of contaminants in groundwater which provides base flow to water bodies (e.g. lateral transport of chlorpyrifos or zinc via groundwater which discharges to the Georges River or open drainage channel).

A 'source–pathway–receptor' approach has been used to assess the potential risks of harm being caused to human, water or environmental receptors from contamination sources on or in the vicinity of the site, via exposure pathways. The possible pathways between the above sources (S1, S2, S3 and S4) and receptors (R1-R4, ER1-ER4) are provided in the table below.

Table 5: Conceptual Site Model

Source	Exposure Pathway	Receptor	Comment
S1: Large scale filling S2: Past agricultural activities S3: Current site uses S4: Hazardous building material	P1 – Ingestion and dermal contact.	R1/R2/R3: Current site users, construction workers, and future site users.	- Complete exposure pathway considered to exist. - Can be managed by adoption of appropriate work health and safety procedures during remediation. The remediation strategy can render the exposure pathway incomplete for future site users (including occupants).
	P2 – Inhalation of dust and/or vapours including HGG.	R1/R2/R3/R4: Current site users, construction workers, future site users, users of adjacent lands.	- Complete exposure pathway considered to exist for inhalation of dust. - Incomplete exposure pathway considered to exist for vapours given the general absence of structures at the site. - Can be managed by adoption of appropriate work health and safety procedures during remediation. The remediation strategy to be adopted will render the exposure pathway incomplete for future site users (including occupants) when structures in which gas can accumulate will be present at the site and also to adjacent land users.
	P3 – Explosion and/or asphyxiation due to the accumulation of HGG in structures (existing or proposed).	R1/R2/R3: Current site users, construction workers, and future site users.	- Incomplete exposure pathway considered to exist for HGG given the general absence of structures at the site. - Can be managed by adoption of appropriate work health and safety procedures during remediation. The remediation strategy can render the exposure pathway incomplete for future site users (including occupants).
	P4 – Abstraction and use (e.g. for drinking or irrigation) of contaminated groundwater.	R1/R3/R4: Current site users, future site users, and adjacent site users.	- Incomplete exposure pathway considered to exist given the general absence of groundwater abstraction at the site. - No known groundwater abstraction in the immediate vicinity of the site. - The remediation strategy to be adopted will render the exposure pathway incomplete for future site users (including occupants) by imposing restrictions on groundwater abstraction.
	P5 – Direct contact with local ecology (upper 2.0 m of the proposed final landform).	ER1 – Local ecology.	- Complete exposure pathway considered to exist, however, the environmental value of the current ecology is likely to be very low. - The remediation strategy can render the exposure pathway incomplete for the upper 2.0 m of the proposed final landform.

Source	Exposure Pathway	Receptor	Comment
	P6 – Surface water run-off.	ER1/ER2/ER3/ER4 – Local ecology, open drainage channel (west), dredge ponds (south), Georges River (east).	- Complete exposure pathway considered to exist, however, further investigations would be required to evaluate any adverse impacts to the receptors.
	P7 – Leaching of contaminants from soil / fill and vertical migration to groundwater.	ER2/ER3/ER4 – Open drainage channel (west), dredge ponds (south), Georges River (east).	- Complete exposure pathway dependent on P8 discussed below.
	P8 – Lateral migration of contaminants in groundwater which provides base flow to water bodies.	ER1/ER2/ER3/ER4 – Local ecology, open drainage channel (west), dredge ponds (south), Georges River (east).	- Potentially complete exposure pathway considered to exist, however, further investigations would be required to confirm whether lateral migration is occurring and to evaluate any adverse impacts to the receptors.

Notes to Table 5:

S2, S3 and S4 are generally considered comparably insignificant to S1 and generally indistinguishable to the release and transport of contaminants which may have occurred due to S1

Based on the CSM summarised above, the identified sources of contamination can be appropriately managed in the interim, during construction and post-construction/post-remediation such that sensitive ecological and human receptors are not adversely affected.

9. Data Quality Objectives

9.1 Introduction

The DSI with limited sampling was devised with reference to the seven step data quality objective (DQO) process which is provided in Appendix B, Schedule B2 of NEPC (2013). The DQO process is outlined as follows:

9.1.1 State the Problem

The site is proposed to be redeveloped as a residential subdivision. Previous investigations have identified potential sources of soil contamination, groundwater contamination and landfill gas issues associated with the sites history as a landfill. The "problem" to be addressed is that the extent and nature of potential contamination on site is not fully understood; it is unclear whether the site is suitable for the proposed redevelopment and if contamination poses a risk to human health or the environment during and after the redevelopment works. The objective of the investigation is therefore to further characterise the nature and extent of contamination at the site and make recommendations for further targeted investigations and remediation to render the site suitable for the proposed redevelopment works.

The site is close to low-density residential developments and the design of the project will consider minimising noise and dust impacts from the proposed works. The project is also located close to sensitive environmental receptors such as the Georges River. A primary constraint for the project is the timeline for the preparation of the site ready for construction of the development. The site is within the Local Government Area (LGA) of Liverpool. DP's proposed project team includes a Principal, Project Manager (Associate), field engineers / scientists and drilling subcontractor. The decision makers are the DP Principal, Project Manager (Associate) and the site auditor in their capacity as auditor.

9.1.2 Identify the Decision / Goal of the Study

Based on the site history of landfilling, it is considered that the contaminants of concern are various organic and inorganic compounds (refer to the CSM in Section 8) for various media including soil, soil gas, groundwater and surface water. As such, the analysis focused on those contaminants relevant to the identified media.

The analytical data for soil was compared to relevant SAC including HIL, HSL, EIL and ESL for residential land use land use as per Tables 1A and 1B in Schedule B1, NEPC (2013). The analytical data for groundwater / surface water was compared to GIL relevant to the particular receptors including HSL (petroleum hydrocarbons) and aquatic ecosystems as per Table 1C in Schedule B1, NEPC (2013). The analytical data for soil gas was compared to relevant GSV, CGS, HSL and interim HIL for trace NMOC as per EPA (2012) and NEPC (2013) or other relevant guidance, as appropriate.

The suitability of the site for the proposed residential development was based on a comparison of the analytical results for all contaminants of concern to the adopted SAC and, if necessary, compared to the 95% UCL of the mean concentrations (relevant to soil contamination under certain circumstances).

The following specific decisions were made, as appropriate:

- What is the conceptual site model (i.e. sources, receptors, migration pathways, exposure)?
- Do the existing fill materials and/or natural soils pose a potential risk to identified receptors?
- Does the existing groundwater beneath the site pose a potential risk to identified receptors?
- Does the existing soil gas beneath the site pose a potential risk (toxic, explosion or asphyxiation) to identified receptors?
- Is the data sufficient to make a decision regarding the abovementioned risks, the compatibility of the site for the proposed development or are additional investigations required?
- Does contamination at the site, if encountered, trigger the Duty to Report requirements under the *Contaminated Land Management Act* 1997 (NSW)?
- Are there any off-site migration issues that need to be considered?
- Is the data sufficient to enable the preparation of a RAP and/or Environmental Management Plan (EMP) should the data suggest these are required?

9.1.3 Identify Inputs to the Decision

Inputs into the decisions were as follows:

- Collection and review of site history information including information regarding previous and current activities undertaken on the site and the surrounding areas;
- Review of previous investigations undertaken as summarised in Section 7;
- Regional geology, topography, ASS risk mapping and hydrogeology;
- Soil, soil gas, groundwater and surface water samples were collected at a combination of targeted and grid-based sampling patterns and analysed for the relevant contaminants of concern;
- The lithology of the site as described in the bore logs;
- If site conditions suggest additional contaminants of concern e.g. if the condition of subsurface material encountered whilst drilling encounter particular odours, further analysis was undertaken;
- Field and laboratory QA/QC data to assess the suitability of the environmental data for the assessment;
- All analysis was undertaken at a NATA accredited laboratory; and
- The results were compared with the SAC, GIL, GSV, CGS, HSL and interim HIL criteria discussed in Section 9.1.2.

9.1.4 Define the Study Boundaries

The site is identified as part (generally the northern half) Lot 7 in Deposited Plan 1065574 and is located approximately 23 km from the Sydney CBD. The site is shown on Drawing 1, Appendix A.

The site covers an irregularly shaped area which occupies a total area of approximately 9 ha. The lateral site boundaries are shown on Drawing 1. The investigation was undertaken to the potential depth of contamination which is currently understood to be the lower of the base of the fill and upper portion of the unconfined aquifer beneath the site.

The investigation of the site was constrained by the presence of existing stockpiles and the timing constraints of the project. It is noted that the stockpiles will be removed from the site and additional testing within the stockpile footprints can be undertaken at such time to confirm subsurface conditions at these portions of the site.

9.1.5 Develop an Analytical Approach (or Decision Rule)

The information obtained during the assessment has been used to characterise the site in terms of contamination issues and risk to human health and/or the environment. The decision rules used in characterising the site were as follows:

- Laboratory test results for fill/soil were assessed individually or statistically, if considered appropriate, to determine the 95% UCL of the mean concentration for each analyte or analyte group (of like materials);
- Laboratory test results for targeted locations (and identified 'hotspots') were assessed individually;
- The adopted SAC, GIL, GSV, CGS, HSL and interim HIL are from EPA endorsed guidelines;
- Where such criteria are not available, other recognised national or international standards were used;
- The contaminant concentrations in fill/soil should meet the following criteria, or further investigation or remedial action is required if:
    - The concentration of the contaminant in soil is more than 2.5 times the SAC. Any location more than 2.5 times the adopted site criteria is classified as a 'hotspot', requiring further assessment / management;
    - The calculated 95% UCL for a relevant area and discrete impacted fill/soil stratum (excluding any 'hotspot' concentrations) exceeds the adopted SAC;
    - The standard deviation of the results is greater than 50% of the SAC;
- The groundwater was not considered significantly impacted by a particular contaminant unless there was no notable or significant increase in background concentrations and/or there were no analyte concentrations in the groundwater samples significantly exceeding the adopted GIL;
- Further investigation, remediation and/or management has been recommended where the site was found to be contaminated or containing contamination 'hotspots' or significantly impacted groundwater; and

- The landfill gas data has been evaluated in the context of relevant GSV, CGS, HSL and interim HIL and the degree of impact will inform the proposed gas mitigations are to be incorporated into the proposed RAP.

Field and laboratory test results was considered useable for the assessment after evaluation against the following data quality indicators (DQIs):

- Precision – a measure of variability or reproducibility of data;
- Accuracy – a measure of closeness of the data to the 'true' value;
- Representativeness – the confidence (qualitative) of data representativeness of media present on site;
- Completeness – a measure of the amount of usable data from a data collection activity; and
- Comparability – the confidence (qualitative) that data may be considered to be equivalent for each sampling and analytical event.

9.1.6 Specify Limits on the Decision Error

Considering that the future site use/development will involve residential land use, decision errors for the respective contaminants of concern for fill/soil were:

1. Deciding that the site's fill/soil exceeds the SAC when they truly do not; and
2. Deciding that the site's fill/soils are within the SAC when they are truly not.

Considering that the assessment of groundwater is intended to determine if the site is impacting negatively on groundwater quality, the decision errors for the contaminants of concern are:

3. Deciding that the groundwater quality exceeds the GIL when it truly does not; and
4. Deciding that the groundwater quality is within the GIL, when it truly is not.

Decision errors for the proposed assessment were minimised and measured by the following:

- Compare new data with available previous investigations to determine the possible range of the parameters of interest;
- The sampling regime targeted key strata identified to account for site variability;
- Sample collection and handling techniques was with reference to DP's *Field Procedures Manual*;
- Samples were prepared and analysed by a NATA accredited laboratory with the acceptance limits for laboratory QA/QC parameters based on the laboratory reported acceptance limits and those stated in NEPC (2013);
- The analyte selection was based on the available site history, past site activities, site features and the findings of the previous investigations. The potential for contaminants other than those proposed to be analysed is currently considered to be low based on the current CSM;
- The SAC, GIL, GSV, CGS, HSL and interim HIL were adopted from established and EPA endorsed guidelines where available. The SAC, GIL, GSV, CGS, HSL and interim HIL have risk probabilities already incorporated;

- A significance level of 0.05 has been adopted for data with statistical analysis of 95% UCL of average concentrations; and
- Only NATA accredited laboratories using NATA endorsed methods were used to perform laboratory analysis. Where NATA endorsed methods are not used, the reasons have been stated. The effect of using non-NATA methods (if relevant) on the decision making process has been explained.

9.1.7 Optimise the Design for Obtaining Data

Sampling design and procedures that were implemented to optimise data collection for achieving the DQOs included the following:

- Only NATA accredited laboratories using NATA endorsed methods were used to perform laboratory analysis whenever possible;
- Grid based soil sampling (within access constraints) was generally used to provide representative coverage of the site;
- Where possible, targeted samples were incorporated into the grid based sampling and selected boreholes for soil sampling were utilised for installation of groundwater and/or landfill gas monitoring wells to provide a more resource and cost effective sampling program;
- To optimise the selection of soil samples for chemical analysis, all samples collected were screened using a PID allowing for site assessment and sample selection. In addition, additional soil samples were collected but kept 'on hold' pending details of initial analysis and were analysed if further delineation was required;
- Adequately experienced environmental scientists/engineers conducted fieldwork and sample analysis interpretation;
- Targeted groundwater and surface water sampling was used to target areas of interest (groundwater) and sensitive ecological receptors (surface water); and
- An SAQP was prepared and the scope was undertaken with reference to the SAQP (DP, 2015b) which took all previous data into account.

10. Rationale and Methodology

10.1 Soil Sampling Rationale

Table A of NSW EPA (1995) recommends a minimum of 99 sampling points for a site of 9 ha for site characterisation based on the detection of circular hot spots using a systemic grid sampling pattern. Samples for DP (2002b) and EIS (2013) were obtained from 12 and 16 locations, respectively, which is approximately 25% of the recommended minimum density. On this basis, and given that access to certain parts of the site remains obstructed by stockpiles, 26 additional bores were drilled and sampled to augment the existing soil contamination dataset. Further sampling may be required following removal of the existing stockpiles.

The total number of test locations (including DP (2002b) and EIS (2013)) is approximately 50% of the recommended minimum density. The proposed density is considered appropriate to inform an overall

site remediation strategy noting that some additional testing may be required during bulk earthworks / site remediation. The sampling density is also considered appropriate in the context of the adopted soil remediation strategy most likely being to cap any existing soil contamination. In this regard, DP also understands that a >1.5 m thick layer of VENM is required across the site in order to raise it above the local flood levels and this layer could essentially comprise an engineered cap.

Targeted near surface sampling should also be undertaken at the diesel above ground storage tank (AST) and the drum storage area following their decommissioning.

10.2 Landfill Gas Sampling Rationale

A remediation trial is currently underway at the site with a view to exploring whether landfill gas concentrations and flow rates can be reduced in the vicinity of two gas wells (JK102 and JK107) which have historically recorded high methane concentrations. The trial has involved the excavation of fill in the vicinity of the two locations. The fill removed has been screened and timber (a contributing source of landfill gas) has been removed from the fill, as far as is practicable, prior to using the screened fill to backfill the excavations. Landfill gas readings have been taken following reinstatement of the ground to evaluate the success of the trial (refer to Section 14.2.4).

Benedict intends to repeat this process where ongoing landfill gas monitoring indicates elevated concentrations of methane and/or flow rates.

Seventeen landfill gas monitoring wells were installed at the site by EIS at 30 m to >60 m spacing (nominally 50 m x 50 m as reported in EIS (2014a)). Some of the EIS wells have subsequently been damaged or destroyed and will be replaced.

CIRIA (2007) recommends gas well spacing that is close / very close (<25 m to 50 m) for moderate risk older domestic landfills (this site is an inert waste landfill) where 'high' sensitivity land use (e.g. residential) is proposed. In the context of the site requiring a significant amount of additional fill (understood to be >1.5 m), a post-fill landfill gas investigation is also likely to be required to confirm the post capping CGS and associated additional gas mitigation measures that will be necessary. It is also noted that full site access at the time of the investigation was limited by the presence of stockpiles. On this basis, ten additional gas monitoring wells (in addition to five shallow nested pair wells) were installed to augment the existing monitoring well network. This included one replacement well (JKBH/MW107a) at one of the backfilled remediation trial excavations and two replacement wells for destroyed (JK118) and partially damaged (JK103) wells. The ten wells included the three proposed groundwater monitoring wells discussed in Section 10.3 below as the groundwater wells can also be utilised for landfill gas testing.

10.3 Groundwater Sampling Rationale

The groundwater monitoring well network at the site currently comprises four monitoring wells placed around the perimeter of the site and two of these (JKBH/MW7 and JKBH/MW9) have been damaged. Three additional monitoring wells (JKBH/MW107, BH/MW216 and BH/MW218) were installed at the central portion of the site with a view to better understand the extent of the elevated concentrations of certain metals and/or pesticides which have been detected at the perimeter wells.

10.4 Surface Water Sampling Rationale

Routine surface water sampling is undertaken at the facility and the data has been briefly reviewed by DP. Surface water sampling was undertaken by DP at the dredge ponds (south), Georges River (east) and drainage channel (west) for an expanded suite of analytes in order to assess whether groundwater from the site is adversely impacting the aforementioned surface water bodies.

11. Site Assessment Criteria

11.1 Soil

The proposed use for the site after development is residential. The relevant SAC have been selected accordingly.

The analytical results from the laboratory testing have been assessed (as a Tier 1 assessment) against the investigation and screening levels in Schedule B1 of NEPC (2013). This guideline has been endorsed by the NSW EPA under the *Contaminated Land Management* Act 1997. The Schedule provides investigation and screening levels for commonly encountered contaminants which are applicable to generic land uses and include consideration of, where relevant, the soil type and the depth of contamination.

11.1.1 Health Investigation and Screening Levels

The HILs and HSLs are scientifically-based, generic assessment criteria designed to be used in the first stage (Tier 1) of an assessment of potential risks to human health from chronic exposure to contaminants. HILs are applicable to assessing health risks arising from direct contact to a range of contaminants. HSLs are used to assess selected petroleum compounds and fractions to assess the risk to human health via inhalation and direct contact with affected soils and groundwater.

HSLs have been developed for a range of petroleum hydrocarbons as either petrol or diesel mixtures, and for different land uses, media, pathways, soil types and depths to contamination.

The investigation and screening levels are not intended to be used as clean up levels. They establish concentrations above which further appropriate investigation (e.g. Tier 2) should be undertaken. They are intentionally conservative and are based on a reasonable worst-case scenario for four generic land uses.

Potential exposure pathways considered were:

- Soil vapour intrusion (for hydrocarbon contamination); and
- Direct contact.

Soil types considered were:

- Sand (conservative), given the general variability of soil types at the site.

Depth to contamination considered was:

- 0 to <1 m for soil HSLs have been adopted as an initial conservative screen; and

- HILs apply generally to the top 3 m of soil for residential land use.

Relevant land use criteria considered were:

- **HIL-A** – Residential with garden/accessible soils; and
- **HSL-A** – Residential with garden/accessible soils.

For petroleum hydrocarbons, the exposure scenario for an intrusive maintenance worker has also been considered and these criteria are extracted from the CRC CARE Technical Reports on which the NEPC (2013) HSLs are based.

Only those contaminants common to both Table 1A(1) (NEPC, 2013) and the list of potential contaminants applied to samples from the proposed analyte list have been included. The adopted soil HILs and HSLs are shown on the following table.

Table 6: Health Investigation and Screening Levels (HILs/HSLs) in mg/kg

Contaminants		Direct Contact		Vapour Intrusion	
		Resident /Site user HIL/HSL-A	Intrusive Worker	Resident /Site user (sand) HSL-A	Intrusive Worker
Heavy Metals	Arsenic	100	-	-	-
	Cadmium	20	-	-	-
	Chromium (VI)	100	-	-	-
	Copper	6000	-	-	-
	Lead	300	-	-	-
	Mercury (inorganic)	40	-	-	-
	Nickel	400	-	-	-
	Zinc	7400	-	-	-
	Manganese	3800	-	-	-
PAH	Benzo(a)pyrene TEQ [1]	3	-	-	-
	Total PAH	300	-	-	-
	Naphthalene	1400	29,000	3	NL
TRH	$C_6 – C_{10}$ (less BTEX) [F1]	4,400	82,000	40 (silt)	NL
	$>C_{10}-C_{16}$ (less Naphthalene) [F2]	3300	62,000	110	NL
	$>C_{16}-C_{34}$	4500	85,000	-	-
	$>C_{34}-C_{40}$	6300	120,000	-	-

Contaminants		Direct Contact		Vapour Intrusion	
		Resident /Site user HIL/HSL-A	Intrusive Worker	Resident /Site user (sand) HSL-A	Intrusive Worker
BTEX	Benzene	100	1100	0.5	77
	Toluene	14,000	120,000	160	NL
	Ethyl Benzene	4500	85,000	55	NL
	Xylene	12,000	130,000	40	NL
OCP/ OPP	Aldrin + Dieldrin	6	-	-	-
	Chlordane	50	-	-	-
	DDT+DDE+DDD	240	-	-	-
	Endosulfan	270	-	-	-
	Endrin	10	-	-	-
	Heptachlor	6	-	-	-
	HCB	10	-	-	-
	Methoxychlor	300	-	-	-
	Chlorpyrifos	160	-	-	-
PCB		1	-	-	-
Phenols		3000	-	-	-
Cyanide		250	-	-	-

Notes to Table 6:

1 - sum of carcinogenic PAH

NL - The soil saturation concentration (Csat) is defined as the soil concentration at which the pore water phase cannot dissolve any more of an individual chemical. The soil vapour that is in equilibrium with the pore water will be at its maximum. If the derived soil HSL exceeds Csat, a soil vapour source concentration for a petroleum mixture could not exceed a level that would results in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as 'not limited' or 'NL'.

The summary results tables presented in Appendix B provide a broader number of criteria for hydrocarbon HSLs based on soil types and depth to contamination in order to assist with interpretation of the dataset.

11.1.2 Ecological Investigation and Screening Levels

Ecological Investigation Levels (EILs) have been developed and discussed in NEPC (2013) for selected metals and organic compounds and are applicable for assessing risk to terrestrial ecosystems. EILs depend on specific soil physiochemical properties and land use scenarios and generally apply to the top 2 m of soil, which essentially corresponds to the root zone and habitation zone of many species. The EIL is determined for a contaminant using the following formula:

EIL = ABC + ACL, where

ABC = Ambient Background Concentration
ACL = Added Contaminant Limit

The ABC of a contaminant is the soil concentration in a specific locality that is the sum of naturally occurring background levels and the contaminants levels that have been introduced from diffuse or non-point sources (e.g. motor vehicle emissions). The ABC is determined through direct measurement at an appropriate reference site (preferred) or through the use of methods defined by Olszowy et al. (1995) or Hamon et al. (2004) (NEPC, 2013).

ACLs are based on the soil characteristics of estimated pH, CEC and clay content.

EILs (and ACLs where appropriate) have been derived for only a short list of contaminants including As, Cu, Cr (III), DDT, naphthalene, Ni, Pb and Zn. An *Interactive (Excel) Calculation Spreadsheet* may be used for calculating site-specific EILs, and has been provided in the ASC NEPM Toolbox.

The relevant EILs have been selected using average pH and CEC of the site soils based on the current and EIS (2013) testing as follows:

- Average pH 9 (range 7.1 to 10.7) based on 15 soil pH sample results within the upper 2.0 m of the soil profile;
- Average CEC 23 (range 4.3 to 39) based on 14 soil CEC sample results within the upper 2.0 m of the soil profile;
- Clay content 14% (EIS, 2013); and
- NSW traffic and 'low' traffic volume.

Table 7: Ecological Investigation Levels (EILs) in mg/kg

Analyte		EIL
Metals	Arsenic	100
	Cadmium	NC
	Chromium (III)	450
	Copper	230
	Lead	1100
	Mercury (inorganic)	NC
	Nickel	300
	Zinc	850
	Manganese	NC
OCP	DDT	180
PAH	Naphthalene	170

Notes to Table 7:
NC - No Criteria

Ecological Screening Levels (ESLs) are used to assess the risk of selected petroleum hydrocarbon compounds, BTEX and benzo(a)pyrene to terrestrial ecosystems. ESLs apply to the top 2 m of the soil profile, which essentially corresponds to the root zone and habitation zone of many species.

ESLs have been derived in NEPC (2013) for the same four petroleum fractions as the HSLs (F1 to F4) as well as BTEX and Benzo(a)pyrene. The ESLs are shown on the following table. The following site specific data and assumptions have been used to determine the ESLs:

- The ESLs will apply to the top 2 m of the soil profile;
- The ESLs for urban residential and public open space apply; and
- A "coarse" soil texture (conservative) has been adopted as an initial screen given the general variability of soil types at the site.

Table 8: Ecological Screening Levels (ESLs) in mg/kg

Analyte		ESL	Comments
TRH	$C_6 - C_{10}$ (less BTEX) [F1]	180*	All ESLs are low reliability apart from those marked with * which are moderate reliability
	$>C_{10}-C_{16}$ (less Naphthalene) [F2]	120*	
	$>C_{16}-C_{34}$ (F3)	300	
	$>C_{34}-C_{40}$ (F4)	2800	
BTEX	Benzene	50	
	Toluene	85	
	Ethyl Benzene	70	
	Xylenes	105	
PAH	B(a)P	0.7	

The summary results tables presented in Appendix B provide a broader number of criteria for hydrocarbon Management Limits based on soil type in order to assist with interpretation of the dataset.

11.1.3 Management Limits for Petroleum Hydrocarbons

In addition to appropriate consideration and application of the HSLs, there are additional considerations which reflect the nature and properties of petroleum hydrocarbons, including:

- Formation of observable light non-aqueous phase liquids (LNAPL);
- Fire and explosion hazards; and
- Effects on buried infrastructure e.g. penetration of, or damage to, in-ground services.

Management Limits to avoid or minimise these potential effects have been adopted in NEPC (2013) as interim Tier 1 guidance. Management Limits have been derived for the same four petroleum fractions as the HSLs (F1 to F4). The adopted Management Limits are shown on the following table. The following site specific data and assumptions have been used to determine the Management Limits:

- The Management Limits will apply to any depth within the soil profile;

- The Management Limits for residential, parkland and open space apply; and
- A "coarse" soil texture (conservative) has been adopted as an initial screen given the general variability of soil types at the site.

Table 9: Management Limits in mg/kg

Analyte		Management Limit
TRH	$C_6 - C_{10}$ (F1)	700
	$>C_{10}-C_{16}$ (F2)	1000
	$>C_{16}-C_{34}$ (F3)	2500
	$>C_{34}-C_{40}$ (F4)	10,000

Notes to Table 9:

Separate management limits for BTEX and naphthalene are not available hence these should not be subtracted from the relevant fractions to obtain F1 and F2

The summary results tables presented in Appendix B provide a broader number of criteria for hydrocarbon Management Limits based on soil type in order to assist with interpretation of the dataset.

11.2 Landfill Gas / Trace Non-Methane Organic Compounds

According to the NSW EPA (2012), methane (CH_4) is a flammable gas that is explosive in the concentration range 5% to 15% v/v in air (somewhat different ranges may apply in atmospheres with enhanced or reduced oxygen concentrations). It is also potentially an asphyxiant if its presence displaces oxygen thereby resulting in an environment with low oxygen concentration. It is less dense than air.

Carbon dioxide (CO_2) is an asphyxiant and toxic gas that is significantly denser than air. Carbon monoxide (CO) is an acutely toxic gas that is also flammable and potentially explosive. It has neutral buoyancy in air. Hydrogen is a flammable, potentially explosive gas that is much less dense than air. Hydrogen sulphide (H_2S) is a flammable and acutely toxic gas that is denser than air. It is highly odorous, and a nuisance, at low concentrations.

Trace gases may also be present depending on the nature of the source material, particularly if landfilled wastes are involved, including volatile organic compounds.

SAC from CIRIA (2007) and as adopted by NSW EPA (2012) (originally modified from Wilson and Card (2007)) for the GSV and CGS have been used to evaluate landfill gas. The GSV and CGS are summarised in the table reproduced from NSW EPA (2012), below.

Table 10: Modified Wilson and Card classification (NSW EPA, 2012)

	Gas screening value threshold (L/hr)	Characteristic gas situation	Risk classification	Additional factors	Typical sources
	<0.07	1	Very low risk	Typically methane <1% v/v and/or carbon dioxide <5% v/v, otherwise consider increase to Situation 2	Natural soils with low organic content Typical fill
	<0.7	2	Low risk	Borehole flow rate not to exceed 70 L/hr, otherwise consider increase to Situation 3	Natural soils with high organic content Fill
	<3.5	3	Moderate risk		Old inert waste landfill Flooded mine workings
	<15	4	Moderate to high risk	Consider need for Level 3 risk assessment	Mine workings susceptible to flooding Closed putrescible waste landfill
	<70	5	High risk	Level 3 risk assessment required	Shallow, un-flooded abandoned mine workings
	>70	6	Very high risk		Recent putrescible waste landfill

Notes:

1. Site characterisation should be based on gas monitoring of concentrations and borehole flow rates for the minimum periods defined in Section 3.4.
2. Source of gas and generation potential must be identified in the conceptual site model.
3. Soil gas investigation should be in accordance with the guidance provided in Section 3.4.
4. Where there is no detectable flow, the lower measurement limit of the instrument should be used.
5. To determine a GSV of <0.07, instruments capable of making accurate concentration measurement to 0.5% v/v and flow measurement to 0.1 L/hr are recommended.

With regard to trace NMOC, the interim HIL-A-B for residential sites provided in NEPC (2013) has been adopted as the SAC for chlorinated hydrocarbons in soil vapour. The screening levels for chlorinated hydrocarbons are presented in the table below.

Table 11: Interim Soil Vapour HIL for Volatile Organic Chlorinated Compounds (µg/m^3)

Chemical	HIL-A-B Residential
TCE	20
1,1,1 – TCA	60 000
PCE	2000
Cis, 1,2, -DCE	80
Vinyl chloride (VC)	30

For petroleum hydrocarbons the soil vapour HSLs for vapour intrusion have been adopted as the SAC. Based on the variable soil conditions encountered at the site the threshold levels for HSL-A-B sand (conservative) were adopted as the appropriate screening levels. The screening levels for petroleum hydrocarbons adopted for the monitoring are presented in the table below.

Table 12: Soil Vapour HSLs for Vapour Intrusion (µg/m^3)

Chemical	HSL-A-B
	0 to 1m
Toluene	1 300 000
Ethylbenzene	330 000
Xylenes	220 000
Naphthalene	800
Benzene	1000
C6 – C10 (less BTEX) [F1]	18 0000
>C10-C16 (less Naphthalene) [F2]	13 0000

The relevant criteria are also shown in the summary results table in Appendix C.

11.3 Groundwater

The SAC used for interpretation of the groundwater data are based on the potential uses, or risk posed by contaminated groundwater, at or down-gradient of the site. Potential uses at or down-gradient of the site may include:

- Groundwater discharge to water bodies sustaining aquatic ecosystems, such as the Georges River, which is the most likely receptor of groundwater from the site;

- Groundwater discharge to recreational water bodies, i.e. the Georges River, which is the most likely receptor of groundwater from the site; and
- Potential potable use (however, this is considered unlikely as scheme water is plumbed to sites in this area).

The potential risk posed by contaminated groundwater, at or down-gradient of the site is exposure to VOC via the vapour intrusion pathway.

Therefore, the concentrations of contaminants in groundwater were assessed against groundwater investigation levels (GILs) adopted from the following applicable documents:

- Protection of aquatic ecosystems:
  - ANZECC (2000) – criteria adopted for the protection of aquatic ecosystems are for slightly to moderately disturbed marine systems (marine water guidelines (MWG)), consistent with the expected discharge point of the brackish Georges River. Criteria adopted for the protection of aquatic ecosystems are for slightly to moderately disturbed freshwater systems (freshwater guidelines (FWG)) have also been included for reference purposes. In the absence of 'high reliability' criteria, 'low reliability' criteria are used where available for some compounds (e.g. ethylbenzene);
- Protection of human health:
  - NEPC (2013) – HSL-A-B for evaluating vapour intrusion risks for hydrocarbon-contaminated groundwater. The HSL-A-B is groundwater depth and soil type dependant. Given the variability of soil types and depths to groundwater, the HSL-A-B for a sand soil profile and depth to groundwater of 2.0 m to 4.0 m has been adopted as an initial conservative screen;
  - ANZECC (2000) – criteria adopted for recreational water (RWG) consistent with the expected discharge point of the Georges River; and
  - NHMRC (2016) – drinking water guidelines, health-based and aesthetic (DWGH, DWGA).

The relevant criteria are shown in the summary results table in Appendix D.

11.4 Surface Water

The SAC used for interpretation of the surface water data are based on the surface water bodies adjacent to the site sustaining aquatic ecosystems, such as the Georges River, drain along the western site boundary and ponds to the south of the site which are the most likely receptor of groundwater from the site. Therefore, the concentrations of contaminants in surface water were assessed against ANZECC (2000) – MWG, FWG and recreational water (refer to details in Section 11.3).

The relevant criteria are shown in the summary results table in Appendix D.

12. Fieldwork

12.1 Drilling and Soil Sampling

An experienced DP Environmental Scientist conducted the field work. A Scout drilling rig utilising solid flight augers was used for the drilling. Soil samples were retrieved (where possible) using an SPT hammer. The surface level at each test location was surveyed using a dGPS.

Samples were generally collected at nominal depth intervals of 1.0 m and based on observed changes in strata, PID response and upon obvious sign of contamination such as strong hydrocarbon odour or staining / discolouration.

Environmental sampling was performed according to standard operating procedures outlined in the DP *Field Procedures Manual*. All sampling data was recorded on DP chain of custody sheets. The general sampling and sample management procedures comprised:

- Collection of samples from the SPT into laboratory-prepared glass jars with Teflon lined lids by hand, capping immediately and ensuring headspace within the sample jar is minimised;
- Collection of a replicate sample in a zip-lock bag for PID screening;
- A new disposable nitrile glove was worn by the field scientist / engineer for each sample collected thereby precluding potential cross-contamination;
- Collection of 10% replicate samples for QC purposes;
- Labelling of sample containers with individual and unique identification details, including project number, sample location and sample depth (where applicable); and
- Placement of the sample jars into a cooled, insulated and sealed container for transport to the laboratory.

The headspace in the zip-lock bag sample was allowed to equilibrate and was screened using the PID. The PID had a 10.6eV lamp and was calibrated with isobutylene gas at 100 ppm and with fresh air prior to commencement of each successive day's field work.

Test locations are shown on Drawing 2, Appendix A.

12.2 Drilling and Installation of Landfill Gas and Groundwater Monitoring Wells

Wells were constructed using class 18 uPVC machine slotted screen and blank sections. The joints were screw threaded in order to prevent the use of glues, which may contaminate the well. The screened section of each well was backfilled with a washed sand filter pack to approximately 0.5 m above the screened interval. Confirmation of the filter pack was achieved by probing. Each well was completed with a hydrated bentonite plug generally 1.0 m thick and concrete at the surface with a steel lockable monument.

Each groundwater monitoring well was developed following installation by removing a minimum of three well volumes, or until dry. The purpose of well development was to remove as far as practicable sediment introduced via drilling and to facilitate connection of the well to the local groundwater regime.

Monitoring well locations are shown on Drawing 2, Appendix A.

12.3 Landfill Gas Sampling

Monitoring of gas concentrations and flow rates was undertaken using a calibrated GA5000. The monitoring was conducted according to the following procedure:

- Atmospheric pressure was recorded prior to monitoring;
- The inlet hose of a GAG000 was connected to the well gas cap; and
- Peak and stabilised readings of carbon dioxide, methane, hydrogen sulphide, carbon monoxide and oxygen were recorded upon stabilisation of parameters or at the end of five minutes of monitoring.

12.3.1 Sampling Trace Non-Methane Organic Compounds

The trace gas NMOC analysis was undertaken using summa canisters. The summa canisters were decontaminated by the laboratory and prepared with a vacuum of between -29 mm Hg to -30 mm Hg. The canisters were connected to the gas sampling cap and opened for the required amount of time such that a vacuum of -5 mm Hg was retained after sample collection.

A duplicate QC sample was also taken from BH/MW216 using a manifold between the primary and duplicate canister for QA/QC purposes.

12.4 Groundwater Sampling

Groundwater sampling was performed according to standard operating procedures outlined in the DP *Field Procedures Manual*. Groundwater samples were collected using a positive displacement low flow bladder pump in order to minimise aeration of the sample and disturbance to the water column thereby enhancing the quality of results for oxygen sensitive volatile analytes, DO and redox. The sampling method is described as follows:

- Measure the static water level using an electronic interface probe and record the thickness of any LNAPL (if encountered);
- Fit the bladder pump with a bore dedicated disposable bladder (and bore dedicated disposable tubing). Lower the pump into the bore and taped off at a level estimated to be 1m below the top of the water column provided it was within screened section of the monitoring well;
- Set the pump at the lowest rate possible that could produce laminar flow out of the bore and measure the drawdown with the interface probe to confirm minimal drawdown;
- Physical parameters (pH, temperature, dissolved oxygen, electrical conductivity and redox) were measured by continuously by passing the purged water through a flow cell; and
- Following stabilisation of the field parameters the appropriate laboratory prepared sample bottles were filled.

The pump and cable were decontaminated between bores by rinsing in a diluted Decon-90 solution and then rinsing in demineralised water.

The following sample handling and transport were employed:

- Laboratory prepared sample bottles were labelled with individual and unique identification, including project number and sample number;
- Samples were placed in insulated coolers and maintained at a temperature of approximately 4^0C until transported to the analytical laboratory;
- Chain of custody documentation was maintained at all times and countersigned by the receiving laboratories on transfer of samples; and
- NATA accredited laboratories were engaged to complete the analyses.

13. Results

13.1 Sub-Surface Conditions

The borehole logs are included in Appendix E and should be read in conjunction with the accompanying standard notes defining classification methods and descriptive terms. Boreholes denoted 'a' are replacement wells for some wells that have been destroyed. Boreholes denoted 'b' are shallow landfill gas wells.

The subsurface conditions are broadly summarised as follows:

- FILLING – sand, clay, silty clay, clayey sand, sandy clay, crushed sandstone, gravel, crushed glass (fine sand to silt particle size), in filling to depths of 0.7 m to 9.2 m and to borehole termination (typically refusal on buried obstructions in the filling) in BH201 at 3.8 m, BH202 at 6.1 m, BH203 at 4.5 m, BH205 at 4.9 m, BH209 at 5.4 m, BH210 at 4.05 m, BH212 at 6.0 m, BH213 at 3.8 m, BH215 at 3.7, BH218 at 8.35, BH220 at 2.6 m, BH221 at 4.9 m, BH222 at 2.9 m and BH118a at 6.4 m. Anthropogenic materials (typically construction and demolition waste including concrete, timber, glass, brick, asphalt, steel, plastic, terracotta and cotton / fabric) were observed throughout the filling at the majority of boreholes consistent with the known history of burial of demolition waste at the site; and
- SILTY CLAY / SAND / CLAYEY SAND – silty clay, sand and sandy clay from depths of 9.2 m at BH204, 6.1 m at BH206, 4.05 m at BH207, 4.0 at BH208, 3.1 m at BH211, 3.8 m at BH5.1, 7.35 m at BH216, 3.75 m at BH233, 5.1 m at JK103a, 9.2 m at JK107a, 0.7 m at BH224 and 0.7 m at BH225 to the depth of borehole termination at depths of between 2.3 m and 10.4 m.

Free groundwater was observed at some boreholes whilst drilling. Some of the observations were consistent with water likely perched on low permeability strata / items (e.g. buried concrete boulders) in the filling.

Surface samples were collected at locations SS217 and SS219 as excessive rubble in fill prevented drilling at these locations. The soil description for each of these samples is:

- SS217: Light brown sandy clay filling with traces of sub-angular and angular igneous gravel; and
- SS219: Light brown sandy clay filling with traces of sub-angular and angular igneous gravel.

No fragments of ACM were observed in drill cuttings whilst drilling.

Selected photographs taken during the various components of fieldwork are included in Appendix A.

13.2 Field Screening Results for Soil

Replicate soil samples collected in zip-lock plastic bags were allowed to equilibrate under ambient temperatures before screening for total photoionisable compounds (i.e. VOC) using a calibrated PID. Results of sample screening are shown on borehole logs presented in Appendix E. The PID readings were all generally low ranging between <5 ppm to 11 ppm. The screening results suggest the general absence of gross VOC contamination. The PID calibration certificate is presented in Appendix F.

13.3 Landfill Gas Sampling Results

Landfill gas monitoring was undertaken on 19 August 2015, 1 October 2015, 27 October 2015 and 10 February 2016. The results, along with the CSV and CGS are summarised in the following tables.

Table 13: Landfill Gas Sampling Results for 19/08/15

Well ID	Flow Rate Peak	Methane Peak %	GSV	CO_2 Peak %	GSV	CGS [1, 2]
JKBH/MW1	0.2	1.3	<0.01	1.7	<0.01	2
JKBH/MW16	0.2	22	0.04	6.7	0.01	3
JKBH/MW7	0.2	14	0.03	9.6	0.02	2
JKBH/MW9	0.3	20.9	0.06	6.1	0.02	3
JK101	0.2	14	0.03	7.7	0.02	2
JK102	0.1	13.2	0.01	7.8	0.01	2
JK103	0.1	0.8	<0.01	1.9	<0.01	1
JK104	0.1	0.5	<0.01	3.1	<0.01	1
JK106	0.2	16.1	0.03	4.2	0.01	2
JK110	0.4	23.2	0.09	6.3	0.03	3
JK113	0.1	9.9	0.01	15.9	0.02	2
JK114	0.2	24.6	0.05	8	0.02	3
JK115	0.2	8.6	0.02	11.1	0.02	2
JK119	0.9	10.5	0.09	6.7	0.06	2
Max Value	**0.9**	**24.6**	**0.22**	**15.9**	**0.14**	**3**

Notes to table:

1. Where methane >1% or CO_2 >5% CGS has been increased to Situation 2 as per Table 6 of NSW EPA (2012)
2. Where methane >20% CGS has been increased to Situation 3 as per Table 7 of NSW EPA (2012)

Atmospheric pressure start 1024 mb end 1024 mb – pressure steady

Table 14: Landfill Gas Sampling Results for 1/10/15

Well ID	Flow Rate Peak	Methane Peak %	GSV	CO_2 Peak %	GSV	CGS [1, 2]
BH/MW216	0.2	16	0.03	6.3	0.01	2
BH/MW218	0.2	24.2	0.05	10.2	0.02	3
BH202	0.2	1.1	<0.01	12.4	0.02	2
BH211	0.3	0	<0.01	1.5	<0.01	1
BH211b	-	0	-	3.7	-	-
BH223	0.2	1.1	<0.01	3.4	0.01	2
JKBH/MW1	0.2	0	<0.01	2	<0.01	1
JKBH/MW7	0.2	4.1	0.01	7	0.01	2
JKBH/MW9	0.1	0	<0.01	2.9	<0.01	1
JK101	0.3	14.3	0.04	7.3	0.02	2
JK102	0.3	12	0.04	6.4	0.02	2
JK103a	0.7	0.7	<0.01	3.1	0.02	1
JK103b	0.3	1.4	<0.01	1.2	<0.01	2
JK104	0.2	0	<0.01	4	0.01	1
JK106	0.4	13.2	0.05	4.5	0.02	2
JKBH/MW107a	0.4	3	0.01	0.2	<0.01	2
JK107b	0.2	10.2	0.02	5.6	0.01	2
JK110	0.5	19	0.1	6.3	0.03	2
JK113	0.4	6	0.02	14.5	0.06	2
JK114	0.2	22.2	0.04	5.3	0.01	3
JK114b	0.2	20.2	0.04	7.2	0.01	3
JK115	0.2	0.6	<0.01	9.1	0.02	1
JKBH/MW16	0.3	8.5	0.03	6.5	0.02	2
JK118a	0.3	17.3	0.05	5.7	0.02	2
JK118b	0.2	12.9	0.03	4.5	0.01	2
JK119	0.7	11.9	0.08	3.1	0.02	2
Max Value	**0.7**	**24.2**	**0.17**	**14.5**	**0.10**	**3**

Notes to table:

1. Where methane >1% or CO_2 >5% CGS has been increased to Situation 2 as per Table 6 of NSW EPA (2012)
2. Where methane >20% CGS has been increased to Situation 3 as per Table 7 of NSW EPA (2012)

Atmospheric pressure start 1023 end1032 mb – pressure increasing

Table 15: Landfill Gas Sampling Results for 27/10/15

Well ID	Flow Rate Peak	Methane Peak %	GSV	CO_2 Peak %	GSV	CGS [1, 2]
BH/MW216	0.1	14.7	0.01	6.7	0.01	2
BH/MW218	-0.2	32.5	<0.01	13.8	<0.01	3
BH202	0.4	0.8	<0.01	13.2	0.05	2
BH211	0.4	0	<0.01	1.7	0.01	1
BH211b	0.3	0	<0.01	3.9	0.01	1
BH223	0.6	3.7	0.02	8.2	0.05	2
BH224	0.4	0	<0.01	10.3	0.04	2

Well ID	Flow Rate Peak	Methane Peak %	GSV	CO_2 Peak %	GSV	CGS [1, 2]
BH225	0.2	0	<0.01	9.6	0.02	2
JKBH/MW1	0.2	0	<0.01	2.2	<0.01	1
JKBH/MW7	0.3	8.5	0.03	3.2	0.01	2
JKBH/MW9	0.2	0	<0.01	3.2	0.01	1
JKBH/MW16	0.2	2.8	0.01	8.3	0.02	2
JK101	0.3	14.1	0.04	10.2	0.03	2
JK102	0.2	13.2	0.03	6.6	0.01	2
JK103a	0.4	0	<0.01	1.7	0.01	1
JK103b	0.6	1.1	0.01	0.7	<0.01	2
JK104	0.5	0	<0.01	1.7	0.01	1
JK106	0.4	10	0.04	3.3	0.01	2
JKBH/MW107a	0.1	15	0.02	5.2	0.01	2
JK107b	0.2	14.4	0.03	2.9	0.01	2
JK110	0.1	25	0.03	6.4	0.01	3
JK113	0.2	1	<0.01	4.5	0.01	1
JK114	0.1	21.2	0.02	6.4	0.01	3
JK114b	0.3	19.1	0.06	7.5	0.02	2
JK115	0.3	7.2	0.02	7	0.02	2
JK118a	0.3	15.2	0.05	5.1	0.02	2
JK118b	0.3	14.5	0.04	4.8	0.01	2
JK119	0.6	16.2	0.1	5.8	0.03	2
Max Value	**0.6**	**32.5**	**0.20**	**13.8**	**0.08**	**3**

Notes to table:

1. Where methane >1% or CO_2 >5% CGS has been increased to Situation 2 as per Table 6 of NSW EPA (2012)
2. Where methane >20% CGS has been increased to Situation 3 as per Table 7 of NSW EPA (2012)

Atmospheric pressure start 1022 mb to 1026 mb – pressure increasing

Table 16: Landfill Gas Sampling Results for 10/02/16

Well ID	Flow Rate Peak	Methane Peak %	GSV	CO_2 Peak %	GSV	CGS [1, 2]
BH/MW216	0.3	16.1	0.05	5.2	0.02	2
BH202	0.2	1.1	<0.01	3.4	0.01	2
BH211a	0.1	1.1	<0.01	5	0.01	2
BH211b	0.2	0.5	<0.01	1.9	<0.01	1
BH223	0.1	3.7	<0.01	10	0.01	2
BH224	0.3	0.1	<0.01	14.4	0.04	2
BH225	0.3	0.2	<0.01	12.1	0.04	2
JKBH/MW1	0.1	0.2	<0.01	3.4	<0.01	1
JKBH/MW7	0	0.5	<0.01	6.8	<0.01	2
JKBH/MW9	0.2	17.5	0.04	23.8	0.05	2
JKBH/MW16	0.3	0.1	<0.01	9.7	0.03	2
JK101	0.3	15.7	0.05	11.4	0.03	2
JK103	6.8	1.7	0.12	0.6	0.04	2

Well ID	Flow Rate Peak	Methane Peak %	GSV	CO_2 Peak %	GSV	CGS [1, 2]
JK103a	0.3	0.9	<0.01	0.2	<0.01	1
JK103b	0.3	5.1	0.02	2.6	0.01	2
JK106	0	14.2	<0.01	6.7	<0.01	2
JKBH/MW107a	0.3	16.4	0.05	0.9	<0.01	2
JK107b	0.2	17.3	0.03	3.8	0.01	2
JK104	0.2	0.5	<0.01	2.3	<0.01	1
JK113	0.1	0.1	<0.01	1	<0.01	1
JK114	0.2	25.3	0.05	4.7	0.01	3
JK114b	0.3	0.1	<0.01	0	<0.01	1
JK115	0.2	0.1	<0.01	0	<0.01	1
JK117*	0.6	11.7	0.07	6.8	0.04	2
JK119	0.4	21.3	0.09	6.9	0.03	3
Max Value	**6.8**	**25.3**	**1.72**	**23.8**	**1.62**	**3**

Notes to table:

1. Where methane >1% or CO_2 >5% CGS has been increased to Situation 2 as per Table 6 of NSW EPA (2012)
2. Where methane >20% CGS has been increased to Situation 3 as per Table 7 of NSW EPA (2012)

*JK117 was inaccessible for previous monitoring events due to stockpile placement

Atmospheric pressure start 1016 mb end 1011 mb – pressure decreasing

The peak methane concentration data for each of the landfill gas monitoring events have been used to generate concentration contours on the following drawings in Appendix A:

- Drawing 3 - Peak Methane Concentration Contours 19/08/15;
- Drawing 4 - Peak Methane Concentration Contours 1/10/15;
- Drawing 5 - Peak Methane Concentration Contours 27/10/15; and
- Drawing 6 - Peak Methane Concentration Contours 10/02/16.

Field sampling records are included in Appendix G.

Where a shallow and deep gas well is present at the one location, the well with the highest methane peak was used to generate the contours. It should also be noted that some wells have been destroyed due to the site owner undertaking a further trial remediation excavation at the south-western portion of the site.

13.4 Groundwater Levels

Groundwater wells, including those installed by J&K, were surveyed using a dGPS. Groundwater levels were gauged on 17 September 2016 using an electronic oil/water interface meter prior to developing the wells. The measured water levels are shown in the following two tables.

Table 17: Summary of Groundwater Level Measurements 17/09/15 (Well Development)

Well ID	Ground Level * m (AHD)	Top of Casing* m (AHD)	SWL m (bgl)	SWL m (AHD)
BH/MW216	7.27	7.99	5.49	1.78
BH/MW218	7.69	8.39	4.61	3.08
JKBH/107a	7.15	7.85	6.43	0.72
JKBH/MW1	2.85	3.32	1.76	1.09
JKBH/MW7	6.51	7.09	5.81	0.70
JKBH/MW9	6.57	7.10	4.79	1.78
JKBH/MW16	5.61	5.86	6.09	-0.48

Notes to table:
*Surveyed by dGPS and top of casing measured from ground level
AHD – Australian Height Datum
SWL – standing water level
bgl – below ground level

Table 18: Summary of Groundwater Level Measurements 1/10/15 (Well Sampling)

Well ID	Ground Level * m (AHD)	Top of Casing* m (AHD)	SWL m (bgl)	SWL m (AHD)
BH/MW216	7.27	7.99	6.00	1.27
BH/MW218	7.69	8.39	7.60	0.09
JKBH/107a	7.15	7.85	6.45	0.70
JKBH/MW1	2.85	3.32	1.89	0.96
JKBH/MW7#	6.51	7.09	5.82	0.69
JKBH/MW9#	6.57	7.10	-	-
JKBH/MW16	5.61	5.86	6.04	-0.43

Notes to table:
*Surveyed by dGPS and top of casing measured from ground level
AHD – Australian Height Datum
SWL – standing water level
bgl – below ground level
well was bent and could not fit bailer or pump in

Based on the groundwater level measurements, groundwater was flowing to the north towards Newbridge Road, east towards the Georges River, to the south towards the ponds and to the west towards the open drainage channel. The inferred groundwater level contours are shown on Drawing 7 and 8, Appendix A. Essentially groundwater appears to be mounded within the site and flowing radially towards adjacent water bodies and low points. This is to be expected as the permeability of fill at the site is likely to be higher than the natural landforms surrounding the site and water bodies are located to the east, south and west of the site.

Field parameters were measured whilst sampling, however, there was insufficient water in BH/MW218. The field parameters are summarised in the following table.

Table 19: Summary of Field Parameters (Groundwater and Surface Water)

Well / Sample ID	Temp. (°C)	DO (mg/L)	TDS (ppm)	EC* (µS/cm)	pH	Redox (mV)
Groundwater Samples						
BH/MW216	20.0	2.16	7200	11 250	6.84	-83
BH/MW218	-	-	-	-	-	-
JKBH/107a	24.3	3.33	2140	3344	6.98	-56
JKBH/MW1	17.5	3.45	3080	4813	6.95	-34
JKBH/MW7#	-	-	-	-	-	-
JKBH/MW9#	-	-	-	-	-	-
JKBH/MW16	25.0	2.09	5940	9281	5.43	-37
Surface Water Samples						
SW1	21.1	7.15	11640	18 188	7.55	40
SW2	25.4	0.43	6320	9875	7.20	-68
SW3	19.5	2.31	3290	5141	7.10	-15

Notes to table:
*Calculated from TDS result
well was bent and could not fit bailer or pump in

For groundwater, temperature ranged between 17.5 and 25.0°C. There was some dissolved oxygen (2.09 to 3.45 mg/L) measured in all wells. The pH of the groundwater was slightly acidic ranging between 5.43 and 6.98 pH units. The electrical conductivity ranged between 3344 and 11 250 µs/cm reflecting values typical of brackish water. Redox potential (Eh) ranged between -83 and -37 mV.

No LNAPL was observed whilst sampling.

Three discrete surface water bodies were sampled and the locations are shown on Drawing 9, Appendix A. For surface water, temperature ranged between 19.5 and 25.4°C. There was some dissolved oxygen (0.43 to 7.15 mg/L) measured in all locations. The pH of the surface water was slightly acidic ranging between 7.10 and 7.55 pH units. The electrical conductivity ranged between 5141 and 18 188 µs/cm reflecting values typical of brackish to saline water. Redox potential (Eh) ranged between -15 and 40 mV.

13.5 Analytical Laboratory Results

Summary results tables including analytical results and relevant assessment criteria are appended as follows:

- Appendix B – Summary Results for Soil;
- Appendix C – Summary Results for Soil Vapour; and
- Appendix D – Summary Results for Groundwater and Surface Water.

Laboratory reports with associated chain of custody documentation are presented in Appendix H.

13.6 Data Quality Assurance and Quality Control

Field and laboratory quality assurance and quality control (QA/QC) procedures formed an integral part of the assessment. The QA/QC procedures and results are presented in Appendix I. Overall, the standard operating procedures (SOPs) were complied with in the field, and the field and laboratory QC samples were generally within the acceptance criteria. On this basis, it is considered that an acceptable level of field and laboratory precision and consistency was achieved and that the laboratory data sets are reliable, accurate and useable for this assessment.

14. Discussion of Results

14.1 Soil Results

Sixty-six soil samples were analysed for metals (arsenic, cadmium chromium, copper, lead, mercury, nickel, zinc and manganese). All the samples recorded concentrations of metals that were below the adopted EILs and HILs with the following exceptions:

- Sample BH203/2.9-3.35 which recorded a concentration of lead at 860 mg/kg which exceeds the HIL-A of 300 mg/kg;
- Sample BH221/2.9-3.35 which recorded a concentration of lead at 620 mg/kg which exceeds the HIL-A of 300 mg/kg;
- Sample BH223/2.0-2.45 which recorded a concentration of copper at 540 mg/kg which exceeds the EIL of 230 mg/kg. The sample was, however, collected from a depth exceeding that to which the EIL generally apply; and
- Sample BH222/0.9-1.35 which recorded a concentration of copper at 250 mg/kg which marginally exceeds the EIL of 230 mg/kg.

Sixty-three soil samples were analysed for TRH and BTEXN. All the samples recorded concentrations of TRH and BTEXN that were below the adopted ESLs and HILs with the following exceptions:

- Sample BH207/0.1-0.2 (coarse soil) which recorded a concentration of TRH C_{16}-C_{34} at 1700 mg/kg which exceeds the ESL of 300 mg/kg;
- Sample BH209/0.1-0.2 (coarse soil) and BH209/0.9-1.35 (coarse soil) which recorded a concentration of TRH C_{16}-C_{34} at 330 mg/kg and 990 mg/kg, respectively, which exceed the ESL of 300 mg/kg;
- Sample BH212/0.1-0.2 (coarse soil) which recorded a concentration of TRH C_{16}-C_{34} at 640 mg/kg which exceeds the ESL of 300 mg/kg;

- Sample BH222/0.1-0.2 (coarse soil) and BH209/0.9-1.35 (coarse soil) which recorded a concentration of TRH C_{16}-C_{34} at 890 mg/kg and 990 mg/kg, respectively, which exceed the ESL of 300 mg/kg; and
- Sample JK103a/0.1-0.2 (coarse soil) which recorded a concentration of TRH C_{16}-C_{34} at 460 mg/kg which exceeds the ESL of 300 mg/kg.

Sixty-five soil samples were analysed for PAH. Detectable concentrations of total PAH were recorded in 41 samples (i.e. 63% of samples tested). Concentrations of total PAH were below the adopted HIL in all samples. Concentrations of B(a)P and B(a)P TEQ were below the adopted ESL and HIL, respectively, for all samples with the following exceptions:

- B(a)P:
  - Samples which exceeded the ESL of 0.7 mg/kg by greater than 2.5 times (i.e. are 'hotspots') and are within the upper 2.0 m of the surface (i.e. where the ESL applies) were:
    - BH207/0.1-0.2 at 20 mg/kg;
    - BH209/0.9-1.35 at 9.5 mg/kg;
    - BH210/0.1-0.2 at 2.8 mg/kg;
    - BH222/0.9-1.35 at 3.6 mg/kg;
  - Samples which exceeded the ESL of 0.7 mg/kg (excluding 'hotspots') and are within the upper 2.0 m of the surface (i.e. where the ESL applies) were:
    - BH206/0.1-0.2 at 1.1 mg/kg;
    - BH209/0.1-0.2 at 1.1 mg/kg;
    - BH209/1.9-2.35 at 0.86 mg/kg;
- B(a)P TEQ:
  - Samples which exceeded the HIL of 3 mg/kg by greater than 2.5 times (i.e. are 'hotspots') and are within the upper 3.0 m of the surface (i.e. where the HIL applies) were:
    - BH207/0.1-0.2 at 29 mg/kg;
    - BH209/0.9-1.35 at 14 mg/kg;
    - BH210/0.1-0.2 at 4.2 mg/kg;
    - JK103a/2.9-3.35 at 17 mg/kg;
  - Samples which exceeded the HIL of 3 mg/kg (excluding 'hotspots') and are within the upper 3.0 m of the surface (i.e. where the HIL applies) were:
    - BH222/0.9-1.35 at 5.4 mg/kg.

Sixty-three soil samples were analysed for OCP. Detectable concentrations of OCP were recorded in five samples. Concentrations of OCP were below the adopted HIL and EIL in all samples. The detectable OCP included Aldrin, DDT, DDE, DDD, Endosulfan and Endrin.

Sixty-three soil samples were analysed for OPP and all samples recorded concentrations below the laboratory reporting limit and therefore well below the adopted HIL.

Sixty-three soil samples were analysed for PCB and all samples recorded concentrations below the laboratory reporting limit and therefore well below the adopted HIL with the exception of:

- Sample BH220/0.1-0.2 which recorded a concentration of 3.7 mg/kg which exceeds the HIL of 1 mg/kg by greater than 2.5 times (i.e. represents a 'hotspot').

Sixty-three soil samples were analysed for total phenols and all samples recorded concentrations below the laboratory reporting limit and therefore well below the adopted HIL.

Sixty-one soil samples were analysed for total cyanide. Detectable concentrations of total cyanide were recorded in five samples. Concentrations of total cyanide were below the adopted HIL in all samples.

14.1.1 Leachability Results

Toxicity characteristic leaching procedure (TCLP) testing was undertaken on selected 'worst case' soil samples which recorded elevated concentrations of metals or PAH. The results on two samples for metals indicate some degree of leachability for some metals, in particular lead at 0.2 mg/L to 1 mg/L and zinc at 1.1 mg/L and 1.8 mg/L. The results on four samples for PAH indicate a limited degree of leachability between <0.016 mg/L (three samples) and 0.029 mg/L (one sample).

14.2 Landfill Gas Results

The HGG monitoring data for the monitoring undertaken on 19 August 2015 is summarised as follows:

- Methane concentrations ranged from 0.5 %v/v to 24.6 %v/v;
- Carbon dioxide concentrations ranged from 1.7 %v/v to 15.9 %v/v;
- Oxygen concentrations ranged from 0.1 %v/v to 15.9 %v/v;
- Carbon monoxide concentrations ranged from 0 ppm to 2 ppm;
- Hydrogen sulphide concentrations ranged from 0 ppm to 1 ppm; and
- Atmospheric pressure readings remained stable for the duration of monitoring at 1024 mb.

The HGG monitoring data for the monitoring undertaken on 1 October 2015 is summarised as follows:

- Methane concentrations ranged from 0.0 %v/v to 24.4 %v/v;
- Carbon dioxide concentrations ranged from 1.2 %v/v to 14.5 %v/v;
- Oxygen concentrations ranged from 0.0 %v/v to 21.7 %v/v;
- Carbon monoxide concentrations ranged from 0 ppm to 19 ppm;
- Hydrogen sulphide concentrations ranged from 0 ppm to 1 ppm; and
- Atmospheric pressure readings increased during monitoring from 1023 mb to 1032 mb.

The HGG monitoring data for the monitoring undertaken on 27 October 2015 is summarised as follows:

- Methane concentrations ranged from 0.0 %v/v to 32.5 %v/v;

- Carbon dioxide concentrations ranged from 1.7 %v/v to 13.8 %v/v;
- Oxygen concentrations ranged from 0.0 %v/v to 21.7 %v/v;
- Carbon monoxide concentrations ranged from 0 ppm to 5 ppm;
- Hydrogen sulphide concentrations ranged from 0 ppm to 2 ppm; and
- Atmospheric pressure readings increased during monitoring from 1022 mb to 1026 mb.

The HGG monitoring data for the monitoring undertaken on 10 February 2016 is summarised as follows:

- Methane concentrations ranged from 0.0 %v/v to 25.3 %v/v;
- Carbon dioxide concentrations ranged from 1.7 %v/v to 23.8 %v/v;
- Oxygen concentrations ranged from 0.0 %v/v to 21.5 %v/v;
- Carbon monoxide concentrations ranged from 4 ppm to 30 ppm;
- Hydrogen sulphide concentrations ranged from 0 ppm to 30 ppm; and
- Atmospheric pressure readings decreased during monitoring from 1016 mb to 1011 mb.

The following table provides a summary of the GSV and CGS for the four monitoring events.

Table 20: Summary of Maximum Results for the Four Landfill Gas Monitoring Events

Date	Flow Rate Peak	Methane Peak %	GSV	CO_2 Peak %	GSV	CGS [1, 2]
19/08/15	0.9	24.6	0.22	15.9	0.14	3
1/10/15	0.7	24.2	0.17	14.5	0.10	3
27/10/15	0.6	32.5	0.20	13.8	0.08	3
10/02/16	6.8	25.3	1.72	23.8	1.62	3

Notes to table:

1. Where methane >1% or CO_2 >5% CGS was increased to Situation 2 as per Table 6 of NSW EPA (2012)
2. Where methane >20% CGS was increased to Situation 3 as per Table 7 of NSW EPA (2012)

The landfill gas results indicate that over the four monitoring events, a worst case CGS of 3 is consistently recorded using the modified Wilson and Card classification which is in the moderate risk category.

14.2.1 Background Gas Wells

The two 'background' landfill gas wells BH224 and BH225 were sampled for the last two monitoring events. The wells recorded maximum methane concentrations of 0.1 %v/v and 0.2 %v/v suggesting that the local estuarine alluvial (possibly swamp deposits) soils are unlikely to be contributing a significant amount of methane to that being generated by fill at the site.

14.2.2 Relationship between Deep and Shallow Gas Well Data

Over the three monitoring events where nested (paired) gas wells were sampled, there did not appear to be a strong indication that the gas concentration increases significantly with depth. Results at

paired wells were broadly comparable with rare exception and the exceptions also included a higher methane concentration at the shallow well compared to the deeper well.

14.2.3 Trace Non-Methane Organic Compounds

The trace NMOC results have indicated that several NMOC are in the landfill gas mixture. NMOC present at detectable concentrations included:

- BTEX;
- 1,2,4-trimethylbenzene;
- Styrene;
- Chloroethane;
- Trichloroethene;
- cis-1,2-dichloroethene;
- Dichlorofluromethane;
- Carbon disulphide;
- Cyclohexane;
- Ethanol;
- Heptane;
- Hexane; and
- Naphthalene.

For those trace NMOC with published screening criteria, the concentrations were below those adopted screening criteria. The trace NMOC detected are considered to be typical of those normally present in landfill gas mixtures from sites with a similar filling history.

14.2.4 Trial Remediation Excavations

Trial remediation excavations were initiated by Benedict in the vicinity of landfill gas wells JK102 and JK107 (now destroyed). The intention of the excavations was to stockpile screen and backfill the trial excavations and monitor landfill gas in the vicinity of the backfilled excavations to evaluate whether the process resulted in a significant reduction in the methane production (concentrations). The screening process is understood to have included the removal of methane generating timber from the fill that was retained on the screen prior to backfilling with the remaining material. Both monitoring wells had previously recorded methane concentrations of around 30 %v/v.

JK102 was retained and following backfilling of the excavation and has recorded methane concentrations of between 12 %v/v and 13.2 %v/v over three monitoring events suggesting a reduction of two thirds.

JK107 (destroyed) was replaced by JKBH/MW107a following backfilling of the excavation. A shallow gas well JK107b was installed adjacent to JKBH/MW107a. The wells have recorded methane concentrations of:

- JKBH/MW107a – between 3 %v/v (first monitoring event following backfilling) and 16.4 %v/v (most recent monitoring event following backfilling) over three monitoring events suggesting a reduction of half; and
- JK107b – between 10.2 %v/v (first monitoring event following backfilling) and 17.3 %v/v (most recent monitoring event following backfilling) over three monitoring events suggesting a reduction of half to one third.

The results at JKBH/MW107a and JK107b indicate a trending increase in methane concentrations and further monitoring would be required to fully assess the result of the trial remediation excavations.

14.3 Groundwater Results

All results for groundwater samples were below the adopted GIL with the following exceptions:

- Ammonia (as N) at 20 mg/L (BH/MW216), 30 mg/L (BH/MW218), 3.2 mg/L (JKBH/MW1), 10 mg/L (JKBH/MW107a), 4.9 mg/L (JKBH/MW16) exceeded the MWG of 0.91 mg/L, FWG of 0.9 mg/L, DWGA of 0.1 mg/L and RWG of 0.1 mg/L;
- Chloride at 2200 mg/L (BH/MW216), 2300 mg/L (BH/MW218), 750 mg/L (JKBH/MW1), 700 mg/L (JKBH/MW107a), 3400 mg/L (JKBH/MW16) exceeded the RWG of 400 mg/L;
- Sulphate at 410 mg/L (BH/MW218), 1100 mg/L (JKBH/MW1), 1700 mg/L (JKBH/MW16) exceeded the DWGA of 250 mg/L, DWGH of 500 mg/L and RWG of 400 mg/L;
- Arsenic at 0.011 mg/L (BH/MW218) exceeded the low reliability MWG of 0.0045 mg/L and DWGH of 0.01 mg/L;
- Chromium at 0.19 mg/L (BH/MW218) exceeded the MWG of 0.0274 mg/L and RWG of 0.05 mg/L;
- Copper at 0.017 mg/L (BH/MW218), 0.005 mg/L (JKBH/MW1), 0.007 mg/L (JKBH/MW107a), 0.004 mg/L (JKBH/MW16) exceeded the MWG of 0.0013 mg/L and FWG of 0.0014 mg/L;
- Lead at 0.007 mg/L (BH/MW218) exceeded the MWG of 0.0044 mg/L and FWG of 0.0034 mg/L;
- Manganese at 1.4 mg/L (BH/MW216), 0.65 mg/L (BH/MW218), 0.95 mg/L (JKBH/MW1), 0.42 mg/L (JKBH/MW107a), 4.4 mg/L (JKBH/MW16) exceeded some or all of the low reliability MWG of 0.08 mg/L, FWG of 1.9 mg/L, DWGA of 0.1 mg/L, DWGH of 0.5 mg/L and RWG of 0.1 mg/L;
- Nickel at 0.009 mg/L (BH/MW216), 0.16 mg/L (BH/MW218), 0.03 mg/L (JKBH/MW1), 0.012 mg/L (JKBH/MW107a), 0.02 mg/L (JKBH/MW16) exceeded some or all of the MWG of 0.007 mg/L, FWG of 0.011 mg/L, DWGH of 0.02 mg/L and RWG of 0.1 mg/L;
- Zinc at 0.06 mg/L (BH/MW216), 0.084 mg/L (BH/MW218), 0.097 mg/L (JKBH/MW1), 0.079 mg/L (JKBH/MW107a), 0.82 mg/L (JKBH/MW16) exceeded the MWG of 0.015 mg/L and FWG of 0.008 mg/L; and
- Dieldrin at 0.000076 mg/L exceeded the low reliability MWG of 0.00001 mg/L. Detectable concentrations of Dieldrin were recorded in all other monitoring wells, however, at concentrations below the adopted GIL.

Chlorpyrifos was detected in groundwater in 2013 (EIS, 2013), however, it was not detected in any samples from the most recent round of monitoring.

14.4 Surface Water Results

All results for surface water samples were below the adopted investigation levels with the following exceptions:

- Ammonia (as N) at 8.4 mg/L (SW2) exceeded the MWG of 0.91 mg/L and FWG of 0.9 mg/L;
- Sulphate at 410 mg/L (BH/MW218), 1100 mg/L (JKBH/MW1), 1700 mg/L (JKBH/MW16) exceeded the DWGA of 250 mg/L, DWGH of 500 mg/L and RWG of 400 mg/L;
- Nitrate (as N) at 0.29 mg/L (SW1) exceeded the FWG of 0.161 mg/L;
- Copper at 0.002 mg/L (SW1) exceeded the MWG of 0.0013 mg/L and FWG of 0.0014 mg/L;
- Manganese at 0.42 mg/L (SW2), 0.1 mg/L (SW3) exceeded low reliability MWG of 0.08 mg/L; and
- Zinc at 0.0018 mg/L (SW3) exceeded the MWG of 0.015 mg/L.

Detectable concentrations of Dieldrin were recorded in at SW1 and SW2, however, at concentrations below the adopted investigation levels.

15. Conclusions

15.1 General

The findings of the current investigation were generally consistent with previous investigations insofar as the drilling programme encountered uncontrolled filling with a component of construction and demolition waste to thicknesses of up to 9.2 m. Many boreholes met refusal on buried obstructions in the filling.

The contaminant concentrations in soil were generally consistent with previous investigations with the exception of the PCB hotspot encountered at BH220. PCB has not previously been detected at the site, but this is most likely attributable to the heterogeneous nature of the waste filling.

Ongoing landfill gas monitoring has confirmed CGS3 and thus the need to incorporate gas mitigation systems into the building design for proposed residential dwellings.

15.2 Relationship between Soil, Groundwater and Surface Water Results

Some contaminants in soil at the site including various metals have been detected at elevated concentrations in groundwater, in particular, zinc. TCLP testing on a limited number of samples also indicates some degree of leachability for some metals including zinc. Concentrations of zinc in surface water bodies adjacent to the site were, however, lower than concentrations in the groundwater.

Under certain circumstances, the OCP Aldrin will oxidise to form Dieldrin. Detectable concentrations of Dieldrin were recorded in all (serviceable) groundwater monitoring wells at the site and in the dredge pond and Georges River surface water bodies. Aldrin and/or Dieldrin have been detected in soil at the site at concentrations below the HIL. It is possible that the source of the Dieldrin in groundwater and surface water is the fill at the site.

The PAH that was detected in filling does not appear to be leaching and migrating vertically to groundwater. This is probably due to the low solubility of the majority of PAH compounds. TCLP testing on a limited number of samples also indicates the PAH is unlikely to leach. PAH was not detected in any groundwater or surface water samples with the exception of JKBH/MW16 as reported in EIS (2013).

15.3 Updated Conceptual Site Model

The data collected for this DSI has generally confirmed that the CSM outlined in Section 8 remains valid. No other sources of contamination have been detected and the data indicates that the large scale filling at the site represents the major point-source of soil contamination and the generation of landfill gas. Groundwater and surface water data suggests that some contaminants likely to be from filling have migrated to groundwater, however, impacts to adjacent surface water bodies appears to be negligible.

15.4 Suitability of the Site for the Proposed Development

Based on the findings of the current investigation it is considered that the site can be made suitable for the proposed residential development subject to the development of a suitable RAP and the implementation of appropriate site remediation as per the recommendations outlined in Section 17.

15.5 Integration of the Development Application and Closure Plan

The site Environment Protection Licence – 10490 version date: 10-Sep-2015 under Section O5.6 required that: *the last licensee must prepare and submit to the EPA within three months of cessation all activities at the premises permitted by this licence, a closure plan in accordance with section 76 of the Protection of the Environment Operations Act 1997*. This process will need to be integrated with the DA process and site remediation activities (refer to Section 17).

16. Geotechnical Considerations

Advice on the geotechnical considerations for the project is currently being provided to Benedict by J&K. The geotechnical methodology for remediating the site from a geotechnical standpoint (i.e. ground improvement) has been summarised by J&K. The summary is provided in Appendix J. The inclusion of the summary should not be interpreted to imply that DP endorses the proposed methodology. It is understood that further details of the geotechnical methodology will be fine-tuned and a report will be prepared by J&K in due course.

17. Recommendations

17.1 Requirements for Site Remediation

A RAP should be prepared with reference to NSW OEH (2011) that outlines the requirements for site remediation necessary in order to render the site suitable for the proposed residential development.

17.1.1 Soil

There are several 'hotspots' of soil contamination that will require remediation. The RAP should determine which 'hotspots' (if any) will need to be remediated and this will be determined based on the proposed final site levels and the thickness of imported VENM that will be used to cap the site.

17.1.2 Landfill Gas

Based on the ongoing landfill gas monitoring at the site, gas mitigation systems will need to be incorporated into the building design for proposed dwellings.

Additional landfill gas monitoring wells should be installed, in particular, in the footprint on any remediation excavations following the screening and backfilling process. They should also be installed at previously inaccessible areas of the site when stockpiles have been moved. The additional monitoring data should be used to finalise the levels of gas mitigation that will be required.

The recent monitoring conducted as part of this DSI suggests that a CGS of 3 is likely to be appropriate for this site as opposed to the previously recommended CGS of 4. The historical worst case CGS of 4 appears to be an outlier in the overall monitoring dataset. With reference to NSW EPA (2012), a CGS of 3 is typical of "old inert waste landfill" which is consistent with the filling at this site. Ongoing monitoring will be required to confirm the CGS.

The RAP will need to outline the relevant measure or system element to achieve a score consistent with what is required based on the CGS.

17.1.3 Groundwater and Surface Water

Given that surface water data suggests that groundwater is unlikely to be having an adverse impact on adjacent surface water, in particular, the Georges River, and impacts on other possible receptors of groundwater are unlikely or implausible (e.g. abstraction for drinking water) it is considered that no groundwater or surface water remediation is required.

17.2 Integration of Site Remediation and Geotechnical Site Improvements

The site remediation will need to be integrated with the geotechnical site improvements. Notably, the J&K summary (Appendix J) item 4 whereby "the entire site is to be excavated, as appropriate, to final terrace level –3m." Whilst it is understood that these details are still subject to detailed design, the excavated material may involve the disturbance of contaminated soil 'hotspots'. This aspect of the

geotechnical site improvements will need to be clearly integrated into the RAP and site remediation when these earthworks occur.

17.3 Additional Investigations to Finalise Site Remediation Strategy

All or some of the following additional soil investigations are required when stockpiles have been removed from the site and a decision is finalised on the thickness of imported VENM that will be used to cap the site to achieve final design levels:

- Targeted near surface sampling at the diesel above ground storage tank (AST) and the drum storage area following their decommissioning;
- Delineation testing in the area of the PCB, PAH and lead 'hotspots' (if required); and
- Grid based sampling across the site with a focus on previously inaccessible areas (i.e. beneath existing stockpiles) in order to meet the EPA (1995) *Sampling Design Guidelines* recommended sampling density.

Ongoing landfill gas monitoring should be undertaken including the installation of additional monitoring wells as discussed in Section 17.1.2.

17.4 Long Term Environmental Management Plan

A long term Environmental Management Plan (EMP) will be required for the ongoing management of contamination remaining on site and landfill gas mitigation systems. The EMP should include:

- Procedures for the management and maintenance of cap and landfill gas mitigation systems; and
- Procedures for scenarios where the capping or landfill gas mitigation systems need to be penetrated and reinstated.

The EMP will require establishment of appropriate public notification under Section 149(2) of the EP&A Act or a covenant registered on the title to land under Section 88B of the Conveyancing Act 1919. The EMP would be prepared prior to or during remediation and finalised following validation of the remedial activities.

18. References

ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality

CIRIA (2007) C665 Assessing Risks Posed by Hazardous Ground Gases to Buildings

EPA (2012) Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases

EPA (1995) Sampling Design Guidelines

Dames & Moore (1994) Report on Groundwater Sampling

Dames & Moore (2000) Landfill Groundwater and Surface Water Monitoring and Assessment Program

DEC (2006) Guidelines for the NSW Site Auditor Scheme

DP (1999) Proposed Environmental Monitoring Program, Sorting, Recovery and Transfer (SRT) Facility, 146 Newbridge Road, Moorebank

DP (2002a) Preliminary Geotechnical Assessment, 146 Newbridge Road, Moorebank

DP (2002b) Report on Preliminary Contamination Assessment, Proposed Residential Development, 146 Newbridge Road, Moorebank

DP (2002c) Geotechnical Assessment, 146 Newbridge Road, Moorebank

DP (2005) Proposed Mixed Commercial / Residential Development, 146 Newbridge Road, Moorebank

DP (2008) Preliminary Desktop Review, Benedict Sand and Gravel, Moorebank

DP (2009a) Desktop Review, Benedict Sand and Gravel, Moorebank

DP (2009b) Environmental and Geotechnical Advice, Benedict Sand and Gravel, 146 Newbridge Road, Moorebank

DP (2009c) Review of Foundation Options, Proposed Residential Development, 146 Newbridge Road, Moorebank

DP (2009d) Compaction and Grading, 146 Newbridge Road, Moorebank

DP (2014a) Initial Comments on the Design of Landfill Gas Mitigation Measures 146 Newbridge Road, Moorebank Stage 1

DP (2014b) Draft Concept Design for Landfill Gas Mitigation Measures, 146 Newbridge Road, Moorebank Stage 1

DP (2015a) Construction Environmental Management Plan, Proposed Retaining Wall, 146 Newbridge Road, Moorebank, NSW

DP (2015b) Sampling and Analysis Quality Plan, Proposed Residential Subdivision, 146 Newbridge Road, Moorebank, NSW

DP (2015c) Report on Geotechnical Investigation, Proposed Residential Subdivision, 146 Newbridge Road, Moorebank

EIS (2013) Stage 1 Environmental Site Assessment for Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014a) Preliminary Hazardous Ground Gas Screening for the Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014b) Hazardous Ground Gas (HGG) Screening Results (Round 2), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014c) Hazardous Ground Gas (HGG) Screening Results (Round 3), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014d) Hazardous Ground Gas (HGG) Screening Results (Round 4), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014e) Hazardous Ground Gas (HGG) Screening Results (Round 5), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

J&K (2013) Geotechnical Investigation for Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

J&K (2016) Geotechnical Methodology for Remediating Benedict's Moorebank Site

NEPC (2013) National Environment Protection (Assessment of Site Contamination) Measure 1999 amended 2013

NHMRC (2016) Australian Drinking Water Guidelines

OEH (2011) Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites

19. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 146 Newbridge Road, Moorebank with reference to DP's proposal SYD150814 dated 10 August 2015 and acceptance received from Mr Ernest Dupere of Benedict Industries Pty Ltd dated 14 August 2015. The report is provided for the exclusive use of Benedict Industries Pty Ltd for this project only and for the purpose described in the report. It should not be used for other projects or by a third party. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and / or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and /or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the environmental components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

Drawings

Site Photographs

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

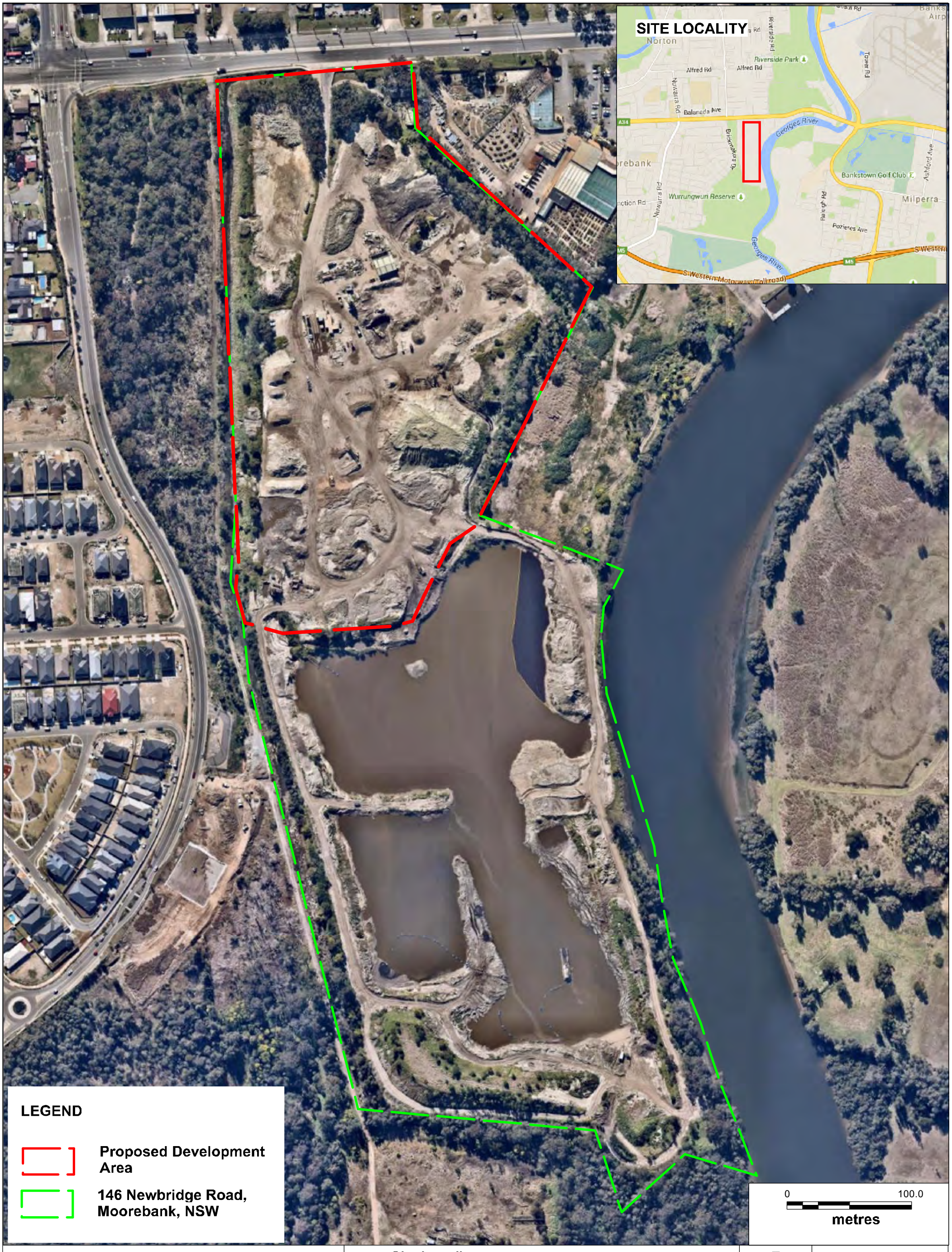
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.



Douglas Partners Geotechnics / Environment / Groundwater	TITLE: Site Locality Detailed Site Investigation 146 Newbridge Road, Moorebank, NSW	N MGA	OFFICE: Sydney DRAWN BY: MJC DATE: 14.10.2015
CLIENT: Benedict Industries Pty Ltd	PROJECT No: 71459.03	DRAWING No: 1	REVISION: A / SCALE: As shown



Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Test Locations
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 17.2.2016

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.03
DRAWING No: 2
REVISION: A
SCALE: As shown

Peak Methane Concentration %

60

40

20

0

Where a shallow and deep well are present at the one location, the well with the highest methane peak has been used to generate the contours.

Well ID	Well ID	Well ID
BH1	JK103	JK115
JKBH/MW16	JK104	JK119
JKBH/MW17	JK106	
JKBH/MW9	JK110	
JK101	JK113	
JK102	JK114	

LEGEND

- Proposed Development Area
- Surface Sample
- a Replacement Well
- b Shallow Gas Well
- Borehole / Gas Well
- Monitoring Well
- Borehole
- Borehole (DP, 2002)
- Borehole (EIS, 2015)
- Borehole / Gas Well (EIS, 2015)
- Monitoring Well Location (EIS, 2015)

JKBH/MW1, JK2, BH1, BH5, BH6, BH201, JK3, BH207, BH206, BH202, BH204, BH205, JK4, BH203, BH208, BH2, JK119, BH7, JK6, JK104, BH209, JK5, JK101, JK102, BH211, BH211b, BH210, JK103a, JK103b, BH9, BH212, JKBH/MW107a, JK107b, JK106, JK8, BH213, JKBH/MW9, BH214, JKBH/MW7, BH/MW216, BH215, BH3, BH8, JK10, JK110, BH10, JK11, JK113, SS217, BH/MW218, JK118a, JK118b, JK12, SS219, JK115, BH220, JK117, BH11, JK14, JK114, JK114b, BH4, JK13, JK116, BH221, BH224, JK15, JKBH/MW16, BH225, BH222, BH12, BH223

0 100.0 metres

Douglas Partners Geotechnics / Environment / Groundwater	TITLE: Peak Methane Concentration Contours 19/8/15 Detailed Site Investigation 146 Newbridge Road, Moorebank, NSW	N MGA	OFFICE: Sydney DRAWN BY: MJC DATE: 17.02.2016
CLIENT: Benedict Industries Pty Ltd	PROJECT No: 71459.03	DRAWING No: 3	REVISION: A / SCALE: As shown

Peak Methane Concentration %

60

40

20

0

Where a shallow and deep well are present at the one location, the well with the highest methane peak has been used to generate the contours.

Wells used to generate the contours

Well ID	Well ID	Well ID	Well ID
BH/MW216	JK101	JK110	JK119
BH/MW218	JK102	JK113	JKBH/MW7
BH202	JK103b	JK114	JKBH/MW9
BH211	JK104	JK115	
BH223	JK106	JKBH/MW16	
JKBH/MW1	JK107b	JK118a	

LEGEND

- Proposed Development Area
- Surface Sample
- a Replacement Well
- b Shallow Gas Well
- Borehole / Gas Well
- Monitoring Well
- Borehole
- Borehole (DP, 2002)
- Borehole (EIS, 2015)
- Borehole / Gas Well (EIS, 2015)
- Monitoring Well Location (EIS, 2015)

JKBH/MW1, JK2, BH1, BH5, BH6, BH201, JK3, BH207, BH206, BH202, BH204, BH205, JK4, BH203, BH208, BH2, JK119, BH7, JK104, JK6, BH209, JK5, JK101, JK102, BH211, BH211b, BH210, JK103a, JK103b, BH9, BH212, JKBH/MW107a, JK107b, BH213, JKBH/MW9, BH214, JK106, JK8, JKBH/MW7, BH/MW216, BH215, BH3, BH8, JK10, JK11, BH10, JK110, JK113, SS217, BH/MW218, JK118a, JK118b, JK12, SS219, JK115, BH220, BH11, JK117, JK14, JK114, JK114b, BH4, JK13, JK116, BH221, BH224, JK15, JKBH/MW16, BH225, BH222, BH12, BH223

0 100.0 metres

Douglas Partners Geotechnics / Environment / Groundwater	TITLE: Peak Methane Concentration Contours 1/10/15 Detailed Site Investigation 146 Newbridge Road, Moorebank, NSW	N MGA	OFFICE: Sydney DRAWN BY: MJC DATE: 17.02.2016
CLIENT: Benedict Industries Pty Ltd	PROJECT No: 71459.03	DRAWING No: 4	REVISION: A / SCALE: As shown

Peak Methane Concentration %

60
40
20
0

Where a shallow and deep well are present at the one location, the well with the highest methane peak has been used to generate the contours.

Wells used to generate the contours

Well ID	Well ID	Well ID	Well ID
BH/MW216	BH225	JK106	JK118a
BH/MW218	JKBH/MW1	KBH/MW107	JK119
BH202	JK101	JK110	JKBH/MW16
BH211	JK102	JK113	JKBH/MW7
BH223	JK103b	JK114	JKBH/MW9
BH224	JK104	JK115	

LEGEND

- Proposed Development Area
- Surface Sample
- a Replacement Well
- b Shallow Gas Well
- Borehole / Gas Well
- Monitoring Well
- Borehole
- Borehole (DP, 2002)
- Borehole (EIS, 2015)
- Borehole / Gas Well (EIS, 2015)
- Monitoring Well Location (EIS, 2015)

0 100.0
metres

Douglas Partners
Geotechnics / Environment / Groundwater

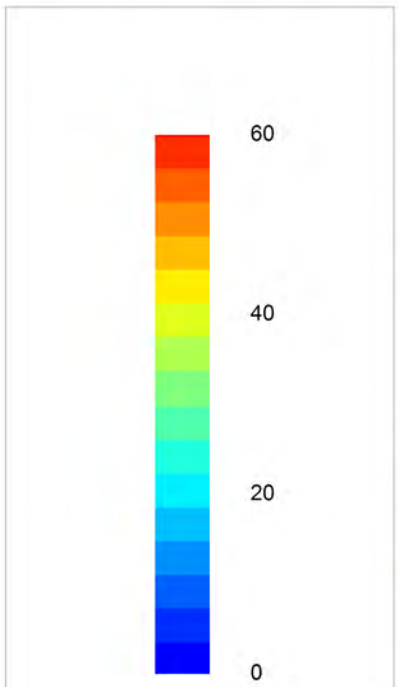
TITLE: Peak Methane Concentration Contours 27/10/15
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 17.02.2016

CLIENT: Benedict Industries Pty Ltd | PROJECT No: 71459.03 | DRAWING No: 5 | REVISION: A | SCALE: As shown

Peak Methane Concentration %



Where a shallow and deep well are present at the one location, the well with the highest methane peak has been used to generate the contours.

Wells used to generate the contours

Well ID	Well ID	Well ID	Well ID
BH/MW216	JKBH/MW1	JK117	JK119
BH202	JK101	JK113	JKBH/MW7
BH211a	JK103b	JK114	JKBH/MW9
BH223	JK106	JK114b	
BH224	JK107b	JK115	
BH225	JK104	JKBH/MW16	

LEGEND

- Proposed Development Area
- Surface Sample
- a Replacement Well
- b Shallow Gas Well
- Borehole / Gas Well
- Monitoring Well
- Borehole
- Borehole (DP, 2002)
- Borehole (EIS, 2015)
- Borehole / Gas Well (EIS, 2015)
- Monitoring Well Location (EIS, 2015)

0 100.0 metres

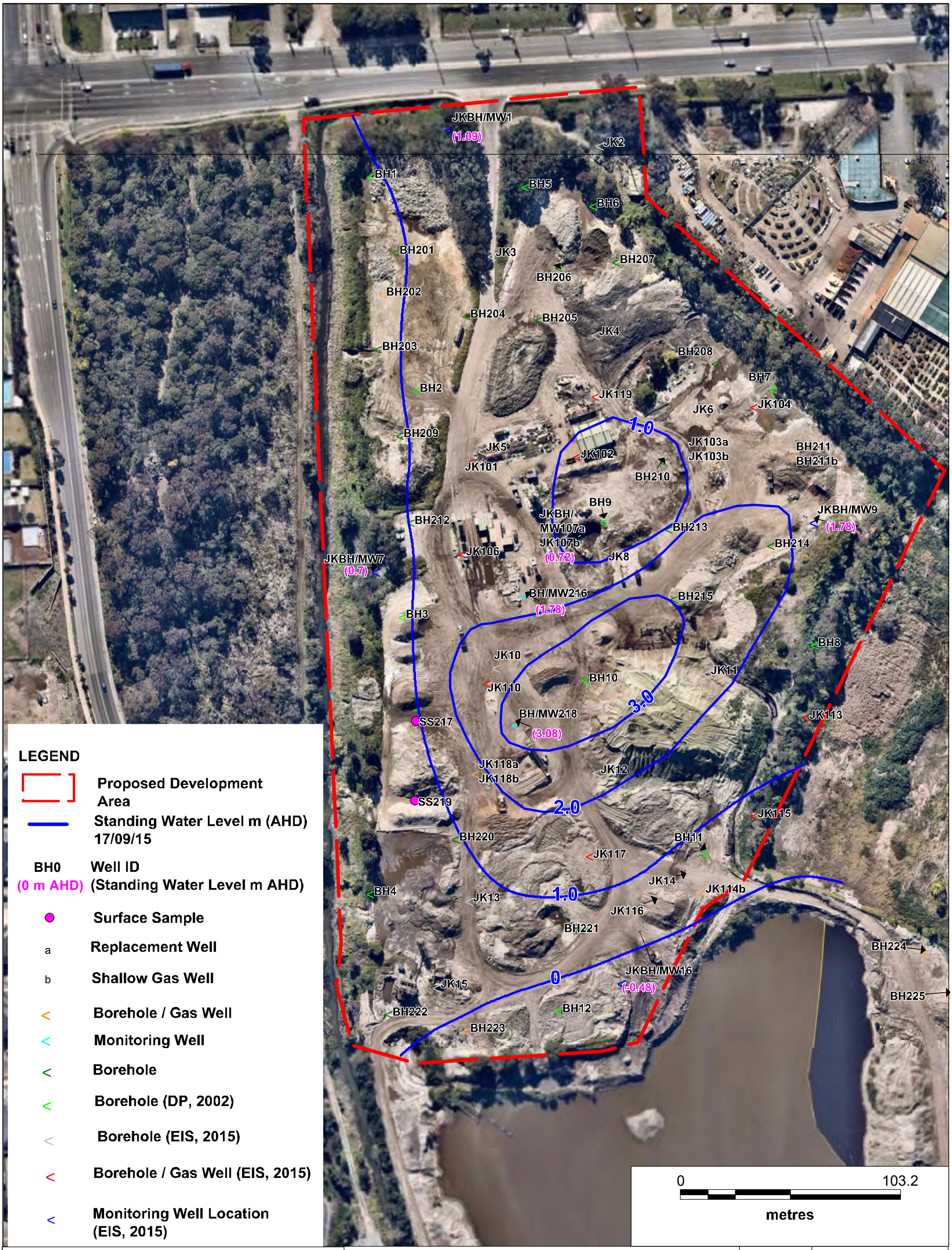
N MGA

Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Peak Methane Concentration Contours 10/2/16
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

OFFICE: Sydney
DRAWN BY: MJC
DATE: 17.02.2016

CLIENT: Benedict Industries Pty Ltd | PROJECT No: 71459.03 | DRAWING No: 6 | REVISION: A | SCALE: As shown

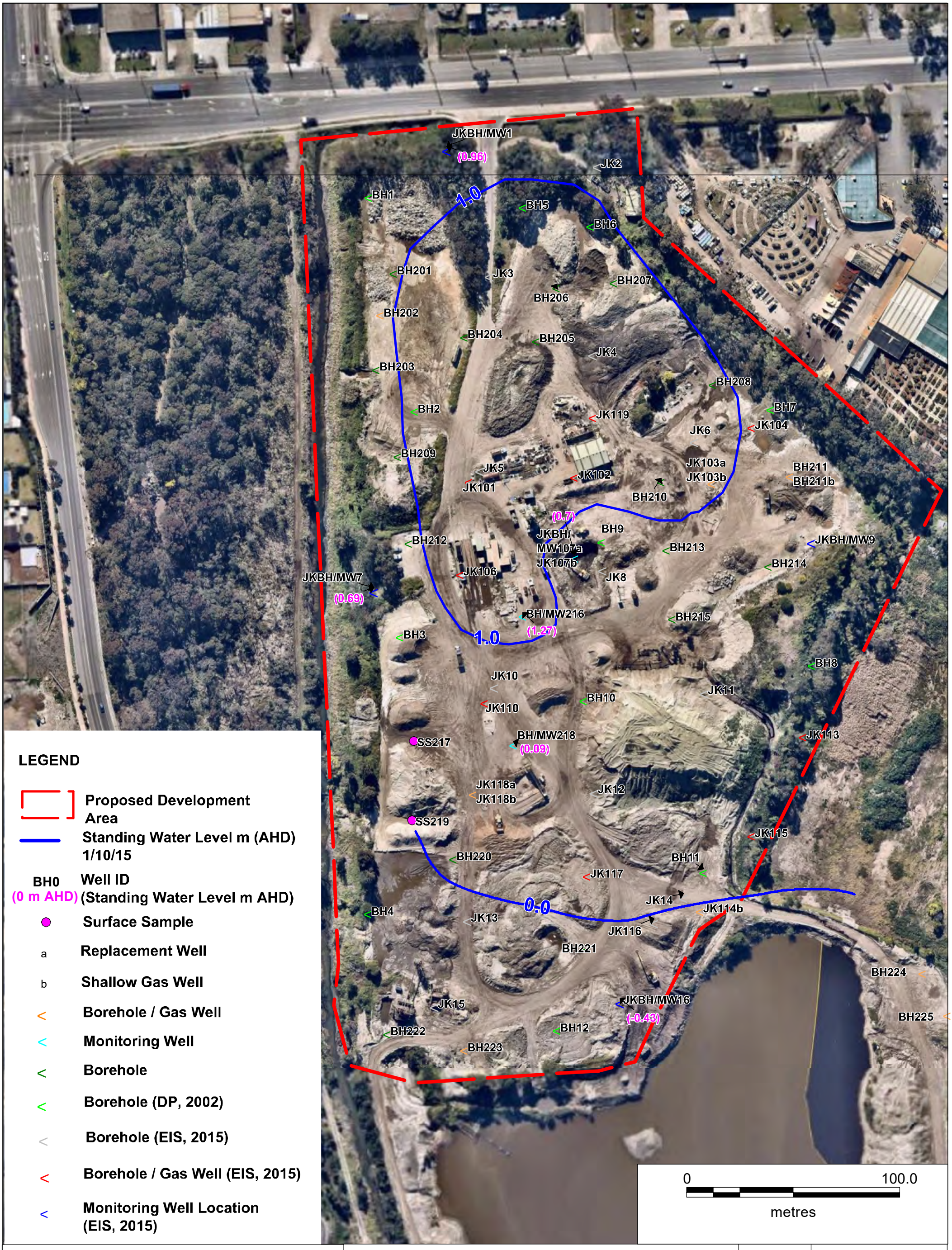


Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Standing Water Level (17.09.15)
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

OFFICE: Sydney
DRAWN BY: BAH
DATE: 19.02.16

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.03
DRAWING No: 7
REVISION: A
SCALE: As shown



Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Standing Water Level (1.10.15)
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

OFFICE: Sydney
DRAWN BY: BAH
DATE: 18.02.2016

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.03
DRAWING No: 8
REVISION: A
SCALE: As shown



Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Surface Water Sample Locations
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

N
MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 19.02.2016

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.03
DRAWING No: 9
REVISION: A
SCALE: As shown



Photo 1 – Installed JK114b (shallow gas well) adjacent to JK114



Photo 2 – Stockpiles in the vicinity of BH220

Douglas Partners Geotechnics | Environment | Groundwater	**Detailed Site Investigation** **146 Newbridge Road** **Moorebank**	PROJECT: 71459.03 PLATE No: 1 REV: 0
	CLIENT: Benedict Industries Pty Ltd	DATE: 14/03/16



Photo 3 – Installed BH211a (shallow gas well) adjacent to BH211



Photo 4 – Typical fill composition (trial remediation excavation at former JK107)

Douglas Partners Geotechnics | Environment | Groundwater	**Detailed Site Investigation** **146 Newbridge Road** **Moorebank**	PROJECT: 71459.03 PLATE No: 2 REV: 0
	CLIENT: Benedict Industries Pty Ltd	DATE: 14/03/16



Photo 5 – Looking north from the dredge pond at the southern site boundary



Photo 6 – Start of trial remediation excavation near JK102

Douglas Partners Geotechnics | Environment | Groundwater	**Detailed Site Investigation** **146 Newbridge Road** **Moorebank**	PROJECT:	71459.03
		PLATE No:	3
		REV:	0
	CLIENT: Benedict Industries Pty Ltd	DATE:	14/03/16



Photo 7 – Metal cable in fill at BH201 wrapped around auger



Photo 8 – Fill excavated from trial remediation excavation at former JK107

Douglas Partners Geotechnics | Environment | Groundwater	**Detailed Site Investigation** **146 Newbridge Road** **Moorebank**	PROJECT: 71459.03 PLATE No: 4 REV: 0
	CLIENT: Benedict Industries Pty Ltd	DATE: 14/03/16

Appendix B

Summary of Soil Results

Douglas Partners
Geotechnics | Environment | Groundwater

Table 1: Summary Results for Metals

Test Location ID	Depth (m)	As [3]	Cd	Cr	Cu	Pb [4]	Hg [5,6]	Ni	Zn	Mn
BH/MW216	0.1-0.2	<4	0.8	13	28	54	<0.1	9	130	200
BH/MW216	3.9-4.35	7	<0.4	21	26	66	0.1	11	83	230
BH/MW216	5.9-6.35	17	<0.4	21	23	51	<0.1	9	170	130
BH/MW218	0.9-1.35	<4	<0.4	4	2	4	<0.1	3	13	68
BH/MW218	2.9-2.35	5	<0.4	14	46	37	<0.1	13	64	110
BH/MW218	5.9-6.35	5	<0.4	15	7	11	<0.1	2	3	5
BH201	0.1-0.2	<4	0.4	7	32	56	<0.1	5	110	61
BH201	0.9-1.35	4	1	15	79	110	0.1	9	170	160
BH202	0.9-1.35	<4	<0.4	45	47	13	<0.1	11	32	1500
BH202	1.9-2.35	6	0.5	26	50	170	0.1	15	140	180
BH203	0.1-0.2	<4	<0.4	7	46	44	<0.1	5	100	87
BH203	0.9-1.35	7	<0.4	14	19	36	<0.1	6	70	40
BH203	2.9-3.35	7	0.5	15	160	860	0.2	14	380	150
BH204	0.1-0.2	<4	<0.4	5	24	47	<0.1	3	83	44
BH204	1.9-2.35	5	<0.4	15	56	72	<0.1	5	140	130
BH204	3.9-4.35	7	<0.4	11	64	150	0.1	16	210	80
BH205	0.9-1.35	<4	<0.4	46	15	12	<0.1	19	25	92
BH205	2.9-3.35	6	<0.4	9	7	13	<0.1	2	5	8
BH205	3.9-4.35	8	<0.4	15	15	15	<0.1	2	15	9
BH206	0.1-0.2	5	<0.4	17	30	140	0.2	15	140	160
BH206	0.9-1.35	8	<0.4	15	22	16	<0.1	11	30	450
BH206	2.35-2.9	<4	<0.4	16	8	25	<0.1	3	9	37
BH206	4.35-4.9	17	<0.4	19	10	32	<0.1	11	30	120
BH207	0.1-0.2	<4	<0.4	25	53	16	<0.1	26	40	490
BH207	0.9-1.35	5	<0.4	15	18	21	<0.1	6	55	73
BH208	1.9-2.35	<4	<0.4	18	21	55	<0.1	13	470	190
BH208	0.9-1.35	<4	<0.4	10	19	32	<0.1	5	44	42
BH208	3.9-4.35	7	<0.4	30	13	26	<0.1	5	16	6
BH209	0.1-0.2	6	<0.4	18	82	98	0.1	13	210	270
BH209	0.9-1.35	<4	<0.4	21	37	35	<0.1	10	75	450
BH209	1.9-2.35	5	<0.4	17	55	35	<0.1	9	66	150
BH209	3.9-4.35	7	0.4	19	25	150	<0.1	10	140	190
BH210	0.1-0.2	<4	<0.4	10	63	11	<0.1	14	33	280
BH210	2.0-2.45	5	<0.4	12	4	10	<0.1	2	5	15
BH211	0.1-0.2	<4	<0.4	12	19	21	<0.1	9	54	200
BH211	0.9-1.35	<4	<0.4	10	5	10	<0.1	2	4	18
BH211	2.9-2.35	4	<0.4	17	3	24	<0.1	4	6	42
BH212	0.1-0.2	<4	<0.4	28	67	16	<0.1	11	39	800
BH212	2.9-3.35	6	0.6	16	41	130	0.1	9	240	120
BH213	0.1-0.2	8	<0.4	19	21	19	<0.1	14	43	200
BH213	2.9-3.35	5	<0.4	13	4	18	<0.1	3	27	27
BH214	0.1-0.2	<4	<0.4	18	46	17	<0.1	11	48	240
BH214	2.2-2.65	<4	<0.4	6	14	54	<0.1	8	33	67
BH215	0.9-1.35	<4	<0.4	9	10	28	<0.1	4	50	61
BH215	1.9-2.35	<4	<0.4	4	17	19	<0.1	2	11	13
BH220	0.1-0.2	4	0.8	16	47	190	0.2	11	290	610
BH221	0.1-0.2	<4	<0.4	11	14	30	0.1	4	69	110
BH221	1.9-2.35	4	<0.4	14	16	92	<0.1	6	78	120
BH221	2.9-3.35	7	0.6	15	45	620	0.2	9	290	180
BH221	3.9-4.35	17	0.7	25	24	86	<0.1	8	150	130
BH222	0.1-0.2	<4	<0.4	16	32	22	<0.1	26	52	560
BH222	0.9-1.35	<4	<0.4	12	85	22	<0.1	12	77	220
BH223	2.0-2.45	5	<0.4	17	540	79	0.2	10	110	190
JK103a	0.1-0.2	<4	<0.4	73	78	6	<0.1	11	26	2300
JK103a	1.9-2.35	<4	<0.4	4	18	31	<0.1	1	14	51
JK103a	2.9-3.35	<4	<0.4	12	22	49	<0.1	9	66	170
JK103a	5.9-6.35	<4	<0.4	3	3	3	<0.1	<1	1	1
JK107a	0.1-0.2	<4	<0.4	9	19	38	<0.1	5	79	87
JK107a	1.9-2.35	10	<0.4	17	29	98	<0.1	10	110	89
JK107a	7.9-8.35	<4	<0.4	5	5	6	<0.1	1	2	2
JK107a	8.9-9.35	<4	<0.4	3	3	6	<0.1	<1	4	3
JK118a	0.1-0.2	<4	<0.4	4	17	15	<0.1	5	25	110
JK118a	1.9-2.35	<4	<0.4	9	12	63	<0.1	6	87	120
JK118a	4.9-5.35	<4	<0.4	15	15	10	<0.1	2	9	9
SS217	0.0-0.1	5	<0.4	9	18	25	<0.1	6	55	120
SS219	0.0-0.1	<4	<0.4	9	24	45	<0.1	7	80	120
BD1/070815	-	8	0.6	13	49	35	<0.1	43	160	340
BD2/080915	-	5	<0.4	9	42	90	0.1	6	75	79
BD3/090915	-	4	0.5	12	27	140	0.1	8	170	100
BD5/100915	-	6	<0.4	16	56	93	<0.1	10	250	85
BD4/100915	-	9	<1	18	23	25	<0.1	6	35	254
BD6/100915	-	6	<1	8	15	14	<0.1	7	15	152
BD7/100915	-	10	<1	30	13	27	<0.1	2	11	<5
BH222(T)	0.9-1.35	<4	<0.4	23	250	42	<0.1	16	160	270
BH204 (T)	3.9-4.35	6	<0.4	13	31	180	<0.1	8	150	110
BH206 (T)	2.35-2.9	<4	<0.4	16	10	35	<0.1	2	10	49
BH/MW216 (T)	5.9-6.35	14	<0.4	18	18	43	<0.1	7	210	74
Laboratory PQL		4	0.4	1	1	1	0.1	1	1	1
NEPM HIL A [1, 2]		100	20	100 [7]	6000	300	40	400	7400	3800
EILs [8] - Urban residential/Public open space		100	NC	450	230	1100	NC	300	850	NC

Notes to Table:

All results in mg/kg on a dry weight basis

NA - Not Applicable

NC - No Criteria

NT - Not Tested

PQL - Practical Quantitation Limits

1 - Health Based Criteria for Residential with Accessible Soils Land Use

2- HIL generally applies to the top 3m of soil

3- HIL assumes 70% oral bioavailability. Site-specific bioavailability may be important and should be considered where appropriate (refer Schedule B7)

4- HIL is based on blood lead models (adult lead model where 50% bioavailability has been considered) Site-specific bioavailability may be important and should be considered where appropriate (refer Schedule B7)

5- Assessment of methyl mercury should only be considered if there is evidence of its potential source

6- HIL does not address elemental mercury

7 - Chromium (VI)

8- EILs refer to contamination present in soil for at least two years

BD1/070815 is the replicate sample of JK107a/1.9-2.35 m (Envirolab)

BD2/080915 is the replicate sample of BH213/2.9-3.35 m (Envirolab)

BD3/090915 is the replicate sample of BH212/2.9-3.35 m (Envirolab)

BD5/100915 is the replicate sample of BH207/0.9-1.35 m (Envirolab)

BD4/100915 is the replicate sample of BH201/0.9-1.35 m (ALS)

BD6/100915 is the replicate sample of BH206/0.9-1.35 m (ALS)

BD7/100915 is the replicate sample of BH208/3.9-4.35 m (ALS)

exceeds NEPM Health-Based Criteria for Residential with accessible soil Landuse

Underlined results exceed NPEM Ecological Investigation Levels for Urban residential/Public open space

Douglas Partners
Geotechnics | Environment | Groundwater

Table 2: Summary Results for Hydrocarbons

Test Location ID	Depth (m)	TRH				TRH (NEPC, 2013)						BTEX				PAHs
		C_6 - C_9	C_{10} - C_{14}	C_{15} - C_{28}	C_{29} - C_{36}	F1 (C_6-C_{10}-BTEX)	F2 (>C_{10}-C_{16} - Napthalene)	C_6-C_{10}	>C_{10}-C_{16}	>C_{16}-C_{34}	>C_{34}-C_{40}	Benzene	Toluene	Ethyl Benzene	Xylenes	Naphthalene
BH/MW216	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH/MW216	3.9-4.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH/MW216	5.9-6.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH/MW218	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH/MW218	2.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH/MW218	5.9-6.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH202	0.9-1.35	<25	<50	<100	240	<25	<50	<25	<50	200	330	<0.5	<1	<2	<1	<1
BH201	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH201	0.9-1.35	<25	<50	<100	110	<25	<50	<25	<50	110	130	<0.5	<1	<2	<1	<1
BH202	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH203	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	110	<100	<0.5	<1	<2	<1	<1
BH203	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH203	2.9-3.35	<25	<50	<100	200	<25	<50	<25	<50	210	170	<0.5	<1	<2	<1	<1
BH204	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	110	<100	<0.5	<1	<2	<1	<1
BH204	1.9-2.35	<25	<50	<100	120	<25	<50	<25	<50	170	<100	<0.5	<1	<2	<1	<1
BH204	3.9-4.35	<25	<50	<100	140	<25	<50	<25	<50	150	130	<0.5	<1	<2	<1	<1
BH205	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH205	2.9-3.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH205	3.9-4.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH206	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	120	<100	<0.5	<1	<2	<1	<1
BH206	0.9-1.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH206	2.35-2.9	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH206	4.35-4.9	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH207	0.1-0.2	<25	<50	850	1200	<25	<50	<25	<50	1700	1300	<0.5	<1	<2	<1	<1
BH207	0.9-1.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH208	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH208	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH208	3.9-4.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH209	0.1-0.2	<25	<50	160	250	<25	<50	<25	<50	330	170	<0.5	<1	<2	<1	<1
BH209	0.9-1.35	<25	<50	370	910	<25	<50	<25	<50	990	1100	<0.5	<1	<2	<1	<1
BH209	1.9-2.35	<25	<50	<100	140	<25	<50	<25	<50	140	150	<0.5	<1	<2	<1	<1
BH209	3.9-4.35	<25	<50	<100	150	<25	<50	<25	<50	120	130	<0.5	<1	<2	<1	<1
BH210	0.1-0.2	<25	<50	260	570	<25	<50	<25	<50	680	580	<0.5	<1	<2	<1	<1
BH210	2.0-2.45	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH211	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH211	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH211	2.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH212	0.1-0.2	<25	<50	230	640	<25	<50	<25	<50	640	840	<0.5	<1	<2	<1	<1
BH212	2.9-3.35	<25	<50	100	250	<25	<50	<25	<50	280	160	<0.5	<1	<2	<1	<1
BH213	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH213	2.9-3.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH214	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH214	2.2-2.65	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH215	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH215	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH220	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	130	<100	<0.5	<1	<2	<1	<1
BH221	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH221	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH221	2.9-3.35	<25	<50	<100	<100	<25	<50	<25	<50	110	<100	<0.5	<1	<2	<1	<1
BH221	3.9-4.35	<25	<50	220	<100	<25	<50	<25	<50	270	<100	<0.5	<1	<2	<1	<1
BH222	0.1-0.2	<25	<50	400	590	<25	<50	<25	<50	890	340	<0.5	<1	<2	<1	<1
BH222	0.9-1.35	<25	<50	450	790	<25	<50	<25	<50	990	890	<0.5	<1	<2	<1	<1
BH223	2.0-2.45	<25	<50	<100	110	<25	<50	<25	<50	100	130	<0.5	<1	<2	<1	<1
JK103a	0.1-0.2	<25	<50	110	550	<25	<50	<25	<50	460	860	<0.5	<1	<2	<1	<1
JK103a	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK103a	2.9-3.35	<25	<50	460	360	<25	<50	<25	<50	720	240	<0.5	<1	<2	<1	<1
JK103a	5.9-6.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK107a	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK107a	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK107a	7.9-8.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK107a	8.9-9.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK118a	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK118a	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK118a	4.9-5.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
SS217	0.0-0.1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
SS219	0.0-0.1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BD1/070815	-	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BD2/080915	-	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BD3/090915	-	<25	<50	<100	<100	<25	<50	<25	<50	110	<100	<0.5	<1	<2	<1	<1
BD5/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD4/100915	-	<25	<50	<100	<100	<25	<50	<25	<50	110	<100	<0.5	<1	<2	<1	<1
BD6/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD7/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Laboratory PQL		25	50	100	100	25	50	25	50	100	100	0.2	0.5	1	1	1
NEPM HSL A [6] SAND		NC	NC			45/70/110/200 [1]	110/240/440/NL [1]	NC	NC	NC	NC	0.5/0.5/0.5/0.5 [1]	160/220/310/540 [1]	55/NL/NL/NL [1]	40/60/95/170 [1]	3/NL/NL/NL [1]
NEPM HSL A [6] SILT		NC	NC			40/65/100/190 [2]	230/NL/NL/NL [2]	NC	NC	NC	NC	0.6/0.7/1/2 [2]	390/NL/NL/NL [2]	NL/NL/NL/NL [2]	95/210/NL/NL [2]	4/NL/NL/NL [2]
NEPM HSL A [6] CLAY		NC	NC			50/90/150/290 [3]	280/NL/NL/NL [3]	NC	NC	NC	NC	0.7/1/2/3 [3]	480/NL/NL/NL [3]	NL/NL/NL/NL [3]	110/310/NL/NL [3]	5/NL/NL/NL [3]
CRC HSL for Intrusive Worker by Vapour Intrusion		NC	NC			NC	NC	NL	NL	NL	NL	77	NL	NL	NL	NL
CRC HSL A for Direct Contact - Resident		NC	NC			NC	NC	4400	3300	4500	6300	100	14000	4500	12000	1400
CRC HSL for Intrusive Worker by Direct Contact		NC	NC			NC	NC	82000	62000	85000	120000	1100	120000	85000	130000	29000
NEPM ESL Residential A,B,C [4, 7] - Coarse Soils		NC	NC			180 *	NC	NC	120 *	300	2800	50	85	70	105	170 [8]
NEPM ESL Residential A,B,C [4, 7] - Fine Soils		NC	NC			180 *	NC	NC	120 *	1300	5600	65	105	125	45	170 [8]
Management limits for TPH fractions in coarse soils - Residential A, B, C [5]		NC	NC			NC	NC	700	1000	2500	10000	NC	NC	NC	NC	NC
Management limits for TPH fractions in fine soils - Residential A, B, C [5]		NC	NC			NC	NC	800	1000	3500	10000	NC	NC	NC	NC	NC

Notes to Table:

All results in mg/kg on a dry weight basis

NC - No Criteria

PID - Photoionisation Detector

PQL - Practical Quantitation Limits

NL - Not Limiting

1- Soil HSLs for vapour intrusion (mg/kg) for SAND samples recovered from 0 m to <1 m / 1 m to <2 m / 2 m to <4 m / >=4 m

2- Soil HSLs for vapour intrusion (mg/kg) for SILT samples recovered from 0 m to <1 m / 1 m to <2 m / 2 m to <4 m / >=4 m

3- Soil HSLs for vapour intrusion (mg/kg) for CLAY samples recovered from 0 m to <1 m / 1 m to <2 m / 2 m to <4 m / >=4 m

4- ESLs are of low reliability except where indicated by * which indicates that the ESLs are of moderate reliability

5- Management limits are applied after consideration of relevant ESLs and HSLs

6- Multiplication factor may be applied (for depths >2m) subject to favourable biodegradation conditions - refer to 2.4.10 NEPC (2013)

7- ESLs apply from the surface to 2 m depth below finished surface/ground level

8- Ecological Investigation Level (EIL) - this value relates to fresh contamination.

exceeds NEPM HSL Health-Based Criteria for Residential with accessible soils Landuse

exceeds NEPM management limits for TRH fractions in coarse/fine soils - Residential Landuse

Underlined results exceed the NEPM ESL guideline values for Residential with accessible Soils Landuse

Bold results exceed the CRC CARE guideline values for HSL

BD1/070815 is the replicate sample of JK107a/1.9-2.35 m (Envirolab)

BD2/080915 is the replicate sample of BH213/2.9-3.35 m (Envirolab)

BD3/090915 is the replicate sample of BH212/2.9-3.35 m (Envirolab)

BD5/100915 is the replicate sample of BH207/0.9-1.35 m (Envirolab)

BD4/100915 is the replicate sample of BH201/0.9-1.35 m (ALS)

BD6/100915 is the replicate sample of BH206/0.9-1.35 m (ALS)

BD7/100915 is the replicate sample of BH208/3.9-4.35 m (ALS)

Douglas Partners
Geotechnics | Environment | Groundwater

Table 3: Summary Results for PAH, OCP, OPP, PCB, Phenols and Cyanide

Test Location ID	Depth (m)	Total PAH	Naphthalene	B(a)P	B(a)P TEQ	Total OCP	Aldrin + Dieldrin	Chlordane	DDT+DDE+ DDD	Endosulfan	Endrin	Heptachlor	HCB	Methoxychlor	Total OPP	Chlorpyrifos	PCB [3]	Total Phenols	Total Cyanide
BH/MW216	0.1-0.2	2.6	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH/MW216	3.9-4.35	0.53	<0.1	0.07	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH/MW216	5.9-6.35	0.47	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH/MW218	0.9-1.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH/MW218	2.9-2.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	0.6
BH/MW218	5.9-6.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH201	0.1-0.2	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	0.6
BH201	0.9-1.35	0.28	<0.1	0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH202	0.9-1.35	4.5	<0.1	0.4	0.6	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH202	1.9-2.35	1.8	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH203	0.1-0.2	1.6	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH203	0.9-1.35	1.2	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH203	2.9-3.35	17	<0.1	1.5	2.1	0.3	0.3	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH204	0.1-0.2	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH204	1.9-2.35	0.51	<0.1	0.08	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<1	<5	<0.5
BH204	3.9-4.35	1.9	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<1	<5	<0.5
BH205	0.9-1.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH205	2.9-3.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH205	3.9-4.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH206	0.1-0.2	17	<0.1	1.1	1.7	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH206	0.9-1.35	<1.45	<0.1	<0.05	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH206	2.35-2.9	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH206	4.35-4.9	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	0.5
BH207	0.1-0.2	250	0.4	20	29	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	0.6	<0.1	<0.7	<5	<0.5
BH207	0.9-1.35	<1.45	<0.1	<0.05	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH208	1.9-2.35	8.5	<0.1	0.65	1	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH208	0.9-1.35	1.9	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH208	3.9-4.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH209	0.1-0.2	13	<0.1	1.1	1.7	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH209	0.9-1.35	110	<0.1	9.5	14	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH209	1.9-2.35	10	<0.1	0.86	1.3	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	4.4
BH209	3.9-4.35	0.76	<0.1	0.1	<0.5	0.2	0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH210	0.1-0.2	28	<0.1	2.8	4.2	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH210	2.0-2.45	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH211	0.1-0.2	0.59	<0.1	0.07	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH211	0.9-1.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH211	2.9-2.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH212	0.1-0.2	7	<0.1	0.4	0.7	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH212	2.9-3.35	3.9	<0.1	0.4	0.7	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	0.5
BH213	0.1-0.2	3.6	<0.1	0.3	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH213	2.9-3.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH214	0.1-0.2	2.5	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH214	2.2-2.65	0.3	<0.1	0.06	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH215	0.9-1.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH215	1.9-2.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH220	0.1-0.2	0.43	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	3.7	<5	<0.5
BH221	0.1-0.2	0.36	<0.1	0.09	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH221	1.9-2.35	0.54	<0.1	0.09	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH221	2.9-3.35	2.9	<0.1	0.3	<0.5	0.1	0.1	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH221	3.9-4.35	0.49	<0.1	0.06	<0.5	0.3	<0.2	<0.2	0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH222	0.1-0.2	2.1	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH222	0.9-1.35	46	2.5	3.6	5.4	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH223	2.0-2.45	6.9	<0.1	0.51	0.8	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK103a	0.1-0.2	5	<0.1	0.56	1	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK103a	1.9-2.35	0.38	<0.1	0.08	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK103a	2.9-3.35	150	0.6	13	17	1	<0.2	<0.2	0.7	0.1	0.2	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK103a	5.9-6.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK107a	0.1-0.2	2.8	<0.1	0.3	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK107a	1.9-2.35	0.33	<0.1	0.07	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK107a	7.9-8.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK107a	8.9-9.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK118a	0.1-0.2	1.9	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK118a	1.9-2.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK118a	4.9-5.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
SS217	0.0-0.1	1.3	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	-
SS219	0.0-0.1	3.4	<0.1	0.3	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	-
BD1/070815	-	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BD2/080915	-	7.5	<0.1	0.77	1.2	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BD3/090915	-	3.3	<0.1	0.4	0.6	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BD5/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD4/100915	-	<0.5	<0.1	<0.05	1.2	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.1	<5	<0.5
BD6/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD7/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Laboratory PQL		0.05/0.2	1	0.05	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	5	0.5
NEPM HIL A [1]		300	NC	NC	3	NC	6	50	240	270	10	6	10	300	NC	160	1	3000 [4]	250
NEPM EIL Residential A,B,C [2]		NC	170	NC	NC	NC	NC	NC	180 [5]	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
NEPM ESL Residential A,B,C [2] - Fine and Coarse Soils		NC	NC	0.7	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

Notes to Table:

All results in mg/kg on a dry weight basis

NC - No Criteria

NT - Not Tested

PQL - Practical Quantitation Limits

TEQ - Toxicity Equivalent Quotient

Total PAH - Sum of positive and PQL values

1 - Health Based Criteria for Residential with Accessible Soils Land Use

2- ESLs apply from the surface to 2 m depth below finished surface/ground level

3- PCB HILs relates to non-dioxin-like PCB only

4- Criterion based on phenol

5- Criterion is for DDT only

exceeds NEPM Health-Based Criteria for Residential with Accessible Soils Landuse

Underline results exceed NEPM EIL or ESL

BD1/070815 is the replicate sample of JK107a/1.9-2.35 m (Envirolab)

BD2/080915 is the replicate sample of BH213/2.9-3.35 m (Envirolab)

BD3/090915 is the replicate sample of BH212/2.9-3.35 m (Envirolab)

BD5/100915 is the replicate sample of BH207/0.9-1.35 m (Envirolab)

BD4/100915 is the replicate sample of BH201/0.9-1.35 m (ALS)

BD6/100915 is the replicate sample of BH206/0.9-1.35 m (ALS)

BD7/100915 is the replicate sample of BH208/3.9-4.35 m (ALS)

Douglas Partners
Geotechnics / Environment / Groundwater

Table 4: Summary Results for TCLP Metals and PAH

Test Location ID	Depth (m)	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn	Total PAH
JK103a	2.9-3.35	-	-	-	-	-	-	-	-	0.029
BH221	2.9-3.35	<0.05	<0.01	<0.01	<0.01	0.2	<0.0005	<0.02	1.1	-
BH222	0.9-1.35	-	-	-	-	-	-	-	-	<0.016
BH209	0.9-1.35	-	-	-	-	-	-	-	-	<0.016
BH203	2.9-3.35	<0.05	0.01	<0.01	0.04	1	<0.0005	<0.02	1.8	-
BH207	0.1-0.2	-	-	-	-	-	-	-	-	<0.016

Notes to Table:

All results in mg/L

Appendix C

Summary of Non-Methane Organic Compound Results

							BTEX				MAH				Chlorinated Hydrocarbons																							Halo
				Freon 113	2-Propanol	Propene	1,2-Dichlorotetrafluoroethane	Benzene	Ethylbenzene	Toluene	Xylene (m & p)	Xylene (o)	1,2,4-trimethylbenzene	1,3,5-trimethylbenzene	1-methyl-4 ethyl benzene	Styrene	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane	1,1-dichloroethane	1,1-dichloroethene	1,2-dichloroethane	1,2-dichloropropane	Benzyl chloride	Bromodichloromethane	Bromoform	Carbon tetrachloride	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-dichloroethene	cis-1,3-dichloropropene	Hexachlorobutadiene	Trichloroethene	Tetrachloroethene	trans-1,2-dichloroethene	trans-1,3-dichloropropene	Vinyl chloride	1,2-dibromoethane
				µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	ug/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3
PQL				**3.8**	**1**	**0.9**	**2.5**	**1.6**	**2**	**1.9**	**4**	**2**	**2.5**	**2.5**	**2.5**	**2**	**2.7**	**3**	**2.7**	**2**	**2**	**2**	**2**	**2.6**	**3**	**5**	**3**	**1.6**	**1**	**2**	**1**	**2**	**2**	**5**	**2.7**	**3**	**2**	**2**	**1**	**3.8**
NEPM 2013 Table 1A(2) Res A Soil Vap VOCC HILs																	60000														80			20	2000			30	
NEPM 2013 Table 1A(5) Res Soil Vapour HSL A/B for Vapour Intrusion, Sand																																							
0-1m								1000	330000	1300000																														
Field_ID	**LocCode**	**WellCode**	**Sampled_Date-Time**																																					
BH/MW216	BH/MW216		27/10/2015	<3.8	<1	<0.9	<2.5	**5**	**7**	**9**	**10**	**4**	**5**	<2.5	<2.5	**10**	<2.7	<3	<2.7	<2	<2	<2	<2	<2.6	<3	<5	<3	<1.6	**3**	<2	<1	**6**	<2	<5	**5**	<3	<2	<2	<1	<3.8
BD1	BH/MW216		27/10/2015	<3.8	<1	<0.9	<2.5	**6**	**7**	**8**	**9**	**3**	**5**	<2.5	<2.5	**10**	<2.7	<3	<2.7	<2	<2	<2	<2	<2.6	<3	<5	<3	<1.6	**4**	<2	<1	**7**	<2	<5	<2.7	<3	<2	<2	<1	<3.8
JK101	JK101		27/10/2015	<3.8	<1	<0.9	<2.5	**4**	**5**	**9**	**10**	**4**	**6**	<2.5	<2.5	<2	<2.7	<3	<2.7	<2	<2	<2	<2	<2.6	<3	<5	<3	<1.6	<1	<2	<1	<2	<2	<5	<2.7	<3	<2	<2	<1	<3.8
JK107B	JK107B		27/10/2015	<3.8	<1	<0.9	<2.5	**8**	**6**	**8**	**10**	**4**	**5**	<2.5	<2.5	**43**	<2.7	<3	<2.7	<2	<2	<2	<2	<2.6	<3	<5	<3	<1.6	**4**	<2	<1	<2	<2	<5	<2.7	<3	<2	<2	<1	<3.8

				genated Hydrocarbons			Halogenated Benzenes					VOCs			Solvents														PAH/Phenols
				Bromomethane	Dichlorodifluoromethane	Trichlorofluoromethane	1,2,4-trichlorobenzene	1,2-dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	Chlorobenzene	1,3-Butadiene	Acrolein	Methyl Methacrylate	1,4-Dioxane	Methyl Ethyl Ketone	2-hexanone (MBK)	4-Methyl-2-pentanone	Carbon disulfide	Cyclohexane	Ethanol	Ethyl acetate	Heptane	Hexane	MTBE	Tetrahydrofuran	Vinyl acetate	Naphthalene
				µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	ug/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3
PQL				**1.9**	**2.5**	**2.8**	**3.7**	**3**	**3**	**3**	**2**	**1**	**1**	**2**	**1.8**	**1.5**	**2**	**2**	**1.6**	**1.7**	**0.9**	**1.8**	**2**	**1.8**	**1.8**	**1.5**	**1.8**	**2.6**
NEPM 2013 Table 1A(2) Res A Soil Vap VOCC HILs																											
NEPM 2013 Table 1A(5) Res Soil Vapour HSL A/B for Vapour Intrusion, Sa																											
0-1m																											800
Field_ID	**LocCode**	**WellCode**	**Sampled_Date-Time**																								
BH/MW216	BH/MW216		27/10/2015	<1.9	**210**	<2.8	<3.7	<3	<3	<3	<2	<1	<1	<2	<1.8	<1.5	<2	<2	<1.6	**88**	**18**	<1.8	**4**	**47**	<1.8	<1.5	<1.8	**7**
BD1	BH/MW216		27/10/2015	<1.9	**230**	<2.8	<3.7	<3	<3	<3	<2	<1	<1	<2	<1.8	<1.5	<2	<2	<1.6	**98**	**19**	<1.8	**5**	**53**	<1.8	<1.5	<1.8	**4**
JK101	JK101		27/10/2015	<1.9	**20**	<2.8	<3.7	<3	<3	<3	<2	<1	<1	<2	<1.8	<1.5	<2	<2	**6**	**110**	**22**	<1.8	**30**	**100**	<1.8	<1.5	<1.8	**10**
JK107B	JK107B		27/10/2015	<1.9	**120**	<2.8	<3.7	<3	<3	<3	<2	<1	<1	<2	<1.8	<1.5	<2	<2	**2**	**130**	**17**	<1.8	**10**	**38**	<1.8	<1.5	<1.8	**10**

Appendix D

Summary of Groundwater and Surface Water Results

			Inorganics						Metals													
			Ammonia (as N)	Chloride	Nitrate (as N)	Nitrite (as N)	Nitrogen (Total Oxidised)	Sulphate	Arsenic (Filtered)	Cadmium (Filtered)	Chromium (III+VI) (Filtered)	Copper (Filtered)	Lead (Filtered)	Manganese (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Phosphorus	Zinc (Filtered)	C10-C16	C16-C34	C34-C40
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.005	1	0.005	0.005		1	0.001	0.0001	0.001	0.001	0.001	0.001	0.00005	0.001	0.01	0.001	0.05	0.1	0.1
ANZECC 2000, Marine Waters, 95% of Species			0.91							0.0007		0.0013	0.0044		0.0001	0.007		0.015			
ANZECC 2000 LOW RELIABILITY MW									0.0045					0.08							
ANZECC 2000 Fresh Waters GILs for 95% of Species			0.9		0.161					0.0002	0.0274	0.0014	0.0034	1.9	0.00006	0.011		0.008			
ANZECC 2000 LOW RELIABILITY FRESH WATER																					
ADWG 2011 Aesthetic			0.5					250				1		0.1				3			
ADWG 2011 Drinking Water					11.5	0.9		500	0.01	0.002		2	0.01	0.5	0.001	0.02					
ANZECC 2000 Recreational water quality and aesthetics			0.1	400	10	1		400	0.05	0.005	0.05	1	0.05	0.1	0.001	0.1		5			
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																					
2-4m																					
4-8m																					
>8m																					
Field_ID	**LocCode**	**Sampled_Date-Time**																			
BH/MW216	BH/MW216	1-Oct-15	20	2200	<0.005	<0.005	-	91	0.002	<0.0001	0.001	0.001	0.001	1.4	<0.00005	0.009	0.7	0.06	<0.05	<0.1	<0.1
BH/MW218	BH/MW218	1-Oct-15	30	2300	<0.25	<0.25	-	410	0.011	<0.0001	0.19	0.017	0.007	0.65	<0.00005	0.16	0.3	0.084	<0.05	<0.1	<0.1
JKBH/MW1	JKBH/MW1	2-Oct-15	3.2	750	0.01	<0.005	-	1100	0.001	0.0001	<0.001	0.005	<0.001	0.95	<0.00005	0.03	<0.05	0.097	<0.05	<0.1	<0.1
BD1/021015	BD1/021015	2-Oct-15	2.56	-	0.03	<0.01	0.03	-	0.003	<0.0001	<0.001	<0.001	<0.001	0.985	<0.0001	0.046	3.58	0.245	<0.1	<0.1	<0.1
JKBH/MW107A	JKBH/MW107A	1-Oct-15	10	700	0.006	<0.005	-	75	0.003	<0.0001	<0.001	0.007	<0.001	0.42	<0.00005	0.012	<0.05	0.079	<0.05	<0.1	<0.1
JKBH/MW16	JKBH/MW16	1-Oct-15	4.9	3400	0.02	<0.005	-	1700	<0.001	0.0001	<0.001	0.004	<0.001	4.4	<0.00005	0.02	<0.05	0.82	<0.05	<0.1	<0.1
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.005	<0.00005	<0.001	-	<0.001	<0.05	<0.1	<0.1
SW1	SW1	1-Oct-15	0.025	6900	0.29	0.006	-	890	<0.001	<0.0001	<0.001	0.002	<0.001	0.012	<0.00005	0.001	<0.05	0.006	<0.05	<0.1	<0.1
SW2	SW2	1-Oct-15	8.4	2700	0.11	0.08	-	590	0.002	<0.0001	<0.001	<0.001	<0.001	0.42	<0.00005	0.005	<0.05	0.005	<0.05	<0.1	<0.1
BD2/011015	SW2	1-Oct-15	8.2	-	0.16	0.083	-	-	0.002	<0.0001	<0.001	<0.001	<0.001	0.4	<0.00005	0.005	<0.05	0.005	<0.05	<0.1	<0.1
SW3	SW3	2-Oct-15	0.017	91	0.02	<0.005	-	12	<0.001	<0.0001	<0.001	<0.001	<0.001	0.1	<0.00005	0.002	<0.05	0.018	<0.05	<0.1	<0.1

			TRH								BTEX								
			F2-NAPHTHALENE	C6 - C9	C10 - C14	C15 - C28	C29-C36	+C10 - C36 (Sum of total)	C10 - C40 (Sum of total)	C6-C10 less BTEX (F1)	C6-C10	Benzene	Ethylbenzene	Toluene	Total BTEX	Xylene (m & p)	Xylene (o)	Xylene Total	1,2,4-trimethylbenzene	1,3,5-trimethylbenzene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.05	0.01	0.05	0.1	0.05			0.01	0.01	0.001	0.001	0.001		0.002	0.001		0.001	0.001
ANZECC 2000, Marine Waters, 95% of Species												0.5								
ANZECC 2000 LOW RELIABILITY MW													0.005	0.18				0.625		
ANZECC 2000 Fresh Waters GILs for 95% of Species												0.95					0.35			
ANZECC 2000 LOW RELIABILITY FRESH WATER																				
ADWG 2011 Aesthetic													0.003	0.025				0.02		
ADWG 2011 Drinking Water												0.001	0.3	0.8				0.6		
ANZECC 2000 Recreational water quality and aesthetics												0.01								
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																				
2-4m			1							1		0.8	NL	NL				NL		
4-8m			1							1		0.8	NL	NL				NL		
>8m			1							1		0.9	NL	NL				NL		
Field_ID	**LocCode**	**Sampled_Date-Time**																		
BH/MW216	BH/MW216	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
BH/MW218	BH/MW218	1-Oct-15	<0.05	<0.1	<0.05	<0.1	<0.1	-	-	<0.01	<0.1	<0.01	<0.01	<0.01	-	<0.02	<0.01	-	<0.01	<0.01
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
BD1/021015	BD1/021015	2-Oct-15	<0.1	<0.02	<0.05	<0.1	<0.05	<0.05	<0.1	<0.02	<0.02	<0.001	<0.002	<0.002	<0.001	<0.002	<0.002	<0.002	-	-
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
R1/021015	R1/021015	2-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	-	-
SW1	SW1	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
SW2	SW2	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
BD2/011015	SW2	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
SW3	SW3	2-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001

			MAH																	
			Isopropylbenzene	n-butylbenzene	n-propylbenzene	p-isopropyltoluene	sec-butylbenzene	Styrene	tert-butylbenzene	1,1,1,2-tetrachloroethane	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane	1,1-dichloroethane	1,1-dichloroethene	1,1-dichloropropene	1,2,3-trichloropropane	1,2-dibromo-3-chloropropane	1,2-dichloroethane	1,2-dichloropropane
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
ANZECC 2000, Marine Waters, 95% of Species													1.9							
ANZECC 2000 LOW RELIABILITY MW															0.7					
ANZECC 2000 Fresh Waters GILs for 95% of Species													6.5							
ANZECC 2000 LOW RELIABILITY FRESH WATER											0.27	0.4	1.9						1.9	0.9
ADWG 2011 Aesthetic								0.004												
ADWG 2011 Drinking Water								0.03							0.03				0.003	
ANZECC 2000 Recreational water quality and aesthetics															0.0003				0.01	
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																				
2-4m																				
4-8m																				
>8m																				
Field_ID	**LocCode**	**Sampled_Date-Time**																		
BH/MW216	BH/MW216	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BH/MW218	BH/MW218	1-Oct-15	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BD1/021015	BD1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW1	SW1	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SW2	SW2	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BD2/011015	SW2	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SW3	SW3	2-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

			Chlorinated Hydrocarbons																	
			1,3-dichloropropane	2,2-dichloropropane	Bromochloromethane	Bromodichloromethane	Bromoform	Carbon tetrachloride	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-dichloroethene	cis-1,3-dichloropropene	Dibromomethane	Hexachlorobutadiene	Trichloroethene	Tetrachloroethene	trans-1,2-dichloroethene	trans-1,3-dichloropropene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.01	0.001	0.01	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
ANZECC 2000, Marine Waters, 95% of Species																				
ANZECC 2000 LOW RELIABILITY MW																				
ANZECC 2000 Fresh Waters GILs for 95% of Species																				
ANZECC 2000 LOW RELIABILITY FRESH WATER			1.1					0.24			0.37			0.0008			0.33	0.07		0.0008
ADWG 2011 Aesthetic																				
ADWG 2011 Drinking Water																0.0007		0.05		
ANZECC 2000 Recreational water quality and aesthetics								0.003									0.03	0.01		
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																				
2-4m																				
4-8m																				
>8m																				
Field_ID	**LocCode**	**Sampled_Date-Time**																		
BH/MW216	BH/MW216	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BH/MW218	BH/MW218	1-Oct-15	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BD1/021015	BD1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW1	SW1	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SW2	SW2	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BD2/011015	SW2	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SW3	SW3	2-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

			Halogenated Hydrocarbons				Halogenated Benzenes										Solvents	PA
			Vinyl chloride	1,2-dibromoethane	Bromomethane	Dichlorodifluoromethane	Trichlorofluoromethane	1,2,3-trichlorobenzene	1,2,4-trichlorobenzene	1,2-dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	2-chlorotoluene	4-chlorotoluene	Bromobenzene	Chlorobenzene	Hexachlorobenzene	Cyclohexane	7,12-dimethylbenz(a)anthracene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.01	0.001	0.01	0.01	0.01	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000001	0.001	
ANZECC 2000, Marine Waters, 95% of Species									0.02										
ANZECC 2000 LOW RELIABILITY MW			0.1																
ANZECC 2000 Fresh Waters GILs for 95% of Species								0.003	0.085	0.16	0.26	0.06							
ANZECC 2000 LOW RELIABILITY FRESH WATER								0.003		0.16	0.26	0.06							
ADWG 2011 Aesthetic										0.001	0.02	0.0003							
ADWG 2011 Drinking Water			0.0003	0.001	0.001					1.5		0.04							
ANZECC 2000 Recreational water quality and aesthetics																			
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																			
2-4m																			
4-8m																			
>8m																			
Field_ID	**LocCode**	**Sampled_Date-Time**																	
BH/MW216	BH/MW216	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
BH/MW218	BH/MW218	1-Oct-15	<0.1	<0.01	<0.1	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.000001	<0.01	-
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
BD1/021015	BD1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.00001	-	<0.0001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.000001	-	-
SW1	SW1	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
SW2	SW2	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
BD2/011015	SW2	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
SW3	SW3	2-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-

	AH	PAH/Phenols														
	Benzo[b+j]fluoranthene	2,4-dimethylphenol	2-methylnaphthalene	2-methylphenol	2-nitrophenol	3-&4-methylphenol	3-methylcholanthrene	4-chloro-3-methylphenol	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(b)&(k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL									0.0001	0.0001	0.0001	0.0001	0.00005	0.0002	0.0001	
ANZECC 2000, Marine Waters, 95% of Species																
ANZECC 2000 LOW RELIABILITY MW											0.00001		0.0002			
ANZECC 2000 Fresh Waters GILs for 95% of Species																
ANZECC 2000 LOW RELIABILITY FRESH WATER																
ADWG 2011 Aesthetic																
ADWG 2011 Drinking Water																
ANZECC 2000 Recreational water quality and aesthetics													0.00001			
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																
2-4m																
4-8m																
>8m																

Field_ID	LocCode	Sampled_Date-Time															
BH/MW216	BH/MW216	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
BH/MW218	BH/MW218	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
JKBH/MW1	JKBH/MW1	2-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
BD1/021015	BD1/021015	2-Oct-15	<0.0001	<0.001	<0.0001	<0.001	<0.001	<0.002	<0.0001	<0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00005	-	<0.0001	<0.0001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
JKBH/MW16	JKBH/MW16	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
SW1	SW1	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
SW2	SW2	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
BD2/011015	SW2	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
SW3	SW3	2-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-

													Halogenated Phenols					
			Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	PAHs (Sum of total)	Phenanthrene	Phenol	Phenolics Total	Pyrene	2,4,5-trichlorophenol	2,4,6-trichlorophenol	2,4-dichlorophenol	2,6-dichlorophenol	2-chlorophenol	Pentachlorophenol
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.0001	0.0001	0.0001	0.0001	0.0001	0.0001		0.0001		0.05	0.0001						
ANZECC 2000, Marine Waters, 95% of Species								0.05			0.4								0.011
ANZECC 2000 LOW RELIABILITY MW					0.0014					0.002									
ANZECC 2000 Fresh Waters GILs for 95% of Species								0.016			0.32				0.003	0.12		0.34	0.0036
ANZECC 2000 LOW RELIABILITY FRESH WATER																			
ADWG 2011 Aesthetic															0.002	0.0003		0.0001	
ADWG 2011 Drinking Water									0.00001						0.02	0.2		0.3	0.01
ANZECC 2000 Recreational water quality and aesthetics														0.001	0.01				0.01
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																			
2-4m								NL											
4-8m								NL											
>8m								NL											
Field_ID	**LocCode**	**Sampled_Date-Time**																	
BH/MW216	BH/MW216	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
BH/MW218	BH/MW218	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
BD1/021015	BD1/021015	2-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00005	<0.0001	<0.001	-	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
R1/021015	R1/021015	2-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
SW1	SW1	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
SW2	SW2	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
BD2/011015	SW2	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
SW3	SW3	2-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-

			Polychlorinated Biphenyls								SVOCs				
			Arochlor 1016	Arochlor 1221	Arochlor 1232	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	PCBs (Sum of total)	Benzo(e)pyrene	Coronene	EPN	Perylene	4,4-DDE
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001					0.000001
ANZECC 2000, Marine Waters, 95% of Species															
ANZECC 2000 LOW RELIABILITY MW															
ANZECC 2000 Fresh Waters GILs for 95% of Species						0.0003		0.00001							
ANZECC 2000 LOW RELIABILITY FRESH WATER			0.000009	0.001	0.0003	0.0006	0.00003	0.00003	0.025						
ADWG 2011 Aesthetic															
ADWG 2011 Drinking Water															
ANZECC 2000 Recreational water quality and aesthetics															
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand															
2-4m															
4-8m															
>8m															
Field_ID	**LocCode**	**Sampled_Date-Time**													
BH/MW216	BH/MW216	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
BH/MW218	BH/MW218	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
BD1/021015	BD1/021015	2-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00005	<0.0001	<0.00001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
R1/021015	R1/021015	2-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
SW1	SW1	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
SW2	SW2	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
BD2/011015	SW2	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
SW3	SW3	2-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001

														Organochlorine Pesticide
			a-BHC	Aldrin	b-BHC	chlordane	Chlordane (cis)	Chlordane (trans)	d-BHC	DDD	DDT	DDT+DDE+DDD	Dieldrin	Endosulfan
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.000001	0.000001	0.000001		0.000001	0.000001	0.000001	0.000001	0.000001		0.000001	
ANZECC 2000, Marine Waters, 95% of Species														0.000005
ANZECC 2000 LOW RELIABILITY MW				0.000003			0.000001	0.000001			0.0000004	0.0000005	0.00001	
ANZECC 2000 Fresh Waters GILs for 95% of Species						0.00003					0.000006			0.00003
ANZECC 2000 LOW RELIABILITY FRESH WATER														
ADWG 2011 Aesthetic														
ADWG 2011 Drinking Water											0.009			0.02
ANZECC 2000 Recreational water quality and aesthetics				0.001		0.006					0.003		0.001	0.04
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand														
2-4m														
4-8m														
>8m														
Field_ID	**LocCode**	**Sampled_Date-Time**												
BH/MW216	BH/MW216	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000008	-
BH/MW218	BH/MW218	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000076	-
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000001	-
BD1/021015	BD1/021015	2-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000003	-
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000003	-
R1/021015	R1/021015	2-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	<0.000001	-
SW1	SW1	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000001	-
SW2	SW2	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000004	-
BD2/011015	SW2	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000004	-
SW3	SW3	2-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	<0.000001	-

	s											
	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	Endrin ketone	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Methoxychlor	Oxychlordane	Azinophos methyl
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.00001
ANZECC 2000, Marine Waters, 95% of Species				0.000004								
ANZECC 2000 LOW RELIABILITY MW	0.000005	0.000005						0.0000004		0.000004		
ANZECC 2000 Fresh Waters GILs for 95% of Species				0.00001			0.0002	0.00001				
ANZECC 2000 LOW RELIABILITY FRESH WATER												
ADWG 2011 Aesthetic												
ADWG 2011 Drinking Water							0.01	0.0003		0.3		0.03
ANZECC 2000 Recreational water quality and aesthetics				0.001			0.01	0.003				0.01
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand												
2-4m												
4-8m												
>8m												
Field_ID	**LocCode**	**Sampled_Date-Time**										
BH/MW216	BH/MW216	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
BH/MW218	BH/MW218	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
BD1/021015	BD1/021015	2-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.000005	<0.00001	<0.00001	<0.00001	<0.00002
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
R1/021015	R1/021015	2-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
SW1	SW1	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
SW2	SW2	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
BD2/011015	SW2	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
SW3	SW3	2-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001

			Bolstar (Sulprofos)	Bromophos-ethyl	Carbophenothion	Azinphos Ethyl	Chlorfenvinphos	Chlorfenvinphos E	Chlorfenvinphos Z	Chlorpyrifos	Chlorpyrifos-methyl	Coumaphos	Demeton-O	Demeton-S	Diazinon	Dichlorvos
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL						0.00001		0.00001	0.00001	0.00001	0.00001				0.00001	0.00001
ANZECC 2000, Marine Waters, 95% of Species										0.000009						
ANZECC 2000 LOW RELIABILITY MW																
ANZECC 2000 Fresh Waters GILs for 95% of Species										0.00001					0.00001	
ANZECC 2000 LOW RELIABILITY FRESH WATER																
ADWG 2011 Aesthetic																
ADWG 2011 Drinking Water			0.01	0.01						0.01					0.004	0.005
ANZECC 2000 Recreational water quality and aesthetics			0.02	0.02	0.001		0.01			0.002					0.01	0.02
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																
2-4m																
4-8m																
>8m																
Field_ID	**LocCode**	**Sampled_Date-Time**														
BH/MW216	BH/MW216	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
BH/MW218	BH/MW218	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
JKBH/MW1	JKBH/MW1	2-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
BD1/021015	BD1/021015	2-Oct-15	<0.00005	<0.0001	<0.00002	<0.00002	<0.00002	-	-	<0.00002	<0.0002	<0.00001	<0.00002	<0.00002	<0.00001	<0.0002
JKBH/MW107A	JKBH/MW107A	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
JKBH/MW16	JKBH/MW16	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
R1/021015	R1/021015	2-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
SW1	SW1	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
SW2	SW2	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
BD2/011015	SW2	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
SW3	SW3	2-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001

			Organophosphorous Pesticides												
			Dimethoate	Disulfoton	Ethion	Ethoprop	Fenitrothion	Fensulfothion	Fenthion	Malathion	Methidathion	Methyl parathion	Mevinphos (Phosdrin)	Monocrotophos	Omethoate	Phorate
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.00001		0.00001		0.00001		0.00001	0.00001		0.00001				
ANZECC 2000, Marine Waters, 95% of Species																
ANZECC 2000 LOW RELIABILITY MW																
ANZECC 2000 Fresh Waters GILs for 95% of Species			0.00015				0.0002			0.00005						
ANZECC 2000 LOW RELIABILITY FRESH WATER																
ADWG 2011 Aesthetic																
ADWG 2011 Drinking Water			0.007	0.004	0.004	0.001	0.007	0.01	0.007	0.07	0.006	0.0007	0.005	0.002	0.001	
ANZECC 2000 Recreational water quality and aesthetics			0.1	0.006	0.006	0.001	0.02	0.02		0.1	0.06	0.006	0.006	0.002	0.0004	
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																
2-4m																
4-8m																
>8m																
Field_ID	**LocCode**	**Sampled_Date-Time**														
BH/MW216	BH/MW216	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
BH/MW218	BH/MW218	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
BD1/021015	BD1/021015	2-Oct-15	<0.00002	<0.00005	<0.00002	<0.00001	<0.002	<0.00001	<0.00005	<0.00002	<0.0001	<0.0005	<0.00002	<0.00002	<0.00001	<0.0001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
R1/021015	R1/021015	2-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
SW1	SW1	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
SW2	SW2	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
BD2/011015	SW2	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
SW3	SW3	2-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-

																	Pesticides
			Prothiofos	Pyrazophos	Ronnel	Terbufos	Thiometon	Trichloronate	Tetrachlorvinphos	Acephate	Demeton-S-methyl	Fenamiphos	Formothion	Parathion	Pirimiphos-methyl	Pirimphos-ethyl	Profenofos
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL											0.00001			0.00001	0.00001	0.00001	
ANZECC 2000, Marine Waters, 95% of Species																	
ANZECC 2000 LOW RELIABILITY MW																	
ANZECC 2000 Fresh Waters GILs for 95% of Species														0.000004			
ANZECC 2000 LOW RELIABILITY FRESH WATER																	
ADWG 2011 Aesthetic																	
ADWG 2011 Drinking Water				0.02		0.0009	0.004		0.1	0.008		0.0005	0.05	0.02	0.09	0.0005	0.0003
ANZECC 2000 Recreational water quality and aesthetics				1	0.06		0.02			0.02			0.1	0.03	0.06	0.001	0.0006
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																	
2-4m																	
4-8m																	
>8m																	
Field_ID	**LocCode**	**Sampled_Date-Time**															
BH/MW216	BH/MW216	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
BH/MW218	BH/MW218	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
JKBH/MW1	JKBH/MW1	2-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
BD1/021015	BD1/021015	2-Oct-15	<0.0001	<0.0001	<0.01	<0.00001	<0.0005	<0.0005	<0.00001	<0.0005	<0.00002	<0.00001	<0.02	<0.0002	<0.00001	<0.00001	<0.00001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
JKBH/MW16	JKBH/MW16	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
SW1	SW1	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
SW2	SW2	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
BD2/011015	SW2	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
SW3	SW3	2-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-

								Fungicides	Other
		Sulfotepp	Temephos	Trichlorfon	Bensulide	Demeton-O & Demeton-S	Naftalofos	Fosetyl-al	Triazophos
		mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	mg/L	mg/L
PQL									
ANZECC 2000, Marine Waters, 95% of Species			0.00005						
ANZECC 2000 LOW RELIABILITY MW									
ANZECC 2000 Fresh Waters GILs for 95% of Species									
ANZECC 2000 LOW RELIABILITY FRESH WATER									
ADWG 2011 Aesthetic									
ADWG 2011 Drinking Water			0.4	0.007					
ANZECC 2000 Recreational water quality and aesthetics			0.03	0.01					
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand									
2-4m									
4-8m									
>8m									
Field_ID	**LocCode**	**Sampled_Date-Time**							
BH/MW216	BH/MW216	1-Oct-15	-	-	-	-	-	-	-	-
BH/MW218	BH/MW218	1-Oct-15	-	-	-	-	-	-	-	-
JKBH/MW1	JKBH/MW1	2-Oct-15	-	-	-	-	-	-	-	-
BD1/021015	BD1/021015	2-Oct-15	<0.000005	<0.00002	<0.00002	<0.1	<0.02	<1	<0.01	<0.000005
JKBH/MW107A	JKBH/MW107A	1-Oct-15	-	-	-	-	-	-	-	-
JKBH/MW16	JKBH/MW16	1-Oct-15	-	-	-	-	-	-	-	-
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-
SW1	SW1	1-Oct-15	-	-	-	-	-	-	-	-
SW2	SW2	1-Oct-15	-	-	-	-	-	-	-	-
BD2/011015	SW2	1-Oct-15	-	-	-	-	-	-	-	-
SW3	SW3	2-Oct-15	-	-	-	-	-	-	-	-

Appendix E

Borehole Logs

Notes and Descriptive Terms

Sampling Methods

Douglas Partners

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Soil Descriptions

Douglas Partners

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 1993. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index $Is_{(50)}$ MPa	Approx Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	M	0.3 - 1.0	6 - 20
High	H	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and loner sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq \text{100 mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Symbols & Abbreviations

Douglas Partners

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core Drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete


Filling

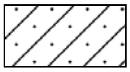
Soils


Topsoil

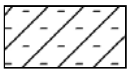

Peat


Clay

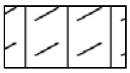

Silty clay

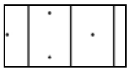

Sandy clay

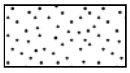

Gravelly clay

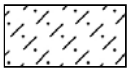

Shaly clay

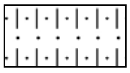

Silt


Clayey silt

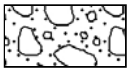

Sandy silt


Sand


Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

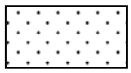

Talus

Sedimentary Rocks

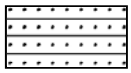

Boulder conglomerate

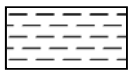

Conglomerate


Conglomeratic sandstone

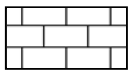

Sandstone


Siltstone


Laminite

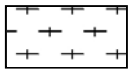

Mudstone, claystone, shale

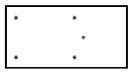

Coal


Limestone

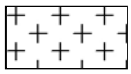
Metamorphic Rocks

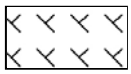

Slate, phyllite, schist

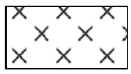

Gneiss

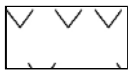

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 6.7 AHD
EASTING: 311924
NORTHING: 6243802
DIP/AZIMUTH: 90°/--

BORE No: BH201
PROJECT No: 71459.03
DATE: 10/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	FILLING - light brown, fine to medium sand filling with some silt and fine to coarse gravel, crushed glass and sandstone fragments		A	0.1 0.2		PID<5		
	0.4 0.5	FILLING - light brown, fine to medium sand filling with some small silty clay clumps, fine gravel and crushed glass			0.9				
		FILLING - dark brown and grey, clay filling with some fine to medium gravel and crushed glass		S*			3,5,7 N = 12 PID<5		
		FILLING - orange, red and brown, silty clay filling with some fine gravel - brick at 1.35m			1.35				
					1.9				
	2.1	FILLING - brown, clayey sand filling with some fine to medium gravel - 300mm collapse		S			4,3,6 N = 9 PID<5		
					2.35				
					2.6				
				S			5,5,8 N = 13 PID<5		
		- white sandstone at 3.0m			3.05				
	3.8	Bore discontinued at 3.8m - refusal on concrete fragment and heavy wire cables							

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *BD4-100915 taken at 0.9-1.35m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.3 AHD
EASTING: 311817
NORTHING: 6243778
DIP/AZIMUTH: 90°/--

BORE No: BH202
PROJECT No: 71459.03
DATE: 3/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	FILLING - fine to medium gravel and crushed glass							1.0m monument stickup Concrete plug
		FILLING - dark brown, silty clay with some fine gravel and asphalt							
		- wet at 0.9m			0.9			▼	0.1-1.5m: 50mm diameter Class 18 PVC Casing
	1.0	FILLING - orange and red, silty clay filling with some fine gravel and asphalt		S	1.35		7,7,8 N = 15 PID<5		
				S	1.9		3,4,7 N = 11 PID=11.2		1.3-6.1m: 5/2mm graded gravel/sand
		- colour change to brown at 2.1m - foam, steel reinforcement and brick fragments at 2.15m			2.35				
				S	2.9		5,6,5 N = 11 PID<5		
					3.35				
		- wood pieces at 3.9m		S	3.9		5,8,5 N = 13 PID<5		1.5-6.1m: 50mm diameter Class 18 Machine-Slotted PVC Screen
					4.35				
		- concrete fragments at 5.1m		S	4.9		3,3,6 N = 9 PID<5		
					5.35				
				S	5.9		3,4,1 N = 5 No PID bag		End cap
	6.1	Bore discontinued at 6.1m - refusal on steel reinforcement			6.1				

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 0.9m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.6 AHD
EASTING: 311817
NORTHING: 6243757
DIP/AZIMUTH: 90°/--

BORE No: BH203
PROJECT No: 71459.03
DATE: 10/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.4	FILLING - light brown, fine to medium sand filling with some crushed glass and fine to medium gravel		A	0.1 0.2		PID<5		
		FILLING - dark brown, clayey sand with some fine gravel						▼	
	1.2			S	0.9 1.35		8,7,7 N = 14 PID<5		
		FILLING - dark grey and brown, silty clay with some sand and fine to medium gravel and brick		S	1.9 2.35		5,6,7 N = 13 PID<5		
		- slight odour at 2.2m							
		- concrete fragment at 2.7-2.9m		S	2.9 3.35		5,5,5 N = 10 PID<5		
		- yellow and white sandstone at 3.25m							
		- metal wire at 3.9m - concrete and steel fragments at 4.1m - steel at 4.1m		S	3.9 4.35		15,23,15 N = 38 PID<5		
	4.5	Bore discontinued at 4.5m - refusal on steel (1.5cm thick?)							

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 0.8m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.2 AHD
EASTING: 311852
NORTHING: 6243749
DIP/AZIMUTH: 90°/--

BORE No: BH204
PROJECT No: 71459.03
DATE: 9/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	FILLING - light brown, clayey sand filling with some fine to medium gravel, tile fragments and some crushed glass		A	0.1 0.2		PID<5		
		FILLING - dark brown, clayey sand filling with some fine gravel and crushed glass							
	0.7	FILLING - dark brown, sandy clay filling with some fine gravel and some wood fragments		S	0.9 1.35		5,22,25 N = 47 PID<5		
		- brick fragments and wood fragments at 1.8m - steel reinforcement at 1.85m		S	1.9 2.35		7,8,4 N = 12 PID<5		
		- terracotta pipe at 3.1m		S	2.9 3.35		3,4,4 N = 8 PID<5		
		- medal alloy fragment at 3.85m - wood fragments at 4.2m - cotton material at 4.6m		S	3.9 4.35		4,13,7 N = 20 PID<5		
				S	4.9 5.35		7,8,10 N = 18 PID<5		
		- cement and wood fragments at 5.35m, slight H_2S odour - roots and wood chips at 5.4-5.9m		S	5.9 6.35		2,12,15 N = 27 PID<5		
		- brick at 6.1m							
		- groundwater at 6.9m		S	6.9 7.35		7,14,16 N = 30 PID<5	▼	
		- saturated at 7.9m - large wood fragments at 8.0-8.35m		S	7.9 8.35		1,15,7 N = 22 No PID bag		
	9.2	SILTY CLAY - yellow and light orange, silty clay		S	8.9 9.35		3 refusal No PID bag 300mm slump		
	9.7	Bore discontinued at 9.7m - target depth reached							

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 6.9m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 6.9 AHD
EASTING: 311891
NORTHING: 6243767
DIP/AZIMUTH: 90°/--

BORE No: BH205
PROJECT No: 71459.03
DATE: 7/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
6.9	0.0	FILLING - dark brown, sandy clay with some fine to medium gravel, asphalt, crushed brick and crushed glass		A	0.1 0.2		PID<5		
5.9	1.0				0.9				
5.8	1.1	FILLING - yellow, fine to medium sand filling with some fine gravel		S			5,12,8 N = 20 PID<5		
		FILLING - brown and yellow mottled, clayey sand filling with some fine to medium gravel and crushed brick			1.35				
5.1	1.8	FILLING - red, light grey and yellow, silty clay filling with some fine gravel		S	1.9		0,2,3 N = 5 PID<5		
					2.35				
4.3	2.6	FILLING - brown, silty clay filling with some fine gravel and crushed brick - dark grey and yellow mottled below 3.2m		S	2.9 3.35		0,0,0 N = 0 PID<5		
3.0	3.9				3.9				
2.9	4.0	FILLING - yellow and light grey, fine to medium sand filling		S			0,3,7 N = 10 PID<5		
		FILLING - red, orange and light grey, silty clay filling			4.35				
2.0	4.9	Bore discontinued at 4.9m - refusal on concrete							

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** CB **CASING:** Uncased
TYPE OF BORING: 110mm diameter solid flight auger
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 6.6 AHD
EASTING: 311895
NORTHING: 6243793
DIP/AZIMUTH: 90°/--

BORE No: BH206
PROJECT No: 71459.03
DATE: 10/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	FILLING - light brown, clayey sand filling with some fine gravel and brick fragments		A	0.1 0.2				
	0.4	FILLING - dark brown, sandy clay filling with fine to medium gravel and some3 fine brick fragments							
		FILLING - orange and brown, silty clay filling with some fine gravel - dark brown below 0.9m - yellow and brown below 1.1m - yellow, brown and red mottled below 1.9m - light grey, red and yellow mottled below 2.9m		S	0.9 1.35		3,3,6 N = 9 PID<5		
				S	1.9 2.35		2,4,3 N = 7 PID<5		
				S	2.9 3.35		2 refusal PID<5 Clump 350mm		
				S	3.9 4.35		4,6,7 N = 13 PID<5		
		- apparently in a soft condition below 5.1m - dark grey with fine asphalt below 5.15m		S	4.9 5.35		5,5,3 N = 8 PID<5		
	6.1	SILTY CLAY - stiff, light grey and red, silty clay		S	5.9 6.35		2,9,12 N = 21 PID<5 Clump 100mm		
	6.7	Bore discontinued at 6.7m - target depth reached							

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *BD6-100915 taken at 0.9-1.35m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 6.5 AHD
EASTING: 311926
NORTHING: 6243802
DIP/AZIMUTH: 90°/--

BORE No: BH207
PROJECT No: 71459.03
DATE: 10/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	FILLING - light brown, clayey sand filling with some fine gravel and brick fragments		A	0.1 0.2		PID<5		
		FILLING - dark brown, clayey sand filling with some fine to medium gravel and brick fragments			0.9				
	1.0	FILLING - dark brown and yellow, fine to medium sand filling with some fine gravel		S*	1.35		8,8,7 N = 15 PID<5		
				S	1.9 2.35		3,3,2 N = 5 PID<5	▼	
	3.0	FILLING - dark brown and red mottled, silty sandy clay with some fine gravel, wet		S	2.9 3.35		2 refusal PID<5 300mm clump		
	4.05	SILTY CLAY - stiff, light grey and red mottled, silty clay		S	3.9 4.35		3,3,5 N = 8 PID<5		
	4.9	Bore discontinued at 4.9m - target depth reached							

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 2.3m

REMARKS: *BD5-100915 taken at 0.9-1.35m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 6.7 AHD
EASTING: 311964
NORTHING: 6243738
DIP/AZIMUTH: 90°/--

BORE No: BH208
PROJECT No: 71459.03
DATE: 10/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	FILLING - light brown, clayey sand filling with some fine to medium gravel, crushed glass, brick fragments and asphalt		A	0.1 0.2		PID<5		
	0.6	FILLING - dark brown, clayey sand filling with some fine to medium gravel and brick							
		FILLING - light and dark grey, silty clay filling with some fine gravel and asphalt - white sandstone at 1.1-1.2m		S	0.9 1.35		9,5,2 N = 7 PID<5		
		- yellow sandstone at 2.0-2.1m - dark brown with medium asphalt below 2.15m		S	1.9 2.35		4,18,16 N = 34 PID<5		
		- brown and yellow, wet below 2.6m		S	2.9 3.35		PID<5 full stump	▼	
	4.0	SILTY CLAY - stiff, red and light grey mottled, silty clay		S*	3.9 4.35		3,9,6 N = 15		
	4.9	Bore discontinued at 4.9m - target depth reached							

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 2.7m

REMARKS: *BD7-100915 taken at 3.9-4.35m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 8.1 AHD
EASTING: 311835
NORTHING: 6243722
DIP/AZIMUTH: 90°/--

BORE No: BH209
PROJECT No: 71459.03
DATE: 9/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
8	0.05	FILLING - light brown, clayey sand filling with some fine gravel		A	0.1 0.2		PID<5		
		FILLING - dark brown, clayey sand filling with some fine to medium gravel, asphalt and crushed glass							
7	1			S	0.9 1.35		40/150mm refusal No PID bag		1
	1.5	FILLING - dark brown, grey and orange, silty clay with some fine gravel							
6	2	- colour change to dark grey at 2.0m - brick at 2.2m - wood fragments at 2.3m - medium to coarse gravel and asphalt at 2.8m		S	1.9 2.35		5,7,8 N = 15 PID<5		2
	2.8	FILLING - dark grey and yellow mottled, silty sandy clay filling with some fine to medium gravel							
5	3	- wood fragments at 3.25m		S	2.9 3.35		4,3,5 N = 8 PID<5		3
4	4	- concrete boulder at 4.2-4.8m		S	3.9 4.35		5,16,20/100mm refusal PID<5		4
3	5			S	4.9 5.1		10/20mm refusal No PID bag		5
	5.4	- brick fragments at 5.3m Bore discontinued at 5.4m - refusal on concrete boulder							
2	6								6
1	7								7
0	8								8
-1	9								9

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.0 AHD
EASTING: 311949
NORTHING: 6243675
DIP/AZIMUTH: 90°/--

BORE No: BH210
PROJECT No: 71459.03
DATE: 4/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
7	0.0								
		FILLING - brown, gravelly sand filling		A	0.1 0.2		PID<5		
6	1			S	1.0		20/20mm refusal PID<5 Limited sample return		1
					1.45				
	1.6	FILLING - orange-brown, silty clay filling with trace fine ironstone gravel, damp							
5	2			S	2.0		3,4,5 N = 9 PID<5		2
	2.1	FILLING - brown, sandy clay with trace fine to medium gravel, moist - evidently in a firm condition			2.45				
	2.7	FILLING - orange-brown and grey, silty clay with some sand and gravel, damp							
4	3			S	3.0		3,5,6 N = 11 PID<5		3
					3.45				
3	4			S	4.0		3/50mm refusal		4
	4.05	Bore discontinued at 4.05m - refusal on concrete			4.05		bouncing, limited return		
2	5								5
1	6								6
0	7								7
-1	8								8
-2	9								9

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** MW **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Second hole attempted 2.5m to north, also concrete refusal at 4.1m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 6.7 AHD
EASTING: 312006
NORTHING: 6243707
DIP/AZIMUTH: 90°/--

BORE No: BH211
PROJECT No: 71459.03
DATE: 8/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	FILLING - brown, sandy clay filling with some fine gravel and some crushed glass		A	0.1 0.2		PID<5		0.8m monument stickup
	0.7	FILLING - light brown, sandy clay filling with some fine to medium gravel and fine to medium crushed brick							0.1-1.3m: Bentonite plug
		FILLING - red, brown, yellow and light grey, silty clay filling with some fine to medium gravel, fine to medium asphalt and fine crushed brick		S	0.9 1.35		5,5,5 N = 10 PID<5		0.0-1.5m: 50mm diameter Class 18 PVC casing
	1.5	FILLING - red and brown, silty clay filling with some fine gravel - light grey sandy clay layer at 2.1m to 2.2m		S	1.9 2.35		1,4,5 N = 9 PID<5		
	3.1	SILTY CLAY - stiff to very stiff, red and light grey, silty clay		S	2.9 3.35		3,5,8 N = 13 PID<5		1.5-6.4m: 50mm diameter Class 18 Machine-slotted PVC screen
		- red and dark grey below 4.0m		S S	3.9 4.0 4.35		2,5,7 N = 12 PID<5 4,7,9 N = 16 PID<5		1.5-10.4m: 5/2mm graded gravel/sand
					5.35				
	6.4	- light grey below 6.15m Bore discontinued at 6.4m - target depth reached		S	5.9 6.35		4,1,12 N = 13 PID<5		End cap

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 6.7 AHD
EASTING: 312006
NORTHING: 6243707
DIP/AZIMUTH: 90°/--

BORE No: BH211B
PROJECT No: 71459.03
DATE: 8/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	FILLING - brown, sandy clay filling with some fine gravel and some crushed glass							0.5m Stickup; 0.0-0.1m: Concrete plug; 0.1-0.7m: Bentonite plug; 0.0-1.0m: 50mm diameter Class 18 PVC casing; 0.7-2.0m: 5/2mm graded gravel/sand; 1.0-2.0m: 50mm diameter Class 18 Machine-Slotted PVC screen; End cap
	0.7	FILLING - light brown, sandy clay filling with some fine to medium gravel and fine to medium crushed brick							
	1	FILLING - red, brown, yellow and light grey, silty clay filling with some fine to medium gravel, fine to medium asphalt and fine crushed brick							
	1.5	FILLING - red and brown, silty clay filling with some fine gravel							
	2.0	Bore discontinued at 2.0m - target depth reached							

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 6.9 AHD
EASTING: 311835
NORTHING: 6243674
DIP/AZIMUTH: 90°/--

BORE No: BH212
PROJECT No: 71459.03
DATE: 9/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	FILLING - light brown, fine to medium sand filling with some fine to medium gravel and asphalt		A	0.1 0.2				
	0.4	FILLING - dark brown, clayey sand filling with some fine to medium gravel and roadbase							
		FILLING - light brown and orange, silty clay filling with some fine gravel - dark brown below 0.7m - brick at 1.0m - concrete at 1.35m		S	0.9 1.35		7,14,10/50mm refusal PID<5		
		- strong H_2S odour at 2.0m		S	1.9 2.35		12,13,6 N = 19 No PID bag		
				S*	2.9 3.35		9,11,5 N = 16 PID<5		
		- crushed sandstone and asphalt gravel at 4.1m - concrete fragment at 4.4-4.8m		S	3.9 4.35		30,23,20/100mm refusal PID<5		
		- steel fragment (10cm?) at 4.9m		S**	4.9 5.35		2,30,17 N = 47 100mm clump		
	6.0	Bore discontinued at 6.0m - refusal on concrete and brick rubble							

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *BD3-090915 taken at 2.9-3.35m. **No SPT sample recovered

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.1 AHD
EASTING: 311938
NORTHING: 6243656
DIP/AZIMUTH: 90°/--

BORE No: BH213
PROJECT No: 71459.03
DATE: 8/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
7	0.05	FILLING - light brown, fine to medium sand filling with some fine to medium gravel and crushed glass		A	0.1 0.2		PID<5		
		FILLING - dark brown, fine to medium sand filling with some fine to medium gravel and brick fragments							
6	1			S	0.9 1.35		9,6,6 N = 12 PID<5		1
5	2	- crushed glass at 2.2m - plastic and wire at 2.5m		S	1.9 2.35		3,5,4 N = 9 PID<5		2
	2.6	FILLING - dark brown, sandy clay with some fine gravel and asphalt							
4	3	- light grey, brown and dark yellow mottled below 2.95m		S*	2.9 3.35		4,4,4 N = 8 PID<5		3
	3.8	Bore discontinued at 3.8m - refusal on concrete slab with reinforced steel top							
3	4								4
2	5								5
1	6								6
0	7								7
-1	8								8
-2	9								9

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *BD2-080915 taken at 2.9-3.35m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.0 AHD
EASTING: 311999
NORTHING: 6243663
DIP/AZIMUTH: 90°/--

BORE No: BH214
PROJECT No: 71459.03
DATE: 8/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	FILLING - crushed glass and fine to medium gravel		A	0.1		PID<5		
		FILLING - light brown, fine to medium sand filling with a trace of clay and medium to coarse gravel			0.2				
		- bricks and brick fragments at 0.7m							
	1.0	CONCRETE SLAB							
	1.2	FILLING - dark brown, fine to m4edium sand filling with some clay and fine to medium gravel and brick fragments			1.2				
	1.4			S			12,9,13 N = 22 PID<5		
		FILLING - brown, red and yellow, silty clay filling with some fine to medium gravel			1.65				
	2.2	FILLING - black, fine to medium sand filling with some fine to medium gravel and brick fragments		S	2.2		6,12,13 N = 25 PID<5		
	2.6	FILLING - light grey and brown, silty clay filling with some fine to medium gravel			2.65				
		- dark brown below 3.2m - brick fragments at 3.4m		S	3.2		7,4,7 N = 11 PID<5		
	3.8	SILTY CLAY - stiff, red and light grey, silty clay			3.65				
				S	4.2		3,5,7 N = 12 PID<5		
					4.65				
	5.1	Bore discontinued at 5.1m - target depth reached							

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 6.8 AHD
EASTING: 311952
NORTHING: 6243640
DIP/AZIMUTH: 90°/--

BORE No: BH215
PROJECT No: 71459.03
DATE: 3/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILLING - brown, sandy clay filling with some fine to medium gravel, plastic, crushed glass and metal pieces							
		FILLING - dark brown and grey, sandy clay filling with some gravel and crushed glass and fine asphalt - brick fragments at 0.8m							
	0.85	FILLING - yellow, white and brown, sand filling with some fine gravel and fine brick fragments		S	0.9 1.35		32,28,22 N = 50 PID=8.3		
	1.8	FILLING - red and brown, silty sandy clay with some fine gravel and fine crushed glass and fine brick fragments - light grey below 2.1m		S	1.9 2.35		3,3,5 N = 8 PID<5		
	2.5	FILLING - light brown, silty clay filling with fine gravel							
	3.0	FILLING - red and orange, clay filling with a trace of silt		S	2.9 3.35		4,5,7 N = 12 PID<5		
	3.7	Bore discontinued at 3.7m - refusal on concrete slab							

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.3 AHD
EASTING: 311888
NORTHING: 6423631
DIP/AZIMUTH: 90°/--

BORE No: BH216
PROJECT No: 71459.03
DATE: 4/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILLING - light brown, fine to medium sand filling with some fine to medium gravel, fine brick fragments and crushed glass		A	0.1		PID<5		Stickup 1.0m; Casing 0.0-2.0m
	0.2				0.2				
	0.3	FILLING - dark brown, fine to medium sand filling with some medium gravel, asphalt and brick							0.0-1.0m: Bentonite
	1	FILLING - dark yellow, fine to medium sand filling with some fine gravel		S	0.9		13,12,5 N = 17 PID<5		
	1.2	FILLING - dark grey and brown, sand filling with some fine gravel and asphalt			1.35				
		FILLING - dark brown, sandy clay filling with some fine to medium gravel and medium brick fragments							
	2	- wood fragments at 1.9m		S	1.9		23,22,17 N = 39 PID<5		
		- dark grey below 2.2m			2.35				
	3				2.9				
	3.0	FILLING - light grey, sandy clay with so me medium concrete fragments, crushed sandstone, fine gravel and wood fragments, damp		S			1,2,2 N = 4 PID<5		1.0-8.0m: Gravel pack
					3.35				
	4	- dark grey below 3.9m - strong methane reading at 0.4m (18.8%)		S	3.9		10,1,5 N = 6 No PID bag, minimal sample return		
					4.35				
	5	- groundwater at 5.1m		S	4.9		6,7,3 N = 10 PID<5	▼	2.0-8.0m: Machine slotted PVC screen
		- concrete boulder at 5.5m			5.35				
	5.8	FILLING - dark grey and black, silty sandy clay with some fine gravel and asphalt		S	5.9		2,2,2 N = 4 PID<5		
	6								
	6.3	FILLING - light grey, silty clay filling, wet			6.35				
	7			S	7.0		3,6,8 N = 14 Minimal return of fill material		
	7.35	SILTY CLAY - stiff, grey mottled yellow, silty clay, damp (yellow colour, pyrite)			7.45				
	8								End cap
	8.0	Bore discontinued at 8.0m - target depth reached							

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 5.1m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.7 AHD
EASTING: 311896
NORTHING: 6243567
DIP/AZIMUTH: 90°/--

BORE No: BH218
PROJECT No: 71459.03
DATE: 3/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
7.7	0.1	FILLING - light brown, sand filling with some fine gravel, fine asphalt and some crushed glass							1.0m monument stickup
	0.3	FILLING - dark brown-black, silty clay filling with some fine asphalt							0.0-0.1m: concrete plug
		FILLING - brown, sand filling with fine to medium gravel, fine to medium asphalt and brick fragments							0.6-1.0m: 50mm diameter Class 18 PVC casing
		- large brick fragments (5cm-8cm) encountered at 0.6m		S	0.9		32,27,30 N = 57 PID<5		
	1.2	FILLING - brown, sandy clay filling with a lot of fine brick and some fine gravel, wet			1.35			▼	
		- water at 1.3m		S	1.9		5,6,4 N = 10 PID<5		
					2.35				
	2.6	FILLING - dark grey, silty clay clay filling with a trace of fine gravel and brick fragments, wet		S	2.9		1,2,3 N = 5 PID<5		0.6-8.0m: 50mm diameter Class 18 Machine-slotted PVC screen
					3.35				
	3.5	FILLING - brown, sandy clay filling with some fine gravel, wet		S	3.9		2,2,3 N = 5 PID<5		
					4.35				
		- brick fragments, crushed asphalt and metal wire at 4.85m		S	4.9		3,4,4 N = 8		1.5-8.0m: 5/2mm graded gravel/sand
					5.35				
		- dark grey, red and brown mottled below 6.0m		S	5.9		2,3,6 N = 9 PID<5		
					6.35				
		- saturated at 6.8m							
	6.9	FILLING - light grey, sand filling (possibly natural)		S	6.9		8,5,4 N = 9 PID<5		
	7.1	FILLING - orange, red and light grey, silty clay filling			7.35				
				S	7.9		5,10,12 N = 22 PID<5		End cap
	8.35	Bore discontinued at 8.35m - refusal on concrete			8.35				

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 1.3m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 5.7 AHD
EASTING: 311853
NORTHING: 6243524
DIP/AZIMUTH: 90°/--

BORE No: BH220
PROJECT No: 71459.03
DATE: 9/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILLING - dark brown, clayey sand filling with white bricks, large concrete fragments (15-45cm) and medium to coarse gravel		A	0.1 0.2		PID<5		
	0.9			S	0.9 1.35		17,38,7 N = 45		
	2.6	Bore discontinued at 2.6m - refusal on concrete and building rubble							

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Note: 2.5m have been excavated prior to sampling

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.9 AHD
EASTING: 311907
NORTHING: 6243483
DIP/AZIMUTH: 90°/--

BORE No: BH221
PROJECT No: 71459.03
DATE: 8/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	FILLING - light brown, fine to medium sand filling with some fine to medium gravel		A	0.1 0.2		PID<5		
		FILLING - dark brown, clayey sand filling with some fine to medium gravel and brick fragments							
	1	- large brick and asphalt fragments at 0.9m		S	0.9 1.35		35,35/70mm refusal PID<5		
	1.8								
	2	FILLING - light grey and brown, sand filling with some clay and fine gravel		S	1.9 2.35		27,37,15 N = 52 PID<5		
	3	- dark brown below 2.9m - wood fragments at 3.1m		S	2.9 3.35		4,9,18 N = 27 PID<5		
		- large brick fragments at 3.35m - wood fragments at 3.6m							
	4	- slight odour at 4.0m		S	3.9 4.35		13,7,10 N = 17		
	4.9	Bore discontinued at 4.9m - refusal on concrete fragment or slab							
	5								
	6								
	7								
	8								
	9								

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 6.4 AHD
EASTING: 311821
NORTHING: 6243438
DIP/AZIMUTH: 90°/--

BORE No: BH222
PROJECT No: 71459.03
DATE: 9/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	FILLING - light brown, fine to medium sand filling with some fine to coarse gravel		A	0.1 0.2		PID<5		
		FILLING - light and dark brown, fine to medium sand filling with some fine to medium gravel and large bricks							
	0.8	- concrete, tiles and building rubble at 0.6m							
	1	FILLING - dark brown, clayey sand filling with some fine to medium gravel and brick		S	0.9		12,7,6 N = 13 PID<5		
		- medium to coarse gravel at 1.5m			1.35				
	2	- concrete at 2.0-2.1m		S	1.9		7,7,10 N = 17 PID<5		
					2.35				
	2.9	Bore discontinued at 2.9m - refusal on concrete fragments							

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 8.5 AHD
EASTING: 311858
NORTHING: 6243435
DIP/AZIMUTH: 90°/--

BORE No: BH223
PROJECT No: 71459.03
DATE: 4/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0			A	0.0				Stickup
		FILLING - brown, silty gravel sand filling			0.2				0.0-0.5m: Concrete
	0.5								
		FILLING - dark grey, gravelly (fine to medium crushed glass), sand filling		S	1.0		28,40 refusal		0.5-1.5m: Bentonite
	1.5				1.3				
		FILLING - brown, clayey sand filling with some fine to coarse gravel, damp		S	2.0		4,4,4 N = 8		
					2.45				
		- moist from 3.0m		S	3.0		0,0,0 N = 0		1.0-5.8m: Gravel pack
					3.45				
	3.75	SAND - brown, fine to medium grained sand with trace clay, moist		S	4.0		1,2,5 N = 7		1.8-5.8m: Machine slotted PVC screen
					4.45				
				S	5.0		1,2,2 N = 4		
					5.45				
				S	6.0		1,1,3 N = 4		End cap
	6.45	Bore discontinued at 6.45m - target depth reached			6.45				

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** MW **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 1.9 AHD
EASTING: 312080
NORTHING: 6243474
DIP/AZIMUTH: 90°/--

BORE No: BH224
PROJECT No: 71459.03
DATE: 14/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.3	FILLING - light brown, clayey sand filling with some concrete, subangular and angular igneous gravel and rootlets							Stick-up of 0.9m
	0.4								0.0-0.5m: filling
	0.7	FILLING - dark brown, sandy clay filling with trace subangular and angular gravel							
	1	FILLING - brown, silty sandy clay filling							0.5-2.3m: Sand
		SAND - light grey and orange, fine to medium sand							0.8-2.3m: Machine slotted PVC screen
	2.3	Bore discontinued at 2.3m - target depth reached							End cap

RIG: Komatsu PL 350LC **DRILLER:** Benedict Industries **LOGGED:** RJL **CASING:** Uncased

TYPE OF BORING: Excavated with 1500mm wide bucket

WATER OBSERVATIONS: Seepage at 2.3m

REMARKS: Well constructed in Test Pit

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 1.7 AHD
EASTING: 312086
NORTHING: 6243453
DIP/AZIMUTH: 90°/--

BORE No: BH225
PROJECT No: 71459.03
DATE: 14/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.3	FILLING - light brown, clayey sand filling with subangular and angular gravel, trace rootlets, concrete							Stickup of 0.55m
	0.4	FILLING - dark brown, sandy clay filling with trace subangular and angular igneous gravel							0.0-0.5m: filling
	0.7	FILLING - brown, silty sandy clay							
	1	SAND - light grey and orange, fine to medium sand							0.5-2.2m: Sand
									0.5-2.2m: Machine slotted PVC screen
	2.2	Bore discontinued at 2.2m - target depth reached							End cap

RIG: Komatsu PL 350LC **DRILLER:** Benedict Industries **LOGGED:** RJL **CASING:** Uncased

TYPE OF BORING: Excavated with 1500mm wide bucket

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Well constructed in Test Pit

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: JK103a
PROJECT No: 71459.03
DATE: 7/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILLING - light brown and brown, sand filling with some fine to medium gravel, fine asphalt and medium crushed concrete		A	0.1 0.2		PID<5		0.8m: monument stickup 0.0-0.1m: Concrete plug
		FILLING - dark brown, sand filling with some crushed concrete, fine to medium gravel and medium brick fragments - light brown below 0.25m - groundwater at 0.9m		S	0.9		5,7,5 N = 12 PID<5	▼	0.1-1.0m: Bentonite plug
	1.4	FILLING - brown and light grey, sandy clay filling with some fine gravel and brick fragments, wet			1.35				
		- bolt at 2.2m - crushed sandstone fragment (3cm) at 2.3m - concrete fragment at 2.6m		S	1.9 2.35		4,7,4 N = 11 PID<5		0.0-4.9m: 50mm diameter Class 18 PVC casing
				S	2.9 3.25		6,7,8 N = 15 PID<5		1.0-6.4m: 5/2mm graded gravel/sand
	3.4	FILLING - light brown, sandy clay filling with some fine gravel, wet							
	3.7	FILLING - brown and red, silty clay filling - red, orange, brown and light grey below 4.2m - wood fragments at 4.3m		S	3.9 4.35		3,4,6 N = 10 PID<5		1.5-6.4m: 50mm diameter Class 18 Machine-Slotted PVC screen
	5.1	- red and brown below 5.0m SILTY CLAY - light grey and red, silty clay		S	4.9 5.35		4,7,12 N = 19 PID<5		
	6.2			S	5.9 6.35		11,8,16 N = 24 PID<5		End Cap
	6.4	SAND - light grey and yellow, fine to medium sand Bore discontinued at 6.4m - target depth reached							

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 0.9m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: JK103b
PROJECT No: 71459.03
DATE: 7/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILLING - light brown and brown, sand filling with some fine to medium gravel, fine asphalt and medium crushed concrete							0.5m Stickup; 0.0-0.1m: Concrete plug; 0.1-0.7m: Bentonite plug; 0.0-1.0m: 50mm diameter Class 18 PVC casing; 0.7-2.0m: 5/2mm graded gravel/sand; 1.0-2.0m: 50mm diameter Class 18 Machine-Slotted PVC screen; End cap
	1	FILLING - dark brown, sand filling with some crushed concrete, fine to medium gravel and medium brick fragments - light brown below 0.25m - groundwater at 0.9m						▼	
	1.4	FILLING - brown and light grey, sandy clay filling with some fine gravel and brick fragments, wet							
	2.0	Bore discontinued at 2.0m							

RIG: Scout 4 **DRILLER:** **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 0.9m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.2 AHD
EASTING: 311905
NORTHING: 6242666
DIP/AZIMUTH: 90°/--

BORE No: JK107a
PROJECT No: 71459.03
DATE: 7/9/2015
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	FILLING - brown, fine to medium sand filling with some fine gravel and some crushed glass		A	0.1 0.2		PID<5		0.8m monument stickup
		FILLING - brown, fine to medium sand filling with some fine gravel							0.1-1.5m: Bentonite plug 0.0-1.5m: 50mm diameter Class 18 PVC casing
				S	0.9 1.35		5,3,2 N = 5 PID<5		
	1.5	FILLING - dark grey and brown, sandy clay filling with some fine gravel, crushed brick fragments and crushed glass		S*	1.9 2.35		0,2,3 N = 5 PID<5		
		- rotting wood fragments at 2.2m							
				S	2.9 3.35		2,8,5 N = 13 PID<5		1.5-10.4m: 50mm diameter Class 18 Machine-slotted PVC screen
		- red sandstone boulder at 4.15m		S	3.9 4.35		19,12,17 N = 29 PID<5		
	4.5	FILLING - brown and dark brown, silty sandy clay filling with some fine gravel and crushed brick fragments							
		- asphalt and crushed concrete at 5.0m		S	4.9 5.35		8,5,8 N = 13 PID=5.4		
									1.5-10.4m: 5/2mm graded gravel/sand
	6.0	FILLING - grey, fine to medium sand filling with a trace of clay and fine gravel		S	5.9 6.35		5,8,11 N = 19 PID<5	▼	
		- reinforcement at 6.8m		S	6.9 7.35		5,6,8 N = 14 PID<5		
	7.5	FILLING - grey, clayey silty fine to medium sand filling - saturated at 7.65m							
		- very slight odour at 7.95m		S	7.9 8.35		13,20,18 N = 38 PID<5		
				S	8.9 9.35		2,1,2 N = 3 PID<5		
	9.2	CLAYEY SAND - light grey, clayey sand, saturated							

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 6.4m

REMARKS: *BD1-070815 taken at 1.9-2.35m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.2 AHD
EASTING: 311905
NORTHING: 6242666
DIP/AZIMUTH: 90°/--

BORE No: JK107a
PROJECT No: 71459.03
DATE: 7/9/2015
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
-3		CLAYEY SAND - light grey, clayey sand, saturated *(continued)*		S	10.0		No PID sample		
	10.4				10.35				End cap
		Bore discontinued at 10.4m - borehole collapse, target depth reached							
-4	11								
-5	12								
-6	13								
-7	14								
-8	15								
-9	16								
-10	17								
-11	18								
-12	19								

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: Free groundwater observed at 6.4m

REMARKS: *BD1-070815 taken at 1.9-2.35m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.1 AHD
EASTING: 311904
NORTHING: 6243666
DIP/AZIMUTH: 90°/--

BORE No: JK107b
PROJECT No: 71459.03
DATE: 7/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
7.1	0.05	FILLING - brown, fine to medium sand filling with some fine gravel and some crushed glass							0.5m Stickup; 0.0-0.1m: Concrete plug; 0.1-0.7m: Bentonite plug; 0.0-1.0m: 50mm diameter Class 18 PVC casing; 0.7-2.0m: 5/2mm graded gravel/sand; 1.0-2.0m: 50mm diameter Class 18 Machine-Slotted PVC screen; End cap
		FILLING - brown, fine to medium sand filling with some fine gravel							
6	1								
	1.5	FILLING - dark grey and brown, sandy clay filling with some fine gravel, crushed brick fragments and crushed glass							
5.1	2.0	Bore discontinued at 2.0m target depth reached						▼	
4	3								
3	4								
2	5								
1	6								
0	7								
-1	8								
-2	9								

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: JK114b
PROJECT No: 71459.03
DATE: 8/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	FILLING - light brown, clayey sand filling with some medium to coarse gravel, brick fragments, concrete fragments and metal pieces							0.5m Stickup; 0.0-0.1m: Concrete plug; 0.1-0.7m: Bentonite plug; 0.0-1.0m: 50mm diameter Class 18 PVC casing; 0.7-2.0m: 5/2mm graded gravel/sand; 1.0-2.0m: 50mm diameter Class 18 Machine-Slotted PVC screen; End cap
	1	- dark brown below 0.8m							
	1.3	FILLING - light brown and grey, fine to medium sand filling with some clay, fine gravel and fine brick fragments							
	2.0	Bore discontinued at 2.0m - target depth reached							
	3								
	4								
	5								
	6								
	7								
	8								
	9								

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: JK118a
PROJECT No: 71459.03
DATE: 8/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	FILLING - light brown, fine to medium sand filling with some fine gravel and a trace of crushed glass		A	0.1		PID<5		0.8m monument stickup
		- a trace of clay at 0.2m			0.2				0.1-1.3m: Bentonite plug
		- dark brown below 0.6m							0.0-1.5m: 50mm diameter Class 18 PVC casing
1	0.9	FILLING - highly compacted, fine to medium sand filling with a trace of clay and fine gravel		S	0.9		33,30/50mm refusal PID<5		
					1.35				
2	1.8	FILLING - brown, red and light grey, silty clay filling with some fine gravel		S	1.9		30,25,16 N = 41 PID<5		
		- brick and asphalt fragments at 2.0m							
	2.4	FILLING - brown, yellow and grey, silty clay filling with some fine gravel, asphalt and crushed brick			2.35				
3	2.9	FILLING - dark brown, silty sandy clay filling with some fine to medium gravel, asphalt and crushed brick		S	2.9		6,11,8 N = 19 PID<5		1.5-6.4m: 50mm diameter Class 18 Machine-slotted PVC screen
		- crushed sandstone at 3.0m to 3.2m							
		- terracotta tile fragments at 3.34m			3.35				
		- blue plastic, coarse brick fragments, coarse gravel, metal fragments and wood fragments at 3.9m			3.9				1.5-10.4m: 5/2mm graded gravel/sand
4	4.0	FILLING - brown, yellow and light grey, silty clay filling with some wood fragments		S	4.35		3,5,10 N = 15 PID<5		
		- blue plastic, coarse gravel, coarse brick fragments and metal fragments at 4.8m		S	4.9		0,0,5 N = 5 PID<5		
5		- black sandstone at 5.0m to 5.1m							
		- wood fragments at 5.3m			5.35				
		- dark brown with slight odour below 5.9m			5.9				
6				S			2,10,15 N = 25 PID<5		
	6.4	Bore discontinued at 6.4m			6.35				End cap
		- target depth reached							
7									
8									
9									

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Benedict Industries Pty Ltd
PROJECT: Detailed Site Investigation
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: JK118b
PROJECT No: 71459.03
DATE: 8/9/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.0	FILLING - light brown, fine to medium sand filling with some fine gravel and a trace of crushed glass - a trace of clay at 0.2m - dark brown below 0.6m							0.5m Stickup 0.0-0.1m: Concrete plug 0.1-0.7m: Bentonite plug 0.0-1.0m: 50mm diameter Class 18 PVC casing 0.7-2.0m: 5/2mm graded gravel/sand 1.0-2.0m: 50mm diameter Class 18 Machine-Slotted PVC screen End cap
	0.9	FILLING - highly compacted, fine to medium sand filling with a trace of clay and fine gravel							
	1.8	FILLING - brown, red and light grey, silty clay filling with some fine gravel							
	2.0	Bore discontinued at 2.0m - target depth reached							

RIG: Scout 4 **DRILLER:** KKE/RKE **LOGGED:** CB **CASING:** Uncased

TYPE OF BORING: 110mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix F

Calibration Certificates

Douglas Partners
Geotechnics | Environment | Groundwater

Photoionisation Detector Calibration Record

Project Name:	MOOREBANK
Project No:	

PID Unit (circle):	MiniRAE 3000 MiniRAE Lite PhotoVAC 2020 Pro Plus (MiniRAE 2000)
Lamp:	10.6 eV

Calibration Details:	
Zero Air:	Ambient
Response Factor:	1.0
Span Gas Type:	Isobutylene
Span Gas Concentration:	100 ppm ⇒ 99.1 ppm

Operator Name:	Chris Bagia	**Signed:**		**Date:**	2/9/15

ThermoFisher SCIENTIFIC

The world leader in serving science

RENTALS

Equipment Certification Report – TPS 90FLMV Water Quality Meter

This Water Quality Meter has been performance checked and calibrated as follows:

Sensor	Concentration	Span 1	Span 2	Traceability Lot #	Pass?
pH	7.00H / pH 4.00	7.00 pH	4.00 pH	/	☑
Conductivity	12.88 mS/cm	0.00 mS/cm	12.88 mS/cm		☑
TDS	36 ppk	0.0 ppk	36.0 ppk		☑
Dissolved Oxygen	Sodium Sulphite / Air	ppm in Sodium Sulphite	8.96 ppm Saturation in Air		☑

Check only

Redox (ORP) *	Electrode operability test	240mV +/- 10%	235 mV		☑

* This meter uses an Ag/AgCl ORP electrode. To convert readings to SHE (Standard Hydrogen Electrode), add 199mV to the mV reading.

☑ Battery Status 7.4 (min 7.2V)
☑ Electrical Safety Tag attached (AS/NZS 3760)

☑ Temperature 21.3 °C
☑ Electrodes Cleaned and checked

Tag No: 000252

Valid to: 10/12/2015

Date: 30/09/2015

Signed: [signature]

Please check that the following items are received and that all items are cleaned and decontaminated before return. A minimum $30 cleaning / service / repair charge may be applied to any unclean or damaged items. Items not returned will be billed for at the full replacement cost.

Sent	Returned	Item
☑	☐	90FLMV Unit. Ops check/Battery status: 8.0
☑	☐	pH sensor with wetting cap, 5m
☑	☐	Conductivity/TDS/Temperature K=10 sensor, 5m
☑	☐	Dissolved oxygen YSI5739 sensor with wetting cap, 5m
☑	☐	Redox (ORP) sensor with wetting cap, 5m
☑	☐	Power supply 240V to 12V DC 200mA
☑	☐	Instruction Manual
☑	☐	Quick Guide
☑	☐	Plastic container with storage solution for pH and ORP sensors
☑	☐	Carry Case
☑	☐	Check to confirm electrical safety (tag must be valid)

Date: 30/09/2015

Signed: [signature]

TFS Reference	CS003436	Return Date:	/ /
Customer Reference		Return Time:	
Equipment ID	90FLMV SR	Condition on return:	
Equipment Serial No.	T5120		

ThermoFisher SCIENTIFIC

Equipment Report – Micropurge Kit (MP10)

This system has been performance checked as follows:

Sample Pro Pump		
☑ Components Cleaned / checked	✓ Ops check	
☑ MP10 Controller	✓ Included in kit	☐ Not included in kit
☑ Components Cleaned / checked	✓ Ops check	
☑ Battery check – On/Off	✓ Flow response	

Date: 30/09/2015 Checked by: MILENKO

Signed: JM

Please check that the following items are received and that all items are cleaned and decontaminated before return. A minimum $20 cleaning / service / repair charge may be applied to any unclean or damaged items. Items not returned will be billed for at the full replacement cost.

Sent	Received	Returned	Item
✓			MP10Control
✓			Red hose
✓			Maintenance kit (O rings, fittings, SS check ball, collett & screen if applicable)
✓			Compressor : REN-6
✓			Quick Start Guide
✓			MP10 Users Guide + Pump operating instructions
✓			Sample Pro Stainless Steel Pump ID: QSP6P-17
✓			2 Bladder
✓			Flow cell ID: EFC500SE
✓			Stainless Steel Hanger Cable 45 m
✓			TUBE CUTTER
			:

Processors Signature/ Initials MS

EE Quote Reference	CS003436	Condition on return
Customer Ref		
Equipment ID	QMP10-6	
Equipment serial no.		
Return Date	/ /	
Return Time		

Appendix G

Landfill Gas Field Sampling Sheets

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project
Location Moorebank

Project No. 71459.02
Reporitng Date

Time *	Well ID					
	JK106		BH7		JK101	
	6.45	6.50	7.00	7.05	7.15	7.20
			Atmospheric pressure (mb)			
Initial	1024	FLOW	1024	FLOW	1024	FLOW
			% Methane			
Initial (T=0)	0.0	0.2	**14.0**	0.0	**8.6**	0.1
30 sec	**16.1**	0.2	**8.8**	0.2	**13.8**	0.2
1.00 min	**16.1**	0.2	**8.8**	0.2	**14.0**	0.2
1.30 min	**16.1**	0.1	**8.8**	0.2	**14.0**	0.2
2.00 min	**16.1**	0.2	**8.8**	0.2	**14.0**	0.2
2.30 min	**16.1**	0.2	**8.8**	0.2	**14.0**	0.2
3.00 min	**16.1**	0.2	**8.8**	0.2	**14.0**	0.2
3.30 min	**16.0**	0.2	**8.7**	0.2	**14.0**	0.2
4.00 min	**16.0**	0.2	**8.8**	0.2	**14.0**	0.1
4.30 min	**16.0**	0.2	**8.8**	0.2	**14.0**	0.1
5.00 min	**16.0**	0.2	**8.8**	0.2	**14.0**	0.1
			% Carbon-di-oxide			
Initial (T=0)	0.1		3.0		7.2	
30 sec	4.2		9.6		7.7	
1.00 min	4.2		9.6		7.7	
1.30 min	4.2		9.6		7.7	
2.00 min	4.2		9.6		7.7	
2.30 min	4.2		9.6		7.7	
3.00 min	4.2		9.6		7.7	
3.30 min	4.2		9.6		7.7	
4.00 min	4.2		9.6		7.6	
4.30 min	4.2		9.6		7.6	
5.00 min	4.2		9.6		7.6	
			% Oxygen			
Initial (T=0)	21.2		1.5		1.1	
30 sec	2.3		0.6		0.7	
1.00 min	0.5		0.6		0.7	
1.30 min	0.5		0.6		0.7	
2.00 min	0.5		0.6		0.7	
2.30 min	0.5		0.6		0.8	
3.00 min	0.5		0.6		0.8	
3.30 min	0.4		0.6		0.8	
4.00 min	0.4		0.6		0.8	
4.30 min	0.4		0.6		0.8	
5.00 min	0.4		0.6		0.8	
			Hydrogen sulphide (ppm)			
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		1.0	
1.00 min	0.0		0.0		1.0	
1.30 min	0.0		0.0		1.0	
2.00 min	0.0		0.0		1.0	
2.30 min	0.0		0.0		1.0	
3.00 min	0.0		0.0		1.0	
3.30 min	0.0		0.0		1.0	
4.00 min	0.0		0.0		1.0	
4.30 min	0.0		0.0		1.0	
5.00 min	0.0		0.0		1.0	
			Carbon-monoxide (ppm)			
Initial (T=0)	2.0		2.0		0.0	
30 sec	2.0		2.0		1.0	
1.00 min	2.0		2.0		1.0	
1.30 min	2.0		2.0		1.0	
2.00 min	2.0		2.0		0.0	
2.30 min	2.0		2.0		0.0	
3.00 min	2.0		1.0		0.0	
3.30 min	2.0		1.0		1.0	
4.00 min	2.0		1.0		0.0	
4.30 min	2.0		1.0		0.0	
5.00 min	2.0		1.0		0.0	
			Balance (%)			
Initial (T=0)	60.5		80.2		80.5	
30 sec	78.7		81.1		77.6	
1.00 min	79.2		81.1		77.6	
1.30 min	79.3		81.1		77.6	
2.00 min	79.3		81.1		77.6	
2.30 min	79.3		81.1		77.6	
3.00 min	79.4		81.1		77.6	
3.30 min	79.4		81.1		77.6	
4.00 min	79.4		81.1		77.6	
4.30 min	79.4		81.1		77.6	
5.00 min	79.4		81.1		77.6	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project
Location Moorebank

Project No. 71459.02
Reporitng Date

Time *	Well ID					
	JK102		JK119		JK103	
	7.30	7.35	7.45	7.50	8.00	8.05
Atmospheric pressure (mb)						
Initial	1024	FLOW	1024	FLOW	1024	FLOW
% Methane						
Initial (T=0)	**13.2**	0.0	**10.5**	-0.1	0.8	0.0
30 sec	**11.0**	0.1	**8.8**	0.6	0.7	-0.1
1.00 min	**11.0**	0.1	**1.6**	0.8	0.6	0.0
1.30 min	**11.0**	0.1	0.2	0.9	0.6	0.0
2.00 min	**11.0**	0.1	0.0	0.8	0.6	0.1
2.30 min	**11.0**	0.1	0.0	0.9	0.5	0.1
3.00 min	**11.0**	0.1	0.0	0.9	0.5	0.0
3.30 min	**11.0**	0.0	0.0	0.8	0.5	0.0
4.00 min	**11.0**	0.1	0.0	0.9	0.4	0.0
4.30 min	**11.0**	0.1	0.0	0.9	0.4	-0.1
5.00 min	**11.0**	0.1	0.0	0.9	0.4	-0.1
% Carbon-di-oxide						
Initial (T=0)	6.6		6.7		1.9	
30 sec	7.8		2.4		1.5	
1.00 min	7.8		0.7		1.3	
1.30 min	7.8		0.2		1.3	
2.00 min	7.8		0.1		1.2	
2.30 min	7.8		0.1		1.1	
3.00 min	7.8		0.1		1.0	
3.30 min	7.8		0.1		1.0	
4.00 min	7.8		0.1		1.0	
4.30 min	7.8		0.1		0.9	
5.00 min	7.8		0.1		0.9	
% Oxygen						
Initial (T=0)	1.3		1.1		21.0	
30 sec	0.4		16.9		14.4	
1.00 min	0.4		20.5		14.7	
1.30 min	0.4		21.5		15.1	
2.00 min	0.4		21.7		15.4	
2.30 min	0.4		21.8		15.8	
3.00 min	0.4		21.8		16.3	
3.30 min	0.4		21.8		16.4	
4.00 min	0.4		21.9		16.8	
4.30 min	0.4		21.9		17.0	
5.00 min	0.5		21.9		17.3	
Hydrogen sulphide (ppm)						
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
Carbon-monoxide (ppm)						
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
Balance (%)						
	80.0		75.4		77.4	
30 sec	80.8		76.3		83.5	
1.00 min	80.8		78.0		83.3	
1.30 min	80.8		78.3		83.1	
2.00 min	80.8		78.2		82.8	
2.30 min	80.8		78.1		82.5	
3.00 min	80.8		78.1		82.1	
3.30 min	80.8		78.1		82.0	
4.00 min	80.8		78.1		81.8	
4.30 min	80.8		78.0		81.6	
5.00 min	80.8		78.0		81.4	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project
Location Moorebank

Project No. 71459.02
Reporitng Date

Time *	Well ID					
	JK104		JK113		JK115	
	8.15	8.20	8.30	8.35	8.55	9.00
	Atmospheric pressure (mb)					
Initial	1024	FLOW	1024	FLOW	1024	FLOW
	% Methane					
Initial (T=0)	0.5	0.0	0.0	0.1	**8.6**	0.1
30 sec	0.0	0.0	**9.8**	0.1	0.0	0.1
1.00 min	0.0	0.0	**9.8**	0.1	0.0	0.2
1.30 min	0.0	0.1	**9.8**	0.1	0.0	0.1
2.00 min	0.0	0.0	**9.8**	0.1	0.0	0.1
2.30 min	0.0	0.0	**9.9**	0.1	0.0	0.1
3.00 min	0.0	0.0	**9.9**	0.0	0.0	0.1
3.30 min	0.0	0.0	**9.9**	0.0	0.0	0.1
4.00 min	0.0	0.0	**9.9**	0.0	0.0	0.1
4.30 min	0.0	0.0	**9.9**	0.1	0.0	0.1
5.00 min	0.0	0.0	**9.9**	0.1	0.0	0.1
	% Carbon-di-oxide					
Initial (T=0)	1.7		15.5		11.1	
30 sec	3.1		15.8		9.3	
1.00 min	3.0		15.8		9.4	
1.30 min	2.7		15.8		9.5	
2.00 min	2.2		15.8		9.5	
2.30 min	2.1		15.9		9.5	
3.00 min	1.9		15.9		9.4	
3.30 min	1.8		15.9		9.4	
4.00 min	1.5		15.9		9.4	
4.30 min	1.2		15.9		9.4	
5.00 min	1.0		15.9		9.4	
	% Oxygen					
Initial (T=0)	17.2		16.3		2.2	
30 sec	10.1		1.0		7.8	
1.00 min	10.1		0.9		7.6	
1.30 min	10.9		0.9		7.6	
2.00 min	12.6		0.9		7.6	
2.30 min	13.0		0.8		7.6	
3.00 min	13.7		0.7		7.6	
3.30 min	14.4		0.7		7.7	
4.00 min	15.6		0.7		7.7	
4.30 min	16.9		0.7		7.7	
5.00 min	17.6		0.7		7.7	
	Hydrogen sulphide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
	Carbon-monoxide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		1.0		0.0	
1.00 min	0.0		1.0		0.0	
1.30 min	0.0		1.0		0.0	
2.00 min	0.0		1.0		0.0	
2.30 min	0.0		2.0		0.0	
3.00 min	0.0		2.0		0.0	
3.30 min	0.0		2.0		0.0	
4.00 min	0.0		2.0		0.0	
4.30 min	0.0		2.0		0.0	
5.00 min	0.0		2.0		0.0	
Initial (T=0)	80.8		64.1		85.7	
30 sec	86.9		73.4		82.9	
1.00 min	86.8		73.5		82.9	
1.30 min	86.3		73.5		82.9	
2.00 min	85.0		73.5		82.9	
2.30 min	84.7		73.5		82.9	
3.00 min	84.2		73.5		82.9	
3.30 min	83.7		73.5		82.9	
4.00 min	82.8		73.5		82.9	
4.30 min	81.7		73.5		82.9	
5.00 min	81.3		73.5		82.9	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project
Location Moorebank

Project No. 71459.02
Reporitng Date
Page No. 4 of 5

Time *	Well ID					
	JK114		BH16		JK110	
	9.10	9.15	9.25	9.30	9.40	9.45
	Atmospheric pressure (mb)					
Initial	1024	FLOW	1024	FLOW	1024	FLOW
	% Methane					
Initial (T=0)	0.5	0.1	**22.0**	0.1	0.8	0.2
30 sec	**24.6**	0.2	0.0	0.2	**23.1**	0.2
1.00 min	**24.6**	0.2	0.0	0.2	**23.2**	0.4
1.30 min	**24.6**	0.2	0.0	0.1	**23.2**	0.4
2.00 min	**24.6**	0.2	0.0	0.1	**23.2**	0.3
2.30 min	**24.6**	0.2	0.0	0.1	**23.2**	0.3
3.00 min	**24.5**	0.2	0.0	0.1	**23.2**	0.3
3.30 min	**24.5**	0.2	0.0	0.0	**23.2**	0.3
4.00 min	**24.5**	0.2	0.0	0.0	**23.1**	0.3
4.30 min	**24.5**	0.1	0.0	0.0	**23.1**	0.3
5.00 min	**24.5**	0.2	0.0	-0.1	**23.1**	0.3
	% Carbon-di-oxide					
Initial (T=0)	8.0		6.7		2.9	
30 sec	6.2		6.7		6.3	
1.00 min	6.2		0.5		6.3	
1.30 min	6.2		0.4		6.3	
2.00 min	6.2		2.7		6.3	
2.30 min	6.1		0.9		6.3	
3.00 min	6.1		0.7		6.3	
3.30 min	6.1		0.7		6.3	
4.00 min	6.1		0.6		6.3	
4.30 min	6.2		0.7		6.3	
5.00 min	6.1		0.6		6.3	
	% Oxygen					
Initial (T=0)	8.0		0.9		6.6	
30 sec	0.1		19.6		0.5	
1.00 min	0.1		20.9		0.4	
1.30 min	0.1		21.0		0.3	
2.00 min	0.1		19.3		0.4	
2.30 min	0.1		20.5		0.3	
3.00 min	0.1		20.8		0.2	
3.30 min	0.1		20.8		0.3	
4.00 min	0.1		20.9		0.3	
4.30 min	0.1		20.8		0.3	
5.00 min	0.1		20.9		0.2	
	Hydrogen sulphide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
	Carbon-monoxide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
	Balance (%)					
Initial (T=0)	61.8		91.7		59.4	
30 sec	69.1		79.0		70.0	
1.00 min	69.2		78.6		70.1	
1.30 min	69.2		78.5		70.2	
2.00 min	69.2		78.9		70.2	
2.30 min	69.2		78.5		70.2	
3.00 min	69.2		78.5		70.2	
3.30 min	69.2		78.5		70.4	
4.00 min	69.2		78.5		70.3	
4.30 min	69.2		78.5		70.3	
5.00 min	69.2		78.5		70.3	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project
Location Moorebank

Project No. 71459.02
Reporitng Date

Time *	Well ID					
	BH9		BH1			
	9.55	10.00	10.20	10.25		
	Atmospheric pressure (mb)					
Initial	1024	FLOW	1024	FLOW		
	% Methane					
Initial (T=0)	**20.9**	0.2	1.3	0.1		
30 sec	**5.2**	0.3	0.0	0.2		
1.00 min	**2.7**	0.3	0.0	0.1		
1.30 min	**2.2**	0.3	0.0	0.1		
2.00 min	**2.1**	0.2	0.0	0.1		
2.30 min	**2.2**	0.2	0.0	0.1		
3.00 min	1.3	0.2	0.0	0.0		
3.30 min	1.4	0.2	0.0	0.1		
4.00 min	0.8	0.2	0.0	0.1		
4.30 min	0.8	0.2	0.0	0.1		
5.00 min	0.9	0.3	0.0	0.0		
	% Carbon-di-oxide					
Initial (T=0)	6.1		1.7			
30 sec	3.2		0.3			
1.00 min	2.6		0.2			
1.30 min	2.3		0.2			
2.00 min	1.8		0.1			
2.30 min	2.2		0.1			
3.00 min	1.2		0.2			
3.30 min	1.4		0.1			
4.00 min	0.8		0.1			
4.30 min	0.9		0.1			
5.00 min	0.9		0.1			
	% Oxygen					
Initial (T=0)	1.5		19.7			
30 sec	16.0		20.4			
1.00 min	17.1		20.8			
1.30 min	17.6		20.9			
2.00 min	17.9		20.9			
2.30 min	17.5		20.9			
3.00 min	18.7		20.8			
3.30 min	18.6		20.9			
4.00 min	19.3		21.0			
4.30 min	19.4		21.1			
5.00 min	19.3		21.0			
	Hydrogen sulphide (ppm)					
Initial (T=0)	0.0		0.0			
30 sec	0.0		0.0			
1.00 min	0.0		0.0			
1.30 min	0.0		0.0			
2.00 min	0.0		0.0			
2.30 min	0.0		0.0			
3.00 min	0.0		0.0			
3.30 min	0.0		0.0			
4.00 min	0.0		0.0			
4.30 min	0.0		0.0			
5.00 min	0.0		0.0			
	Carbon-monoxide (ppm)					
Initial (T=0)	0.0		0.0			
30 sec	0.0		0.0			
1.00 min	0.0		0.0			
1.30 min	0.0		0.0			
2.00 min	0.0		0.0			
2.30 min	0.0		0.0			
3.00 min	0.0		0.0			
3.30 min	0.0		0.0			
4.00 min	0.0		0.0			
4.30 min	0.0		0.0			
5.00 min	0.0		0.0			
	Balance (%)					
Initial (T=0)	7.5		79.6			
30 sec	78.0		79.1			
1.00 min	78.1		79.0			
1.30 min	77.8		79.0			
2.00 min	78.6		79.0			
2.30 min	78.2		79.0			
3.00 min	78.9		79.0			
3.30 min	78.8		79.0			
4.00 min	79.1		78.9			
4.30 min	78.9		78.8			
5.00 min	79.1		78.9			

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date
Page No. 1 of 9

Time *	Well ID					
	BH1		BH202		JK101	
	6.20		6.40		7.00	
	Atmospheric pressure (mb)					
Initial	1023	FLOW	1023	FLOW	1025	FLOW
	% Methane					
Initial (T=0)	0.0	0.0	0.0	0.0	0.0	0.0
30 sec	0.0	0.1	1.1	0.1	**14.2**	0.2
1.00 min	0.0	0.1	1.1	0.1	**14.0**	0.2
1.30 min	0.0	0.1	1.1	0.2	**14.0**	0.3
2.00 min	0.0	0.1	1.1	0.2	**14.0**	0.2
2.30 min	0.0	0.2	1.1	0.2	**14.0**	0.2
3.00 min	0.0	0.2	1.1	0.3	**14.5**	0.3
3.30 min	0.0	0.2	1.1	0.2	**14.2**	0.2
4.00 min	0.0	0.2	1.1	0.2	**14.2**	0.1
4.30 min	0.0	0.2	1.1	0.2	**14.3**	0.2
5.00 min	0.0	0.2	1.1	0.2	**14.1**	0.2
	% Carbon-di-oxide					
Initial (T=0)	3.5		0.1		0.1	
30 sec	2.3		11.9		7.2	
1.00 min	1.2		12.2		7.2	
1.30 min	1.5		12.2		7.3	
2.00 min	1.9		12.4		7.1	
2.30 min	1.9		12.2		7.2	
3.00 min	2.0		12.3		7.4	
3.30 min	2.0		12.4		7.3	
4.00 min	2.0		12.3		7.3	
4.30 min	2.0		12.4		7.3	
5.00 min	1.8		12.4		7.3	
	% Oxygen					
Initial (T=0)	20.3		21.5		21.0	
30 sec	19.7		2.0		1.3	
1.00 min	20.2		0.9		1.2	
1.30 min	20.2		0.9		1.0	
2.00 min	20.0		0.7		1.1	
2.30 min	20.0		0.9		1.1	
3.00 min	20.1		0.9		0.4	
3.30 min	20.0		0.7		0.8	
4.00 min	20.0		0.8		0.7	
4.30 min	20.0		0.7		0.6	
5.00 min	20.2		0.6		0.8	
	Hydrogen sulphide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		1.0	
	Carbon-monoxide (ppm)					
Initial (T=0)	18.0		2.0		0.0	
30 sec	12.0		9.0		3.0	
1.00 min	8.0		14.0		5.0	
1.30 min	6.0		16.0		7.0	
2.00 min	5.0		16.0		8.0	
2.30 min	4.0		17.0		9.0	
3.00 min	3.0		18.0		10.0	
3.30 min	2.0		19.0		10.0	
4.00 min	2.0		19.0		10.0	
4.30 min	1.0		19.0		11.0	
5.00 min	1.0		19.0		11.0	
	Balance (%)					
Initial (T=0)	78.0		67.8		56.6	
30 sec	78.0		85.4		77.7	
1.00 min	78.3		85.8		77.7	
1.30 min	78.2		85.7		77.6	
2.00 min	78.2		86.0		77.7	
2.30 min	78.1		85.7		77.5	
3.00 min	78.1		85.8		77.8	
3.30 min	78.0		85.9		77.8	
4.00 min	78.1		85.8		77.8	
4.30 min	77.9		85.9		77.9	
5.00 min	78.1		85.9		77.9	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date
Page No. 2 of 9

Time *	Well ID					
	JK7		JK106		JK119	
	7.20		7.35		7.55	
	Atmospheric pressure (mb)					
Initial	1025	FLOW	1025	FLOW	1026	FLOW
	% Methane					
Initial (T=0)	0.1	0.1	**5.7**	0.1	0.0	0.0
30 sec	2.2	0.2	**12.6**	0.4	**11.9**	0.4
1.00 min	**2.7**	0.2	**13.2**	0.4	**3.0**	0.6
1.30 min	**3.1**	0.2	**12.9**	0.3	1.4	0.7
2.00 min	**3.3**	0.1	**13.2**	0.3	0.9	0.7
2.30 min	**3.3**	0.2	**13.2**	0.3	0.9	0.7
3.00 min	**3.5**	0.2	**13.2**	0.4	0.8	0.7
3.30 min	**3.5**	0.0	**13.2**	0.3	0.6	0.6
4.00 min	**3.7**	0.1	**12.9**	0.3	0.5	0.7
4.30 min	**3.9**	0.0	**12.7**	0.4	0.3	0.7
5.00 min	**4.1**	0.0	**13.0**	0.4	0.3	0.7
	% Carbon-di-oxide					
Initial (T=0)	0.2		4.5		0.2	
30 sec	4.1		3.7		3.1	
1.00 min	4.8		3.6		1.2	
1.30 min	5.5		3.5		0.6	
2.00 min	5.8		3.6		0.4	
2.30 min	5.9		3.6		0.5	
3.00 min	6.0		3.6		0.4	
3.30 min	6.1		3.6		0.3	
4.00 min	6.5		3.5		0.3	
4.30 min	6.7		3.5		0.2	
5.00 min	7.0		3.5		0.2	
	% Oxygen					
Initial (T=0)	21.4		4.0		20.3	
30 sec	12.3		0.6		16.5	
1.00 min	11.0		0.6		19.8	
1.30 min	9.4		0.9		20.6	
2.00 min	8.8		0.5		20.9	
2.30 min	8.7		0.7		20.9	
3.00 min	8.1		0.6		21.0	
3.30 min	8.0		0.6		21.1	
4.00 min	6.6		1.0		21.2	
4.30 min	6.0		1.3		21.2	
5.00 min	5.5		0.9		21.2	
	Hydrogen sulphide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		1.0		0.0	
4.30 min	0.0		1.0		0.0	
5.00 min	0.0		1.0		0.0	
	Carbon-monoxide (ppm)					
Initial (T=0)	0.0		3.0		0.0	
30 sec	0.0		4.0		0.0	
1.00 min	0.0		5.0		0.0	
1.30 min	0.0		5.0		0.0	
2.00 min	0.0		6.0		0.0	
2.30 min	0.0		6.0		0.0	
3.00 min	0.0		6.0		0.0	
3.30 min	0.0		6.0		0.0	
4.00 min	0.0		6.0		0.0	
4.30 min	0.0		6.0		0.0	
5.00 min	1.0		6.0		0.0	
	Balance (%)					
Initial (T=0)	74.8		83.1		49.9	
30 sec	81.2		82.9		73.376.7	
1.00 min	81.5		82.8		77.6	
1.30 min	82.0		82.6		77.7	
2.00 min	82.1		82.6		77.9	
2.30 min	82.0		82.6		77.9	
3.00 min	82.4		82.7		78.0	
3.30 min	82.3		82.7		78.2	
4.00 min	83.1		82.6		78.3	
4.30 min	83.3		82.4		78.3	
5.00 min	83.4		82.5		78.2	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date
Page No. 3 of 9

Time *	Well ID					
	JK103a		JK103b		JK104	
	8.15		8.25		8.55	
	Atmospheric pressure (mb)					
Initial	1027	FLOW	1027	FLOW	1028	FLOW
	% Methane					
Initial (T=0)	0.0	0.0	0.0	0.0	0.0	0.0
30 sec	0.7	0.5	1.4	0.2	0.0	0.1
1.00 min	0.0	0.6	0.8	0.2	0.0	0.1
1.30 min	0.0	0.6	0.8	0.2	0.0	0.2
2.00 min	0.0	0.6	0.7	0.2	0.0	0.1
2.30 min	0.0	0.6	0.6	0.3	0.0	0.1
3.00 min	0.0	0.7	0.7	0.2	0.0	0.1
3.30 min	0.0	0.6	0.7	0.3	0.0	0.1
4.00 min	0.0	0.7	0.7	0.3	0.0	0.0
4.30 min	0.0	0.6	0.7	0.2	0.0	0.0
5.00 min	0.0	0.6	0.7	0.2	0.0	0.0
	% Carbon-di-oxide					
Initial (T=0)	0.2		1.2		0.1	
30 sec	3.1		0.6		4.0	
1.00 min	0.7		0.4		4.0	
1.30 min	0.3		0.4		.3.8	
2.00 min	0.2		0.3		2.7	
2.30 min	0.2		0.3		2.4	
3.00 min	0.1		0.3		2.1	
3.30 min	0.1		0.3		1.7	
4.00 min	0.1		0.3		1.6	
4.30 min	0.1		0.3		1.4	
5.00 min	0.2		0.3		1.3	
	% Oxygen					
Initial (T=0)	21.2		21.1		21.7	
30 sec	18.2		20.5		14.2	
1.00 min	20.5		20.7		13.7	
1.30 min	21.1		20.7		13.9	
2.00 min	21.1		20.8		16.1	
2.30 min	21.2		20.9		16.7	
3.00 min	21.2		20.8		17.3	
3.30 min	21.2		20.9		18.3	
4.00 min	21.3		20.9		18.5	
4.30 min	21.3		20.9		18.3	
5.00 min	21.2		20.9		19.0	
	Hydrogen sulphide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
	Carbon-monoxide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
	Balance (%)					
Initial (T=0)	78.5		75.9		74.6	
30 sec	78.5		78.2		82.0	
1.00 min	78.8		78.2		82.3	
1.30 min	78.7		78.2		82.0	
2.00 min	78.7		78.2		81.1	
2.30 min	78.7		78.1		80.8	
3.00 min	78.6		78.1		80.4	
3.30 min	78.6		78.1		80.0	
4.00 min	78.6		78.1		79.9	
4.30 min	78.6		78.1		79.8	
5.00 min	78.6		78.1		79.6	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date
Page No. 4 of 9

Time *	Well ID					
	BH211		BH211a		JK9	
	9.20		9.30		9.45	
	Atmospheric pressure (mb)					
Initial	1029		1029		1029	
	% Methane					
Initial (T=0)	0.0	0.0	0.0		0.0	0.0
30 sec	0.0	0.3	0.0		0.0	0.1
1.00 min	0.0	0.3	0.0		0.0	0.1
1.30 min	0.0	0.3	0.0		0.0	0.1
2.00 min	0.0	0.3	0.0		0.0	0.1
2.30 min	0.0	0.3	0.0		0.0	0.1
3.00 min	0.0	0.3	0.0		0.0	0.1
3.30 min	0.0	0.2	0.0		0.0	0.1
4.00 min	0.0	0.2	0.0		0.0	0.1
4.30 min	0.0	0.3	0.0		0.0	0.1
5.00 min	0.0	0.2	0.0		0.0	0.0
	% Carbon-di-oxide					
Initial (T=0)	0.1		1.1		2.9	
30 sec	1.5		3.6		0.0	
1.00 min	1.4		3.6		0.0	
1.30 min	1.4		3.6		0.0	
2.00 min	1.4		3.6		0.0	
2.30 min	1.4		3.6		0.0	
3.00 min	1.4		3.6		0.0	
3.30 min	1.0		3.6		0.0	
4.00 min	1.3		3.6		0.0	
4.30 min	1.3		3.7		0.0	
5.00 min	1.2		3.7		0.0	
	%Oxygen					
Initial (T=0)	21.5		20.6		18.8	
30 sec	20.7		18.8		21.1	
1.00 min	20.7		18.8		21.3	
1.30 min	20.7		18.8		21.3	
2.00 min	20.7		18.8		21.3	
2.30 min	20.7		18.8		21.3	
3.00 min	20.7		18.8		21.3	
3.30 min	20.7		18.8		21.3	
4.00 min	20.8		18.8		21.3	
4.30 min	20.8		18.8		21.3	
5.00 min	20.8		18.8		21.3	
	Hydrogen sulphide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
	Carbon-monoxide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	1.0		0.0		0.0	
1.00 min	1.0		0.0		0.0	
1.30 min	2.0		0.0		0.0	
2.00 min	2.0		0.0		0.0	
2.30 min	2.0		0.0		0.0	
3.00 min	2.0		0.0		0.0	
3.30 min	2.0		0.0		0.0	
4.00 min	2.0		0.0		0.0	
4.30 min	2.0		0.0		0.0	
5.00 min	2.0		0.0		0.0	
	Balance (%)					
Initial (T=0)	77.1		76.3		80.8	
30 sec	77.8		77.6		78.8	
1.00 min	77.8		77.6		78.7	
1.30 min	77.9		77.6		78.7	
2.00 min	77.9		77.6		78.7	
2.30 min	77.9		77.6		78.7	
3.00 min	77.9		77.6		78.6	
3.30 min	78.0		77.5		78.6	
4.00 min	78.0		77.6		78.6	
4.30 min	78.0		77.6		78.6	
5.00 min	78.0		77.5		78.6	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date
Page No. 5 of 9

Time *	Well ID					
	JKJ113		JK102		JK107b	
	10.10		10.30		10.50	
	Atmospheric pressure (mb)					
Initial	1030	FLOW	1030	FLOW	1030	FLOW
	% Methane					
Initial (T=0)	0.0	0.1	0.0	0.0	**10.2**	0.0
30 sec	**4.4**	0.2	**11.7**	0.2	**8.6**	0.2
1.00 min	**4.8**	0.3	**11.9**	0.2	**8.5**	0.1
1.30 min	**5.2**	0.3	**11.7**	0.2	**8.3**	0.1
2.00 min	**5.4**	0.3	**11.9**	0.2	**7.8**	0.1
2.30 min	**5.7**	0.3	**11.9**	0.3	**7.6**	0.1
3.00 min	**5.6**	0.2	**11.9**	0.3	**7.3**	0.0
3.30 min	**5.8**	0.3	**12.0**	0.3	**6.7**	0.0
4.00 min	**5.9**	0.3	**11.9**	0.2	**5.5**	0.0
4.30 min	**6.0**	0.4	**11.7**	0.3	**4.3**	-0.1
5.00 min	**6.0**	0.3	**11.8**	0.2	**3.1**	0.0
	% Carbon-di-oxide					
Initial (T=0)	0.1		0.2		5.6	
30 sec	11.8		6.3		0.2	
1.00 min	12.7		6.4		0.2	
1.30 min	13.7		6.3		0.2	
2.00 min	13.9		6.4		0.2	
2.30 min	14.3		6.4		0.2	
3.00 min	14.0		6.4		0.2	
3.30 min	14.4		6.4		0.2	
4.00 min	14.5		6.4		0.2	
4.30 min	14.4		6.3		0.2	
5.00 min	14.4		6.3		0.2	
	% Oxygen					
Initial (T=0)	21.5		21.2		2.1	
30 sec	3.4		1.0		3.2	
1.00 min	2.6		0.1		3.4	
1.30 min	1.7		0.7		3.4	
2.00 min	1.5		0.3		4.6	
2.30 min	1.1		0.2		4.9	
3.00 min	1.5		0.3		5.5	
3.30 min	1.0		0.3		6.7	
4.00 min	0.8		0.4		9.4	
4.30 min	0.9		0.6		11.8	
5.00 min	0.9		0.5		14.0	
	Hydrogen sulphide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
	Carbon-monoxide (ppm)					
Initial (T=0)	0.0		0.0		2.0	
30 sec	8.0		0.0		4.0	
1.00 min	11.0		1.0		4.0	
1.30 min	13.0		1.0		4.0	
2.00 min	14.0		2.0		3.0	
2.30 min	15.0		2.0		3.0	
3.00 min	16.0		3.0		3.0	
3.30 min	16.0		3.0		3.0	
4.00 min	17.0		3.0		2.0	
4.30 min	17.0		3.0		1.0	
5.00 min	17.0		3.0		0.0	
	Balance (%)					
Initial (T=0)	65.4		64.5		88.2	
30 sec	80.1		81.1		88.0	
1.00 min	79.6		81.4		87.9	
1.30 min	79.2		81.2		87.6	
2.00 min	79.0		81.6		87.5	
2.30 min	79.0		81.5		87.3	
3.00 min	79.0		81.4		87.1	
3.30 min	78.8		81.5		85.8	
4.00 min	78.7		81.3		85.0	
4.30 min	78.7		81.4		83.9	
5.00 min	78.7		81.2		82.7	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date
Page No. 6 of 9

Time *	Well ID					
	JK107a		MW216		JK110	
	11.00		11.20		11.40	
	Atmospheric pressure (mb)					
Initial	1030	FLOW	1030	FLOW	1031	FLOW
	% Methane					
Initial (T=0)	**3.0**	0.0	0.3	0.0	0.2	0.1
30 sec	0.0	0.2	**15.8**	0.2	**18.8**	0.3
1.00 min	0.0	0.3	**15.8**	0.2	**18.8**	0.4
1.30 min	0.0	0.3	**15.9**	0.2	**19.0**	0.4
2.00 min	0.0	0.4	**15.9**	0.2	**19.0**	0.4
2.30 min	0.0	0.3	**15.8**	0.2	**19.0**	0.5
3.00 min	0.0	0.3	**15.9**	0.2	**19.0**	0.4
3.30 min	0.0	0.3	**16.0**	0.2	**19.0**	0.4
4.00 min	0.0	0.3	**16.0**	0.2	**19.0**	0.4
4.30 min	0.0	0.3	**15.8**	0.2	**19.0**	0.5
5.00 min	0.0	0.4	**16.0**	0.2	**19.0**	0.4
	% Carbon-di-oxide					
Initial (T=0)	0.0		1.8		6.2	
30 sec	0.0		6.2		6.3	
1.00 min	0.0		6.1		6.3	
1.30 min	0.0		6.2		6.3	
2.00 min	0.0		6.2		6.3	
2.30 min	0.0		6.2		6.3	
3.00 min	0.0		6.2		6.3	
3.30 min	0.0		6.2		6.3	
4.00 min	0.1		6.2		6.3	
4.30 min	0.2		6.2		6.3	
5.00 min	0.2		6.3		6.3	
	% Oxygen					
Initial (T=0)	14.7		19.2		21.2	
30 sec	21.5		0.7		0.8	
1.00 min	21.5		0.6		0.4	
1.30 min	21.6		0.4		0.2	
2.00 min	21.6		0.4		0.2	
2.30 min	21.6		0.5		0.2	
3.00 min	21.6		0.3		0.2	
3.30 min	21.6		0.2		0.2	
4.00 min	21.5		0.2		0.2	
4.30 min	21.3		0.4		0.2	
5.00 min	21.2		0.1		0.1	
	Hydrogen sulphide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
	Carbon-monoxide (ppm)					
Initial (T=0)	0.0		1.0		0.0	
30 sec	0.0		2.0		0.0	
1.00 min	0.0		2.0		0.0	
1.30 min	0.0		3.0		0.0	
2.00 min	0.0		3.0		1.0	
2.30 min	0.0		4.0		1.0	
3.00 min	0.0		4.0		1.0	
3.30 min	0.0		4.0		2.0	
4.00 min	1.0		5.0		2.0	
4.30 min	3.0		5.0		2.0	
5.00 min	5.0		5.0		2.0	
	Balance (%)					
Initial (T=0)	82.3		65.0		62.2	
30 sec	78.5		77.4		74.4	
1.00 min	78.4		77.5		74.4	
1.30 min	78.4		77.5		74.6	
2.00 min	78.4		77.6		74.5	
2.30 min	78.4		77.5		74.5	
3.00 min	78.4		77.5		74.6	
3.30 min	78.4		77.7		74.5	
4.00 min	78.4		77.6		74.6	
4.30 min	78.5		77.5		74.5	
5.00 min	78.6		77.6		74.5	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date
Page No. 7 of 9

Time *	Well ID					
	JK118A		JK118B		MW218	
	11.55		12.05		12.20	
Atmospheric pressure (mb)						
Initial	1031	FLOW	1031	FLOW	1031	FLOW
% Methane						
Initial (T=0)	**17.3**	0.1	**12.9**	0.2	0.6	0.1
30 sec	**13.2**	0.2	0.0	0.2	**24.2**	0.1
1.00 min	**13.1**	0.2	0.0	0.2	**24.2**	0.2
1.30 min	**13.2**	0.2	0.0	0.2	**23.5**	0.1
2.00 min	**13.1**	0.3	0.0	0.2	**22.5**	0.2
2.30 min	**13.1**	0.2	0.0	0.2	**21.3**	0.2
3.00 min	**13.2**	0.2	0.0	0.2	**20.2**	0.2
3.30 min	**13.2**	0.2	0.0	0.1	**18.6**	0.2
4.00 min	**13.2**	0.2	0.0	0.1	**16.6**	0.2
4.30 min	**13.2**	0.3	0.0	0.1	**15.1**	0.2
5.00 min	**13.2**	0.2	0.0	0.1	**13.3**	0.2
% Carbon-di-oxide						
Initial (T=0)	5.7		4.5		1.9	
30 sec	4.6		1.4		10.2	
1.00 min	4.7		1.4		10.1	
1.30 min	4.7		1.4		9.9	
2.00 min	4.7		1.4		9.6	
2.30 min	4.7		1.4		9.3	
3.00 min	4.7		1.4		9.0	
3.30 min	4.7		1.4		8.5	
4.00 min	4.7		1.4		7.9	
4.30 min	4.7		1.4		7.3	
5.00 min	4.7		1.4		6.7	
% Oxygen						
Initial (T=0)	1.2		0.4		2.8	
30 sec	0.4		1.6		8.6	
1.00 min	0.1		1.7		8.7	
1.30 min	0.2		1.7		8.9	
2.00 min	0.2		1.6		9.2	
2.30 min	0.3		1.6		9.6	
3.00 min	0.1		1.8		9.9	
3.30 min	0.1		1.8		10.2	
4.00 min	0.1		1.9		10.9	
4.30 min	0.1		2.0		11.5	
5.00 min	0.1		2.1		12.3	
Hydrogen sulphide (ppm)						
Initial (T=0)	0.0		0.0		0.0	
30 sec	1.0		0.0		0.0	
1.00 min	1.0		0.0		0.0	
1.30 min	1.0		0.0		0.0	
2.00 min	1.0		0.0		0.0	
2.30 min	1.0		0.0		0.0	
3.00 min	1.0		0.0		0.0	
3.30 min	1.0		0.0		0.0	
4.00 min	1.0		0.0		0.0	
4.30 min	1.0		0.0		0.0	
5.00 min	1.0		0.0		0.0	
Carbon-monoxide (ppm)						
Initial (T=0)	1.0				0.0	
30 sec	2.0		0.0		3.0	
1.00 min	3.0		0.0		4.0	
1.30 min	3.0		0.0		4.0	
2.00 min	3.0		0.0		5.0	
2.30 min	3.0		0.0		5.0	
3.00 min	3.0		0.0		4.0	
3.30 min	3.0		0.0		5.0	
4.00 min	3.0		0.0		5.0	
4.30 min	3.0		0.0		5.0	
5.00 min	3.0		0.0		5.0	
Balance (%)						
Initial (T=0)	79.5		97.2		61.1	
30 sec	82.0		96.9		56.9	
1.00 min	82.0		96.9		57.2	
1.30 min	82.0		96.9		58.0	
2.00 min	82.0		97.0		59.0	
2.30 min	82.0		96.8		60.3	
3.00 min	82.0		96.8		61.5	
3.30 min	82.1		96.8		63.3	
4.00 min	82.1		96.7		65.4	
4.30 min	82.1		96.6		67.0	
5.00 min	82.0		96.4		68.2	

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date
Page No. 8 of 9

Time *	Well ID					
	JK115		JK114		JK114a	
	12.50		13.10		13.25	
	Atmospheric pressure (mb)					
Initial	1031	FLOW	1032	FLOW	1032	FLOW
	% Methane					
Initial (T=0)	0.6	0.1	0.0	0.0	**20.2**	0.1
30 sec	0.0	0.1	**22.2**	0.1	**9.5**	0.1
1.00 min	0.0	0.1	**22.2**	0.1	**8.5**	0.1
1.30 min	0.0	0.1	**22.2**	0.2	**8.4**	0.2
2.00 min	0.0	0.1	**22.2**	0.1	**8.4**	0.2
2.30 min	0.0	0.2	**22.0**	0.1	**8.5**	0.1
3.00 min	0.0	0.1	**22.1**	0.0	**8.5**	0.1
3.30 min	0.0	0.2	**22.2**	0.0	**8.4**	0.1
4.00 min	0.0	0.2	**22.1**	0.0	**8.4**	0.1
4.30 min	0.0	0.2	**22.2**	0.0	**8.4**	0.1
5.00 min	0.0	0.1	**22.2**	0.0	**8.5**	0.0
	% Carbon-di-oxide					
Initial (T=0)	6.7		0.3		5.1	
30 sec	9.1		5.3		6.9	
1.00 min	8.9		5.3		7.2	
1.30 min	8.9		5.3		7.2	
2.00 min	8.9		5.3		7.1	
2.30 min	9.0		5.3		7.1	
3.00 min	9.0		5.3		7.2	
3.30 min	8.9		5.3		7.1	
4.00 min	8.9		5.3		7.1	
4.30 min	8.8		5.3		7.2	
5.00 min	8.8		5.3		7.2	
	% Oxygen					
Initial (T=0)	21.1		21.5		0.8	
30 sec	12.7		1.0		0.2	
1.00 min	12.6		0.1		.2.	
1.30 min	12.7		0.0		3.0	
2.00 min	12.7		0.0		0.3	
2.30 min	12.6		0.1		0.1	
3.00 min	12.7		0.0		0.1	
3.30 min	12.8		0.0		0.3	
4.00 min	12.7		0.0		0.3	
4.30 min	12.9		0.0		0.2	
5.00 min	12.9		0.0		0.2	
	Hydrogen sulphide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
	Carbon-monoxide (ppm)					
Initial (T=0)	0.0		0.0		1.0	
30 sec	0.0		0.0		1.0	
1.00 min	0.0		0.0		1.0	
1.30 min	0.0		0.0		1.0	
2.00 min	0.0		0.0		1.0	
2.30 min	0.0		1.0		1.0	
3.00 min	0.0		1.0		1.0	
3.30 min	0.0		2.0		1.0	
4.00 min	0.0		2.0		1.0	
4.30 min	0.0		2.0		1.0	
5.00 min	0.0		2.0		1.0	
	Balance (%)					
Initial (T=0)	71.1		54.3		80.8	
30 sec	78.3		72.1		84.0	
1.00 min	78.1		72.5		84.2	
1.30 min	78.1		72.5		84.2	
2.00 min	78.4		72.6		84.2	
2.30 min	78.4		72.5		84.2	
3.00 min	78.4		72.6		84.2	
3.30 min	78.3		72.6		84.1	
4.00 min	78.3		72.6		84.1	
4.30 min	78.3		72.6		84.1	
5.00 min	78.4		72.6		84.1	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date

Time *	Well ID					
	JK116		BH223			
	13.45		14.05			
Atmospheric pressure (mb)						
Initial	1032	FLOW	1032	FLOW		
% Methane						
Initial (T=0)	**8.5**	0.2	0.0	0.1		
30 sec	0.0	0.2	1.1	0.1		
1.00 min	0.0	0.3	1.1	0.1		
1.30 min	0.0	0.3	1.1	0.2		
2.00 min	0.0	0.3	1.1	0.1		
2.30 min	0.0	0.3	1.1	0.1		
3.00 min	0.0	0.2	1.1	0.2		
3.30 min	0.0	0.3	1.1	0.2		
4.00 min	0.0	0.3	1.1	0.2		
4.30 min	0.0	0.3	1.1	0.1		
5.00 min	0.0	0.3	1.1	0.1		
% Carbon-di-oxide						
Initial (T=0)	6.5		0.3			
30 sec	4.8		3.4			
1.00 min	4.1		3.4			
1.30 min	4.0		3.4			
2.00 min	4.0		3.4			
2.30 min	3.9		3.4			
3.00 min	4.0		3.4			
3.30 min	3.9		3.3			
4.00 min	4.0		3.4			
4.30 min	3.9		3.4			
5.00 min	3.9		3.4			
% Oxygen						
Initial (T=0)	1.3		21.6			
30 sec	14.2		14.1			
1.00 min	17.7		13.6			
1.30 min	18.2		13.5			
2.00 min	18.2		13.5			
2.30 min	18.3		13.4			
3.00 min	18.3		13.4			
3.30 min	18.4		13.6			
4.00 min	18.4		13.5			
4.30 min	18.4		13.5			
5.00 min	18.5		13.5			
Hydrogen sulphide (ppm)						
Initial (T=0)	0.0		0.0			
30 sec	0.0		0.0			
1.00 min	0.0		0.0			
1.30 min	0.0		0.0			
2.00 min	0.0		0.0			
2.30 min	0.0		0.0			
3.00 min	0.0		0.0			
3.30 min	0.0		0.0			
4.00 min	0.0		0.0			
4.30 min	0.0		0.0			
5.00 min	0.0		0.0			
Carbon-monoxide (ppm)						
Initial (T=0)	0.0		0.0			
30 sec	0.0		0.0			
1.00 min	0.0		0.0			
1.30 min	0.0		0.0			
2.00 min	0.0		0.0			
2.30 min	0.0		0.0			
3.00 min	0.0		0.0			
3.30 min	0.0		0.0			
4.00 min	0.0		0.0			
4.30 min	0.0		0.0			
5.00 min	0.0		0.0			
Balance (%)						
Initial (T=0)	88.9		76.2			
30 sec	79.8		81.7			
1.00 min	78.1		82.0			
1.30 min	77.8		82.0			
2.00 min	77.8		82.0			
2.30 min	77.7		82.0			
3.00 min	77.7		82.1			
3.30 min	77.7		82.0			
4.00 min	77.6		82.0			
4.30 min	77.5		82.1			
5.00 min	77.5		82.1			

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date

Time *	Well ID					
	JK1		BH202		JK101	
	6.00		6.15		6.30	
	Atmospheric pressure (mb)					
Initial	1022	FLOW	1022	FLOW	1022	FLOW
	% Methane					
Initial (T=0)	0.0	0.2	0.0	0.0	0.7	0.0
30 sec	0.0	0.1	0.8	0.3	**14.1**	0.2
1.00 min	0.0	0.1	0.8	0.4	**14.1**	0.2
1.30 min	0.0	0.2	0.8	0.4	**14.1**	0.3
2.00 min	0.0	0.2	0.8	0.3	**14.1**	0.2
2.30 min	0.0	0.2	0.8	0.3	**14.1**	0.2
3.00 min	0.0	0.2	0.8	0.4	**14.1**	0.3
3.30 min	0.0	0.1	0.8	0.3	**13.9**	0.2
4.00 min	0.0	0.2	0.8	0.3	**13.9**	0.1
4.30 min	0.0	0.1	0.8	0.3	**13.9**	0.2
5.00 min	0.0	0.1	0.8	0.3	**13.8**	0.2
	% Carbon-di-oxide					
Initial (T=0)	2.2		0.1		10.2	
30 sec	1.2		12.7		7.5	
1.00 min	1.0		13.0		7.5	
1.30 min	1.0		13.0		7.5	
2.00 min	1.0		13.2		7.5	
2.30 min	1.0		13.2		7.5	
3.00 min	1.0		13.2		7.5	
3.30 min	0.9		13.1		7.4	
4.00 min	0.9		13.1		7.4	
4.30 min	0.8		13.1		7.4	
5.00 min	0.8		13.1		7.4	
	% Oxygen					
Initial (T=0)	19.4		21.1		1.6	
30 sec	19.8		3.1		1.0	
1.00 min	20.0		1.0		0.8	
1.30 min	20.1		0.9		0.8	
2.00 min	20.1		0.8		0.8	
2.30 min	20.1		0.6		0.8	
3.00 min	20.1		0.7		0.9	
3.30 min	20.2		0.7		1.1	
4.00 min	20.2		0.7		1.1	
4.30 min	20.2		0.6		1.1	
5.00 min	20.2		0.7		1.2	
	Hydrogen sulphide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		1.0	
1.00 min	0.0		0.0		1.0	
1.30 min	0.0		0.0		1.0	
2.00 min	0.0		0.0		1.0	
2.30 min	0.0		0.0		1.0	
3.00 min	0.0		0.0		1.0	
3.30 min	0.0		0.0		1.0	
4.00 min	0.0		0.0		2.0	
4.30 min	0.0		0.0		2.0	
5.00 min	0.0		0.0		2.0	
	Carbon-monoxide (ppm)					
Initial (T=0)	2.0		2.0		4.0	
30 sec	1.0		1.0		4.0	
1.00 min	1.0		1.0		4.0	
1.30 min	0.0		2.0		4.0	
2.00 min	0.0		2.0		4.0	
2.30 min	0.0		2.0		4.0	
3.00 min	0.0		3.0		4.0	
3.30 min	0.0		3.0		4.0	
4.00 min	0.0		3.0		4.0	
4.30 min	0.0		3.0		4.0	
5.00 min	0.0		3.0		4.0	
	Balance (%)					
Initial (T=0)	79.3		68.3		76.8	
30 sec	79.0		84.2		77.5	
1.00 min	78.9		85.3		77.5	
1.30 min	78.9		85.3		77.5	
2.00 min	78.9		85.4		77.6	
2.30 min	78.9		85.4		77.6	
3.00 min	78.9		85.4		77.6	
3.30 min	79.0		85.4		77.6	
4.00 min	79.0		85.4		77.6	
4.30 min	78.9		85.4		77.7	
5.00 min	78.9		85.4		77.6	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date

Time *	Well ID					
	JK102		JK119		JK103a	
	6.45		7.00		7.15	
Atmospheric pressure (mb)						
Initial	1022	FLOW	1022	FLOW	1022	FLOW
% Methane						
Initial (T=0)	12.2	0.1	**12.7**	-0.1	0.0	0.1
30 sec	12.9	0.2	**16.2**	0.1	0.0	0.3
1.00 min	**13.1**	0.2	**9.6**	0.3	0.0	0.3
1.30 min	**13.1**	0.2	**3.6**	0.5	0.0	0.4
2.00 min	**13.1**	0.1	1.1	0.5	0.0	0.3
2.30 min	**13.2**	0.2	0.8	0.5	0.0	0.2
3.00 min	**13.2**	0.2	0.6	0.5	0.0	0.3
3.30 min	**13.1**	0.0	0.5	0.6	0.0	0.3
4.00 min	**13.0**	0.1	0.2	0.4	0.0	0.2
4.30 min	**13.1**	0.0	0.0	0.4	0.0	0.2
5.00 min	**13.2**	0.0	0.0	0.5	0.0	0.2
% Carbon-di-oxide						
Initial (T=0)	6.2		5.8		0.1	
30 sec	6.5		5.6		1.7	
1.00 min	6.5		2.8		1.6	
1.30 min	6.6		1.3		1.6	
2.00 min	6.6		0.6		1.5	
2.30 min	6.6		0.4		1.5	
3.00 min	6.5		0.4		1.5	
3.30 min	6.5		0.3		1.4	
4.00 min	6.6		0.2		1.4	
4.30 min	6.6		0.1		1.4	
5.00 min	6.6		0.2		1.4	
% Oxygen						
Initial (T=0)	1.7		0.8		22.0	
30 sec	0.9		9.5		21.4	
1.00 min	0.6		16.2		21.4	
1.30 min	0.6		19.3		21.4	
2.00 min	0.6		20.5		21.4	
2.30 min	0.6		20.9		21.4	
3.00 min	0.5		21.0		21.4	
3.30 min	0.7		21.1		21.4	
4.00 min	0.7		21.3		21.4	
4.30 min	0.6		21.4		21.4	
5.00 min	0.5		21.4		21.4	
Hydrogen sulphide (ppm)						
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		1.0		0.0	
4.30 min	0.0		1.0		0.0	
5.00 min	0.0		1.0		0.0	
Carbon-monoxide (ppm)						
Initial (T=0)	3.0		1.0		0.0	
30 sec	3.0		1.0		0.0	
1.00 min	2.0		0.0		0.0	
1.30 min	2.0		0.0		0.0	
2.00 min	2.0		0.0		0.0	
2.30 min	2.0		0.0		0.0	
3.00 min	2.0		0.0		0.0	
3.30 min	2.0		0.0		0.0	
4.00 min	2.0		0.0		0.0	
4.30 min	2.0		0.0		0.0	
5.00 min	2.0		0.0		0.0	
Balance (%)						
Initial (T=0)	79.3		74.4		76.3	
30 sec	79.7		72.0		77.0	
1.00 min	79.7		74.9		77.0	
1.30 min	79.7		77.0		77.0	
2.00 min	79.7		77.9		77.1	
2.30 min	79.7		78.0		77.1	
3.00 min	79.7		78.1		77.1	
3.30 min	79.7		78.1		77.1	
4.00 min	79.7		78.3		77.2	
4.30 min	79.7		78.4		77.2	
5.00 min	79.7		78.2		77.2	

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date
Page No. 3 of 10

Time *	Well ID					
	JK103b		JK104		BH211	
	7.30		7.45		8.10	
	Atmospheric pressure (mb)					
Initial	1022	FLOW	1027	FLOW	1024	FLOW
	% Methane					
Initial (T=0)	0.0	0.3	0.3	0.1	0.0	0.1
30 sec	1.1	0.5	0.0	0.3	0.0	0.3
1.00 min	0.7	0.6	0.0	0.3	0.0	0.3
1.30 min	0.5	0.6	0.0	0.4	0.0	0.4
2.00 min	0.4	0.6	0.0	0.5	0.0	0.3
2.30 min	0.4	0.6	0.0	0.5	0.0	0.2
3.00 min	0.3	0.5	0.0	0.5	0.0	0.3
3.30 min	0.3	0.6	0.0	0.5	0.0	0.3
4.00 min	0.4	0.6	0.0	0.5	0.0	0.2
4.30 min	0.3	0.6	0.0	0.5	0.0	0.2
5.00 min	0.4	0.6	0.0	0.5	0.0	0.2
	% Carbon-di-oxide					
Initial (T=0)	0.4		0.6		0.1	
30 sec	0.7		1.7		1.7	
1.00 min	0.4		1.0		1.6	
1.30 min	0.3		0.7		1.6	
2.00 min	0.3		0.6		1.5	
2.30 min	0.3		0.6		1.5	
3.00 min	0.3		0.6		1.5	
3.30 min	0.3		0.6		1.4	
4.00 min	0.3		0.6		1.4	
4.30 min	0.3		0.6		1.4	
5.00 min	0.3		0.6		1.4	
	% Oxygen					
Initial (T=0)	21.5		21.1		22.0	
30 sec	19.3		16.9		21.4	
1.00 min	20.9		18.5		21.4	
1.30 min	21.3		19.8		21.4	
2.00 min	21.4		19.9		21.4	
2.30 min	21.4		20.0		21.4	
3.00 min	21.5		20.0		21.4	
3.30 min	21.5		20.0		21.4	
4.00 min	21.5		20.1		21.4	
4.30 min	21.5		20.1		21.4	
5.00 min	21.5		20.1		21.4	
	Hydrogen sulphide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
	Carbon-monoxide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
	Balance (%)					
Initial (T=0)	70.5		78.2		76.3	
30 sec	78.7		81.2		77.0	
1.00 min	78.0		80.1		77.0	
1.30 min	77.9		79.5		77.0	
2.00 min	77.9		79.4		77.1	
2.30 min	78.0		79.4		77.1	
3.00 min	77.9		79.4		77.1	
3.30 min	77.9		79.4		77.1	
4.00 min	77.9		79.3		77.2	
4.30 min	77.9		79.3		77.2	
5.00 min	77.9		79.3		77.2	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date
Page No. 4 of 10

Time *	Well ID					
	BH21LB		JK9		JK113	
	8.30		8.45		9.00	
Atmospheric pressure (mb)						
Initial	1024		1024		1024	
% Methane						
Initial (T=0)	0.0	0.1	0.0	0.0	0.0	0.1
30 sec	0.0	0.1	0.0	0.2	0.5	0.2
1.00 min	0.0	0.3	0.0	0.2	0.5	0.2
1.30 min	0.0	0.2	0.0	0.2	0.5	0.2
2.00 min	0.0	0.3	0.0	0.2	0.6	0.2
2.30 min	0.0	0.2	0.0	0.0	0.7	0.2
3.00 min	0.0	0.3	0.0	0.0	0.8	0.2
3.30 min	0.0	0.3	0.0	0.0	0.8	0.1
4.00 min	0.0	0.3	0.0	0.0	0.9	0.1
4.30 min	0.0	0.3	0.0	-0.1	0.9	0.1
5.00 min	0.0	0.3	0.0	-0.1	1.0	0.0
% Carbon-di-oxide						
Initial (T=0)	1.2		3.2		0.1	
30 sec	3.9		0.1		2.2	
1.00 min	3.7		0.1		2.3	
1.30 min	3.7		0.1		2.6	
2.00 min	3.7		0.1		3.1	
2.30 min	3.7		0.1		3.5	
3.00 min	3.7		0.1		3.8	
3.30 min	3.6		0.1		4.4	
4.00 min	3.7		0.1		4.1	
4.30 min	3.7		0.1		4.3	
5.00 min	3.7		0.1		4.5	
%Oxygen						
Initial (T=0)	21.1		18.6		21.4	
30 sec	18.1		21.4		18.4	
1.00 min	18.2		21.6		18.2	
1.30 min	18.2		21.6		17.9	
2.00 min	18.3		21.6		17.2	
2.30 min	18.3		21.7		16.7	
3.00 min	18.3		21.7		16.4	
3.30 min	18.3		21.7		16.1	
4.00 min	18.3		21.7		15.9	
4.30 min	18.3		21.7		15.6	
5.00 min	18.3		21.7		15.4	
Hydrogen sulphide (ppm)						
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
Carbon-monoxide (ppm)						
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
Balance (%)						
Initial (T=0)	75.1		80.6		76.8	
30 sec	78.1		78.4		79.0	
1.00 min	78.0		78.4		79.0	
1.30 min	78.0		78.3		78.9	
2.00 min	78.0		78.3		78.9	
2.30 min	78.0		78.3		79.0	
3.00 min	78.0		78.3		79.0	
3.30 min	78.0		78.3		79.0	
4.00 min	78.0		78.3		79.0	
4.30 min	78.0		78.2		79.1	
5.00 min	78.0		78.2		79.1	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date
Page No. 5 of 10

Time *	Well ID					
	BH216		JK107a		JK107b	
	9.15		9.30		9.45	
	Atmospheric pressure (mb)					
Initial	1024	FLOW	1024	FLOW	1024	FLOW
	% Methane					
Initial (T=0)	0.0	0.0	**12.9**	0.0	**14.4**	0.1
30 sec	**14.6**	0.1	**15.0**	0.1	**6.8**	0.2
1.00 min	**14.7**	0.0	**15.0**	0.1	**6.8**	0.2
1.30 min	**14.6**	0.1	**15.0**	0.1	**6.8**	0.2
2.00 min	**14.7**	0.1	**15.0**	0.0	**6.8**	0.2
2.30 min	**14.8**	0.1	**15.0**	0.1	**6.8**	0.2
3.00 min	**14.5**	0.0	**15.0**	0.1	**6.9**	0.2
3.30 min	**14.6**	0.0	**15.0**	0.1	**6.9**	0.2
4.00 min	**14.5**	0.0	**15.0**	0.0	**7.0**	0.2
4.30 min	**14.5**	0.0	**15.0**	0.1	**7.2**	0.2
5.00 min	**14.4**	0.0	**15.0**	0.1	**7.2**	0.2
	% Carbon-di-oxide					
Initial (T=0)	0.1		5.2		2.9	
30 sec	6.7		3.1		0.8	
1.00 min	6.7		2.9		0.9	
1.30 min	6.7		2.9		0.9	
2.00 min	6.8		2.9		0.9	
2.30 min	6.8		2.9		0.9	
3.00 min	6.7		2.9		0.9	
3.30 min	6.7		2.9		0.9	
4.00 min	6.6		2.9		0.9	
4.30 min	6.6		2.9		0.9	
5.00 min	6.6		2.9		0.9	
	% Oxygen					
Initial (T=0)	21.4		1.5		1.1	
30 sec	1.0		0.8		2.0	
1.00 min	0.5		0.8		2.1	
1.30 min	0.5		0.9		2.0	
2.00 min	0.3		0.8		1.9	
2.30 min	0.2		0.8		1.9	
3.00 min	0.5		0.8		1.8	
3.30 min	0.5		.		1.7	
4.00 min	0.6		7.0		1.5	
4.30 min	0.5		7.7		1.3	
5.00 min	0.6		0.8		1.4	
	Hydrogen sulphide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
	Carbon-monoxide (ppm)					
Initial (T=0)	0.0		0.0		1.0	
30 sec	0.0		1.0		4.0	
1.00 min	0.0		1.0		5.0	
1.30 min	0.0		1.0		5.0	
2.00 min	0.0		1.0		5.0	
2.30 min	1.0		1.0		5.0	
3.00 min	1.0		1.0		5.0	
3.30 min	1.0		1.0		5.0	
4.00 min	1.0		1.0		5.0	
4.30 min	1.0		1.0		5.0	
5.00 min	1.0		1.0		5.0	
	Balance (%)					
Initial (T=0)	63.1		80.6		90.9	
30 sec	77.8		81.2		90.3	
1.00 min	78.1		81.2		90.3	
1.30 min	78.2		81.2		90.3	
2.00 min	78.2		81.2		90.4	
2.30 min	78.2		81.3		90.4	
3.00 min	78.4		81.3		90.4	
3.30 min	78.3		81.3		90.4	
4.00 min	78.3		81.3		90.5	
4.30 min	78.4		81.3		90.6	
5.00 min	78.3		81.3		90.4	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date
Page No. 6 of 10

Time *	Well ID					
	JK106		JK7		JK110	
	10.50		11.05		11.45	
Atmospheric pressure (mb)						
Initial	1025	FLOW	1025	FLOW	1025	FLOW
% Methane						
Initial (T=0)	0.0	0.1	**8.5**	0.1	0.0	-0.1
30 sec	**9.4**	0.3	1.2	0.3	**24.4**	0.1
1.00 min	**9.4**	0.4	0.9	0.3	**24.7**	0.1
1.30 min	**10.0**	0.4	0.9	0.3	**24.8**	0.1
2.00 min	**9.9**	0.4	0.9	0.2	**24.9**	0.1
2.30 min	**10.0**	0.3	0.9	0.2	**25.0**	0.1
3.00 min	**10.0**	0.4	1.0	0.2	**24.5**	0.1
3.30 min	**10.0**	0.4	1.1	0.2	**24.3**	0.0
4.00 min	**9.9**	0.4	1.1	0.2	**24.4**	0.1
4.30 min	**9.8**	0.4	1.2	0.2	**24.2**	0.1
5.00 min	**9.8**	0.4	1.2	0.2	**23.7**	0.1
% Carbon-di-oxide						
Initial (T=0)	0.1		2.8		0.1	
30 sec	3.2		2.4		6.3	
1.00 min	3.2		2.5		6.4	
1.30 min	3.3		2.5		6.4	
2.00 min	3.3		2.5		6.4	
2.30 min	3.3		2.6		6.4	
3.00 min	3.3		2.7		6.3	
3.30 min	3.3		2.9		6.3	
4.00 min	3.3		3.0		6.4	
4.30 min	3.3		3.1		6.4	
5.00 min	3.3		3.2		6.3	
% Oxygen						
Initial (T=0)	20.9		3.9		18.1	
30 sec	4.4		15.3		0.8	
1.00 min	3.8		15.5		0.5	
1.30 min	3.6		15.6		0.5	
2.00 min	3.6		15.5		0.4	
2.30 min	3.5		15.2		0.3	
3.00 min	3.3		15.0		0.6	
3.30 min	3.2		14.6		0.7	
4.00 min	3.3		14.3		0.3	
4.30 min	2.4		14.2		0.2	
5.00 min	3.2		14.0		0.4	
Hydrogen sulphide (ppm)						
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
Carbon-monoxide (ppm)						
Initial (T=0)	0.0		1.0		0.0	
30 sec	2.0		0.0		0.0	
1.00 min	3.0		0.0		0.0	
1.30 min	3.0		0.0		0.0	
2.00 min	3.0		0.0		0.0	
2.30 min	3.0		0.0		0.0	
3.00 min	4.0		0.0		0.0	
3.30 min	4.0		0.0		0.0	
4.00 min	4.0		0.0		0.0	
4.30 min	4.0		0.0		0.0	
5.00 min	4.0		0.0		0.0	
Balance (%)						
Initial (T=0)	72.4		88.2		61.1	
30 sec	82.9		81.2		68.3	
1.00 min	83.1		81.1		68.4	
1.30 min	83.2		81.1		68.4	
2.00 min	83.2		81.1		68.3	
2.30 min	83.3		81.2		68.6	
3.00 min	83.4		81.3		68.6	
3.30 min	83.5		81.5		68.6	
4.00 min	83.5		81.6		69.0	
4.30 min	83.5		81.6		69.2	
5.00 min	83.7		81.7		69.7	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date
Page No. 7 of 10

Time *	Well ID					
	BH218		JK118a		JK118b	
	12.05		12.25		12.35	
	Atmospheric pressure (mb)					
Initial	1025	FLOW	1026	FLOW	1026	FLOW
	% Methane					
Initial (T=0)	0.3	-0.4	0.0	0.1	**14.5**	0.0
30 sec	**32.5**	-0.3	**15.0**	0.2	0.0	0.1
1.00 min	**31.9**	-0.3	**15.0**	0.3	0.0	0.2
1.30 min	**31.7**	-0.2	**15.1**	0.3	0.0	0.3
2.00 min	**31.6**	-0.2	**15.1**	0.3	0.0	0.2
2.30 min	**31.9**	-0.2	**15.1**	0.2	0.0	0.2
3.00 min	**31.6**	-0.2	**15.1**	0.2	0.0	0.3
3.30 min	**31.6**	-0.2	**15.1**	0.2	0.0	0.2
4.00 min	**31.1**	-0.2	**15.1**	0.1	0.0	0.3
4.30 min	**30.6**	-0.2	**15.1**	0.1	0.0	0.3
5.00 min	**29.5**	-0.2	**15.2**	0.1	0.0	0.2
	% Carbon-di-oxide					
Initial (T=0)	0.1		0.0		4.8	
30 sec	13.7		5.0		2.3	
1.00 min	13.8		5.1		2.3	
1.30 min	13.6		5.1		2.3	
2.00 min	13.5		5.1		2.3	
2.30 min	13.7		5.1		2.3	
3.00 min	13.5		5.1		2.3	
3.30 min	13.5		5.1		2.3	
4.00 min	13.3		5.1		2.3	
4.30 min	13.0		5.1		2.3	
5.00 min	12.7		5.1		2.3	
	% Oxygen					
Initial (T=0)	21.3		21.7		0.7	
30 sec	5.9		0.6		1.8	
1.00 min	3.0		0.2		1.9	
1.30 min	3.1		0.1		1.9	
2.00 min	3.1		0.0		1.9	
2.30 min	2.9		0.0		1.9	
3.00 min	3.1		0.0		2.0	
3.30 min	3.0		0.0		2.0	
4.00 min	3.2		0.0		2.0	
4.30 min	3.3		0.0		2.0	
5.00 min	3.2		0.0		2.0	
	Hydrogen sulphide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
	Carbon-monoxide (ppm)					
Initial (T=0)	0.0				0.0	
30 sec	0.0		0.0		0.0	
1.00 min	2.0		0.0		0.0	
1.30 min	2.0		0.0		0.0	
2.00 min	3.0		0.0		0.0	
2.30 min	3.0		0.0		0.0	
3.00 min	3.0		0.0		0.0	
3.30 min	4.0		0.0		0.0	
4.00 min	4.0		0.0		0.0	
4.30 min	5.0		0.0		0.0	
5.00 min	6.0		0.0		0.0	
	Balance (%)					
Initial (T=0)	79.0		62.8		96.1	
30 sec	50.0		79.5		95.8	
1.00 min	51.5		79.7		95.8	
1.30 min	51.4		79.6		95.8	
2.00 min	51.6		79.8		95.8	
2.30 min	51.5		79.8		95.8	
3.00 min	51.8		79.8		95.8	
3.30 min	52.0		79.8		98.7	
4.00 min	52.6		79.8		98.7	
4.30 min	53.6		79.8		98.7	
5.00 min	55.0		79.8		98.7	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date

Time *	Well ID					
	BH223		JK16		JK114	
	12.50		13.05		13.20	
	Atmospheric pressure (mb)					
Initial	1026	FLOW	1026	FLOW	1026	FLOW
	% Methane					
Initial (T=0)	0.6	0.2	**2.8**	0.0	**0.1**	-0.1
30 sec	**3.7**	0.4	0.0	0.1	**21.2**	0.0
1.00 min	**3.7**	0.5	0.0	0.1	**21.0**	0.0
1.30 min	**3.7**	0.5	0.0	0.2	**20.9**	0.0
2.00 min	**3.6**	0.5	0.0	0.1	**21.2**	0.1
2.30 min	**3.6**	0.5	0.0	0.1	**21.2**	0.1
3.00 min	**3.5**	0.5	0.0	0.0	**21.1**	0.0
3.30 min	**3.5**	0.6	0.0	0.0	**21.2**	0.0
4.00 min	**3.3**	0.6	0.0	0.0	**21.2**	0.0
4.30 min	**3.2**	0.6	0.0	0.0	**21.1**	0.0
5.00 min	**3.0**	0.6	0.0	0.0	**21.2**	0.0
	% Carbon-di-oxide					
Initial (T=0)	2.6		7.1		6.4	
30 sec	8.2		8.2		5.4	
1.00 min	8.2		8.1		5.3	
1.30 min	8.2		8.0		5.3	
2.00 min	8.1		8.0		5.4	
2.30 min	8.1		8.0		5.4	
3.00 min	8.1		8.0		5.3	
3.30 min	8.0		8.3		5.4	
4.00 min	7.9		8.1		5.3	
4.30 min	7.8		8.2		5.4	
5.00 min	7.7		7.9		5.4	
	% Oxygen					
Initial (T=0)	2.5		3.3		47.0	
30 sec	1.9		14.2		0.0	
1.00 min	2.0		14.5		0.1	
1.30 min	2.0		14.6		0.2	
2.00 min	2.0		14.7		0.0	
2.30 min	2.2		14.7		0.0	
3.00 min	2.1		14.8		0.0	
3.30 min	2.2		14.6		0.0	
4.00 min	2.4		14.8		0.0	
4.30 min	2.5		14.7		0.0	
5.00 min	2.8		14.9		0.0	
	Hydrogen sulphide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
	Carbon-monoxide (ppm)					
Initial (T=0)	0.0		0.0		0.0	
30 sec	1.0		0.0		0.0	
1.00 min	1.0		0.0		0.0	
1.30 min	2.0		0.0		0.0	
2.00 min	2.0		0.0		0.0	
2.30 min	2.0		0.0		0.0	
3.00 min	2.0		0.0		0.0	
3.30 min	2.0		0.0		0.0	
4.00 min	2.0		0.0		0.0	
4.30 min	2.0		0.0		0.0	
5.00 min	2.0		0.0		0.0	
	Balance (%)					
Initial (T=0)	85.5		83.3		73.4	
30 sec	86.2		77.6		73.4	
1.00 min	86.2		77.6		73.6	
1.30 min	86.2		77.3		73.5	
2.00 min	86.2		77.2		73.5	
2.30 min	86.1		77.3		73.5	
3.00 min	86.3		77.2		73.4	
3.30 min	86.3		77.2		73.5	
4.00 min	86.3		77.1		73.5	
4.30 min	86.4		77.2		73.5	
5.00 min	86.6		77.1		73.4	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date
Page No. 9 of 10

Time *	Well ID					
	JK114b		JK115		BH224	
	13.30		13.45		14.00	
Atmospheric pressure (mb)						
Initial	1026	FLOW	1026	FLOW	1026	FLOW
% Methane						
Initial (T=0)	**19.1**	0.2	**7.2**	0.1	0.0	0.1
30 sec	**8.2**	0.2	0.0	0.2	0.0	0.2
1.00 min	**7.5**	0.3	0.0	0.3	0.0	0.3
1.30 min	**7.5**	0.3	0.0	0.3	0.0	0.3
2.00 min	**7.5**	0.3	0.0	0.3	0.0	0.4
2.30 min	**7.5**	0.3	0.0	0.3	0.0	0.2
3.00 min	**7.5**	0.2	0.0	0.2	0.0	0.3
3.30 min	**7.5**	0.3	0.0	0.2	0.0	0.3
4.00 min	**7.5**	0.3	0.0	0.2	0.0	0.3
4.30 min	**7.5**	0.3	0.0	0.2	0.0	0.2
5.00 min	**7.5**	0.3	0.0	0.2	0.0	0.3
% Carbon-di-oxide						
Initial (T=0)	5.4		6.6		6.4	
30 sec	7.3		7.0		7.9	
1.00 min	7.5		7.1		8.4	
1.30 min	7.5		7.1		8.5	
2.00 min	7.5		7.1		8.5	
2.30 min	7.5		7.0		8.5	
3.00 min	7.4		7.0		8.5	
3.30 min	7.4		7.0		8.7	
4.00 min	7.5		7.0		8.9	
4.30 min	7.5		7.0		9.5	
5.00 min	7.5		7.0		10.3	
% Oxygen						
Initial (T=0)	0.8		1.7		14.4	
30 sec	0.0		13.4		12.8	
1.00 min	0.0		13.5		12.3	
1.30 min	0.0		13.5		12.3	
2.00 min	0.0		13.6		12.3	
2.30 min	0.0		13.7		12.3	
3.00 min	0.0		13.7		12.3	
3.30 min	0.0		13.7		12.1	
4.00 min	0.0		13.7		11.9	
4.30 min	0.0		13.7		11.1	
5.00 min	0.0		13.7		10.1	
Hydrogen sulphide (ppm)						
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
Carbon-monoxide (ppm)						
Initial (T=0)	0.0		0.0		0.0	
30 sec	0.0		0.0		0.0	
1.00 min	0.0		0.0		0.0	
1.30 min	0.0		0.0		0.0	
2.00 min	0.0		0.0		0.0	
2.30 min	0.0		0.0		0.0	
3.00 min	0.0		0.0		0.0	
3.30 min	0.0		0.0		0.0	
4.00 min	0.0		0.0		0.0	
4.30 min	0.0		0.0		0.0	
5.00 min	0.0		0.0		0.0	
Balance (%)						
Initial (T=0)	81.0		87.1			
30 sec	84.9		79.5			
1.00 min	85.0		79.4			
1.30 min	85.0		79.4			
2.00 min	85.0		79.3			
2.30 min	85.0		79.3			
3.00 min	85.0		79.2			
3.30 min	85.1		79.3			
4.00 min	85.0		79.3			
4.30 min	85.0		79.3			
5.00 min	85.0		79.3			

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client Benedict
Project DSI
Location Moorebank

Project No. 71459.03
Reporting Date
Page No. 10 of 10

Time *	Well ID					
	BH225					
	14.15					
Atmospheric pressure (mb)						
Initial	1026	FLOW				
% Methane						
Initial (T=0)	0.0	0.1				
30 sec	0.0	0.1				
1.00 min	0.0	0.2				
1.30 min	0.0	0.2				
2.00 min	0.0	0.2				
2.30 min	0.0	0.1				
3.00 min	0.0	0.1				
3.30 min	0.0	0.2				
4.00 min	0.0	0.1				
4.30 min	0.0	0.1				
5.00 min	0.0	0.1				
% Carbon-di-oxide						
Initial (T=0)	9.6					
30 sec	5.1					
1.00 min	4.9					
1.30 min	5.0					
2.00 min	5.0					
2.30 min	5.1					
3.00 min	5.2					
3.30 min	5.3					
4.00 min	5.5					
4.30 min	5.7					
5.00 min	5.9					
% Oxygen						
Initial (T=0)	10.4					
30 sec	16.8					
1.00 min	17.0					
1.30 min	17.0					
2.00 min	17.0					
2.30 min	16.9					
3.00 min	16.9					
3.30 min	16.8					
4.00 min	16.6					
4.30 min	16.3					
5.00 min	16.1					
Hydrogen sulphide (ppm)						
Initial (T=0)	0.0					
30 sec	0.0					
1.00 min	0.0					
1.30 min	0.0					
2.00 min	0.0					
2.30 min	0.0					
3.00 min	0.0					
3.30 min	0.0					
4.00 min	0.0					
4.30 min	0.0					
5.00 min	0.0					
Carbon-monoxide (ppm)						
Initial (T=0)	0.0					
30 sec	0.0					
1.00 min	0.0					
1.30 min	0.0					
2.00 min	0.0					
2.30 min	0.0					
3.00 min	0.0					
3.30 min	0.0					
4.00 min	0.0					
4.30 min	0.0					
5.00 min	0.0					
Balance (%)						
Initial (T=0)	80.2					
30 sec	78.1					
1.00 min	78.1					
1.30 min	78.0					
2.00 min	78.0					
2.30 min	78.0					
3.00 min	77.9					
3.30 min	77.9					
4.00 min	78.0					
4.30 min	78.0					
5.00 min	78.0					

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client: Benedict
Project:
Location:

Project No.: 71459.03
Reporting Date:
Page No.: 1 of 1

Time*	Well ID					
	[illegible]		BH202		BH101	
	6.00am		6.25		6.40	
Atmospheric pressure (mb)						
Initial	1016		1017		1017	
% Methane						
Initial (T=0)	0.2	0.1	0.2	0.1	1	0.1
30 sec	0.2	0	0.5	0.1	15.7	0.3
1.00 min	0.2	-0.1	1	0.2	15.7	0.3
1.30 min	0.2	-0.1	1	0.2	15.7	0.3
2.00 min	0.2	-0.1	1.1	0.2	15.7	0.2
2.30 min	0.2	-0.1	1.1	0.2	15.6	0.3
3.00 min	0.2	-0.1	1.1	0.2	15.6	0.3
3.30 min	0.2	-0.1	1.1	0.1	15.5	0.2
4.00 min	0.2	-0.1	1.1	0.1	15.5	0.3
4.30 min	0.2	-0.1	1.1	0.2	15.5	0.3
5.00 min	0.2	-0.1	1.1	0.2	15.4	0.3
% Carbon-dioxide						
Initial (T=0)	3.4		13.1		11.4	
30 sec	0.5		5.5		8.5	
1.00 min	1.3		16		8.5	
1.30 min	0.2		14.9		8.5	
2.00 min	1.2		15.2		8.4	
2.30 min	0.6		15.3		8.6	
3.00 min	0.7		15.4		8.6	
3.30 min	1		15.4		8.3	
4.00 min	1		15.4		8.3	
4.30 min	0.7		15.6		8.3	
5.00 min	0.3		15.6		8.3	
% Oxygen						
Initial (T=0)	18		21.5		1.6	
30 sec	20.7		12.3		1	
1.00 min	20.1		7.2		1.1	
1.30 min	20.7		1.4		1.1	
2.00 min	20.7		1		1.2	
2.30 min	20.3		0.4		1.2	
3.00 min	20.5		0.8		1.2	
3.30 min	20.2		0.8		1.3	
4.00 min	20.5		0.7		1.3	
4.30 min	20.5		0.7		1.2	
5.00 min	20.2		0.7		1.2	
Hydrogen sulphide (ppm)						
Initial (T=0)	0		0		0	
30 sec	0		0		2	
1.00 min	0		0		2	
1.30 min	0		0		2	
2.00 min	0		0		2	
2.30 min	0		0		2	
3.00 min	0		0		2	
3.30 min	0		0		2	
4.00 min	0		0		2	
4.30 min	0		0		2	
5.00 min	0		0		2	
Carbon-monoxide (ppm)						
Initial (T=0)	9		13		27	
30 sec	7		10		21	
1.00 min	5		12		19	
1.30 min	5		13		19	
2.00 min	5		14		18	
2.30 min	5		15		18	
3.00 min	5		16		18	
3.30 min	5		17		18	
4.00 min	5		17		18	
4.30 min	5		17		18	
5.00 min	5		18		18	
Balance (%)						
Initial (T=0)	78.7		78.6		72.1	
30 sec	79.4		81.7		78.5	
1.00 min	79.2		82.5		78.8	
1.30 min	79.9		82.6		78.6	
2.00 min	79.0		82.7		78.8	
2.30 min	78.9		82.7		78.8	
3.00 min	79		82.8		78.8	
3.30 min	79		82.8		78.9	
4.00 min	79		82.8		78.9	
4.30 min	79		82.8		78.9	
5.00 min	79.1		82.6		78.9	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client: Benedict
Project:
Location:

Project No.: 71459.03
Reporting Date:
Page No.: 1 of 1

Time *	Well ID					
	BK106		#2 JKBH/MW7		JK119	
	6.55		7.15		7.30	
Atmospheric pressure (mb)						
Initial	1017		1017		1016	
% Methane						
Initial (T=0)	14.2	0	0.5	0	0.5	0
30 sec	9.4	0	0.2	0	21.3	0.2
1.00 min	8.9	0	0.2	-0.1	12	0.3
1.30 min	8.9	0	0.2	0	11.9	0.2
2.00 min	9	0	0.2	0	8.5	0.2
2.30 min	8.9	0	0.2	0	7.5	0.2
3.00 min	9	0	0.2	0	6.6	0.2
3.30 min	9	0	0.2	0	5.7	0.2
4.00 min	9	0	0.2	0	4.8	0.2
4.30 min	9	0	0.2	0	4.1	0.2
5.00 min	9	0	0.2	0	4	0.2
% Carbon-di-oxide						
Initial (T=0)	6.7		0.2		5.5	
30 sec	4.3		5.7		6.9	
1.00 min	4.2		5.7		4.2	
1.30 min	4.2		5.8		3.5	
2.00 min	4.2		5.9		3	
2.30 min	4.2		6		2.7	
3.00 min	4.1		6.1		2.4	
3.30 min	4.1		6.3		2	
4.00 min	4.1		6.5		1.7	
4.30 min	4.1		6.6		1.5	
5.00 min	4.1		6.8		1.2	
% Oxygen						
Initial (T=0)	2		21.1		5.6	
30 sec	0.8		9.4		12.8	
1.00 min	0.5		9.2		16.7	
1.30 min	0.8		9.1		17.1	
2.00 min	0.8		8.9		17.7	
2.30 min	0.8		8.7		18	
3.00 min	0.8		8.7		18.5	
3.30 min	0.8		7.7		18.8	
4.00 min	0.8		7.5		19.3	
4.30 min	0.8		7.1		19.5	
5.00 min	0.7		8.7		19.6	
Hydrogen sulphide (ppm)						
Initial (T=0)	0		0		0	
30 sec	0		0		0	
1.00 min	0		0		0	
1.30 min	0		0		0	
2.00 min	0		0		0	
2.30 min	0		0		0	
3.00 min	0		0		0	
3.30 min	0		0		0	
4.00 min	0		0		0	
4.30 min	0		0		0	
5.00 min	0				0	
Carbon-monoxide (ppm)						
Initial (T=0)	20		4		18	
30 sec	18		6		12	
1.00 min	16		5		9	
1.30 min	15		6		8	
2.00 min	14		6		6	
2.30 min	14		7		6	
3.00 min	14		7		5	
3.30 min	12		8		5	
4.00 min	12		8		5	
4.30 min	12		9		5	
5.00 min	14		9		4	
Balance (%)						
Initial (T=0)	81.5		78.8		51.9	
30 sec	82.9		87.7		64.9	
1.00 min	86.1		84.9		69.1	
1.30 min	86.1		84.9		70.3	
2.00 min	86.1		85.1		71.3	
2.30 min	86.1		85.1		72	
3.00 min	86.1		85.5		73	
3.30 min	86.1		85.8		73.8	
4.00 min	86.1		85.8		74.6	
4.30 min	86		86.1		75	
5.00 min	86.1		86.1		75.3	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client: Benedict
Project:
Location:

Project No. 71459.03
Reporting Date:
Page No. 1 of 1

partially damaged

Time *	Well ID					
	JWD3_9		[illegible]		~~JW~~ JK13H/mw 9	
	[illegible]		[illegible]		8:30	
Atmospheric pressure (mb)						
Initial	1016		[illegible]		1016	
% Methane						
Initial (T=0)	0.3	0	0.5	0.8	1.2	0.1
30 sec	0.4	0.2	[illegible]	6.8	5.4	0.2
1.00 min	0.3	0.2	[illegible]	[illegible]	11.9	0.2
1.30 min	0.2	0.2	1.2	[illegible]	16.1	0.2
2.00 min	0.2	0.3	1.1	6.2	16.9	0.1
2.30 min	0.2	0.3	0.9	6.8	17.4	0.0
3.00 min	0.2	0.2	0.8	6.8	17.5	0.1
3.30 min	0.2	0.2	0.7	6.8	17.5	0.1
4.00 min	0.2	0.2	0.6	6.8	17.5	0.1
4.30 min	0.2	0.2	0.6	6.8	17.4	0.1
5.00 min	0.2	0.2	0.6	6.8	17.4	0.2
% Carbon-di-oxide						
Initial (T=0)	0.2		0.6		[illegible]	
30 sec	0.2		[illegible]		[illegible]	
1.00 min	0.1		0.5		15.4	
1.30 min	0.1		0.5		21.8	
2.00 min	0.1		0.4		[illegible]	
2.30 min	0.1		0.3		23.6	
3.00 min	0.1		0.3		23.8	
3.30 min	0.1		[illegible]		23.8	
4.00 min	0.1		0.2		23.7	
4.30 min	0.1		0.2		23.7	
5.00 min	0.1		0.2		23.7	
% Oxygen						
Initial (T=0)	20.6		20		[illegible]	
30 sec	20.3		18.6		1.7	
1.00 min	20.7		19.4		8.8	
1.30 min	20.7		19.1		5.8	
2.00 min	20.7		19.4		5.3	
2.30 min	20.6		19.7		4.9	
3.00 min	20.7		19.4		4.9	
3.30 min	20.6		20		4.8	
4.00 min	20.6		20.1		4.9	
4.30 min	20.6		20.2		4.8	
5.00 min	20.5		20.3		4.8	
Hydrogen sulphide (ppm)						
Initial (T=0)	0		0		0	
30 sec	0		0		0	
1.00 min	0		0		0	
1.30 min	0		0		0	
2.00 min	0		0		0	
2.30 min	0		0		0	
3.00 min	0		0		0	
3.30 min	0		0		0	
4.00 min	0		0		0	
4.30 min	0		0		0	
5.00 min	0		0		0	
Carbon-monoxide (ppm)						
Initial (T=0)	12		16		19	
30 sec	7		10		9	
1.00 min	5		8		10	
1.30 min	5		5		11	
2.00 min	5		8		12	
2.30 min	5		8		13	
3.00 min	5		6		14	
3.30 min	5		7		14	
4.00 min	5		7		15	
4.30 min	5		10		15	
5.00 min	5		[illegible]		15	
Balance (%)						
Initial (T=0)	73.3		[illegible]		76.2	
30 sec	78.8		[illegible]		[illegible]	
1.00 min	79		[illegible]		69.3	
1.30 min	79		[illegible]		55.4	
2.00 min	79		[illegible]		54.4	
2.30 min	79.1		[illegible]		[illegible]	
3.00 min	79.1		[illegible]		53.9	
3.30 min	79.1		[illegible]		54	
4.00 min	79.1		[illegible]		[illegible]	
4.30 min	79.1		[illegible]		54.1	
5.00 min	79.1		[illegible]		[illegible]	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

dipped, water at ~1m below toc
bailed dry once resampled after 730 mins.

Client	Benedict			Project No.	71459.03
Project				Reporting Date	
Location				Page No.	1 of 1

Time *	Well ID					
	~~11.09~~ JK104		BH211B		BH211	
	8:59		9:08		9:20	
Atmospheric pressure (mb)						
Initial	1016		1016		1016	
% Methane						
Initial (T=0)	0.5	0.1	0.5	0.0	0.2	0
30 sec	0.2	0.1	0.1	0.1	1.1	0.1
1.00 min	0.2	0.2	0.1	0.1	0.8	0
1.30 min	0.2	0.1	0.1	0.1	0.7	0
2.00 min	0.2	0.2	0.1	0.1	0.7	0
2.30 min	0.2	0.1	0.1	0.0	0.7	0
3.00 min	0.2	0.1	0.1	0.1	0.7	0
3.30 min	0.2	0.1	0.1	0.2	0.7	0
4.00 min	0.2	0.1	0.1	0.1	0.7	0
4.30 min	0.2	0.0	0.1	0.1	0.7	0.1
5.00 min	0.2	0.0	0.1	0.1	0.7	0
% Carbon-di-oxide						
Initial (T=0)	2.3		1.9		1	
30 sec	0.9		0.1		5	
1.00 min	0.8		0.1		5.4	
1.30 min	0.7		0.1		3.1	
2.00 min	0.6		0.1		3	
2.30 min	0.6		0.1		3	
3.00 min	0.6		0.1		2.9	
3.30 min	0.6		0.1		2.9	
4.00 min	0.6		0.1		2.9	
4.30 min	0.6		0.1		2.9	
5.00 min	0.6		0.1		2.9	
% Oxygen						
Initial (T=0)	9.3		19.1		20.9	
30 sec	13.8		21.2		17.6	
1.00 min	14.5		21.2		18.5	
1.30 min	15.3		21.2		18.7	
2.00 min	15.7		21.3		18.8	
2.30 min	16.4		21.3		18.8	
3.00 min	16.5		21.3		18.8	
3.30 min	16.6		21.2		18.8	
4.00 min	16.5		21.2		18.8	
4.30 min	16.3		21.2		18.9	
5.00 min	16.7		21.2		18.8	
Hydrogen sulphide (ppm)						
Initial (T=0)	0		0		0	
30 sec	0		0		0	
1.00 min	0		0		0	
1.30 min	0		0		0	
2.00 min	0		0		0	
2.30 min	0		0		0	
3.00 min	0		0		0	
3.30 min	0		0		0	
4.00 min	0		0		0	
4.30 min	0		0		0	
5.00 min	0		0		0	
Carbon-monoxide (ppm)						
Initial (T=0)	11		15		15	
30 sec	9		9		10	
1.00 min	8		8		8	
1.30 min	8		7		8	
2.00 min	8		7		8	
2.30 min	8		7		8	
3.00 min	8		6		8	
3.30 min	8		6		8	
4.00 min	8		6		8	
4.30 min	8		6		8	
5.00 min	8		6		8	
Balance (%)						
Initial (T=0)	87.8		79.4		78.2	
30 sec	85		78.6		76.0	
1.00 min	84.4		78.6		77.4	
1.30 min	82.7		78.6		77.5	
2.00 min	83.1		79.6		77.6	
2.30 min	82.8		78.5		77.6	
3.00 min	82.6		78.6		77.6	
3.30 min	82.7		78.6		77.6	
4.00 min	82.7		78.6		77.7	
4.30 min	82.7		78.6		77.7	
5.00 min	82.5		78.6		77.5	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client: Benedict
Project:
Location:

Project No.: 71459.03
Reporting Date:
Page No.: 1 of 1

Time *	Well ID					
	~~103~~ JKBH/mwic7B		~~102~~ JKBH/mwic7A		216BH/MW216	
	9:35		9:55		10:10	
Atmospheric pressure (mb)						
Inital	1016		1016		1015	
% Methane						
Initial (T=0)	15.1	0.2	15.8	0.1	16.7	0.2
30 sec	16.6	0.3	17.0	0.2	10.3	0.2
1.00 min	16.4	0.3	16.9	0.2	10.1	0.2
1.30 min	16.4	0.3	17	0.2	10.1	0.3
2.00 min	16.3	0.3	16.9	0.2	10.1	0.3
2.30 min	16.3	0.3	17.0	0.2	10.1	0.3
3.00 min	16.3	0.2	17.0	0.1	10	0.3
3.30 min	16.2	0.2	17.1	0.2	10	0.3
4.00 min	16.1	0.3	17.1	0.2	10	0.3
4.30 min	16.3	0.2	17.1	0.1	10	0.3
5.00 min	16.2	0.2	17.3	0.2	9.9	0.3
% Carbon-di-oxide						
Initial (T=0)	0.9		2.8		3.5	
30 sec	0.8		2.8		5.2	
1.00 min	0.8		2.8		5.2	
1.30 min	0.8		3.8		5.2	
2.00 min	0.8		3.8		5.2	
2.30 min	0.8		3.8		5.2	
3.00 min	0.8		3.8		5.2	
3.30 min	0.8		3.8		5.2	
4.00 min	0.8		3.8		5.2	
4.30 min	0.8		3.8		5.2	
5.00 min	0.8		3.8		5.2	
% Oxygen						
Initial (T=0)	1		0.9		1.3	
30 sec	0.9		0.7		0.5	
1.00 min	1.1		0.9		0.5	
1.30 min	1.1		0.8		0.5	
2.00 min	1.1		0.8		0.5	
2.30 min	1.2		0.8		0.5	
3.00 min	1.2		0.7		0.5	
3.30 min	1.1		0.7		0.5	
4.00 min	1.0		0.7		0.5	
4.30 min	1.0		0.7		0.5	
5.00 min	1.0		0.6		0.4	
Hydrogen sulphide (ppm)						
Initial (T=0)	4		1		0	
30 sec	6		0		0	
1.00 min	6		0		0	
1.30 min	6		0		0	
2.00 min	7		0		0	
2.30 min	7		0		0	
3.00 min	7		0		0	
3.30 min	7		0		0	
4.00 min	7		0		0	
4.30 min	7		0		0	
5.00 min	7		0		0	
Carbon-monoxide (ppm)						
Initial (T=0)	18		22		21	
30 sec	17		18		16	
1.00 min	17		17		15	
1.30 min	18		17		14	
2.00 min	18		17		15	
2.30 min	18		17		15	
3.00 min	18		17		15	
3.30 min	18		17		15	
4.00 min	19		17		18	
4.30 min	18		17		15	
5.00 min	18		17		15	
Balance (%)						
Initial (T=0)	81.7		78.5		83.6	
30 sec	81.7		78.6		84.2	
1.00 min	81.7		78.5		84.2	
1.30 min	81.7		78.5		84.2	
2.00 min	81.9		78.5		84.2	
2.30 min	81.8		78.5		84.3	
3.00 min	81.8		78.4		84.2	
3.30 min	81.8		78.6		84.4	
4.00 min	81.8		78.4		84.4	
4.30 min	81.8		78.2		84.4	
5.00 min	81.9		78.3		84.5	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client: Benedict
Project:
Location:

Project No.: 71459.03
Reporting Date:
Page No.: 1 of 1

Time *	Well ID					
	JK113		JK115		JK114	
	10.40		11.10		12.15	
Atmospheric pressure (mb)						
Initial	1016		1016		1014	
% Methane						
Initial (T=0)	0.1	0	0.1	0.1	25.1	0.2
30 sec	0.1	0.1	0.1	0.1	25.2	0.2
1.00 min	0.1	0.1	0.1	0.1	25.2	0.2
1.30 min	0.1	0.1	0.1	0.1	25.3	0.2
2.00 min	0.1	0.0	0.1	0.1	25.1	0.1
2.30 min	0.1	0.0	0.1	0.2	25.0	0.2
3.00 min	0.1	0.0	0.1	0.2	25.2	0.1
3.30 min	0.1	0.1	0.1	0.2	25.2	0.1
4.00 min	0.1	0.0	0.1	0.1	25.1	0.1
4.30 min	0.1	0.0	0.1	0.1	25.1	0.1
5.00 min	0.1	0.0	0.1	0.1	25.1	0.1
% Carbon-di-oxide						
Initial (T=0)	0.6		0.0		4.6	
30 sec	0.6		0.0		4.7	
1.00 min	0.6		0.0		4.7	
1.30 min	0.6		0.0		4.7	
2.00 min	0.7		0.0		4.7	
2.30 min	0.8		0.0		4.6	
3.00 min	0.8		0.0		4.7	
3.30 min	0.8		0.0		4.7	
4.00 min	0.9		0.0		4.7	
4.30 min	1.0		0.0		4.7	
5.00 min	1.0		0.0		4.7	
% Oxygen						
Initial (T=0)	19.6		20.5		0.8	
30 sec	19.2		20.3		0.7	
1.00 min	19.2		20.4		0.6	
1.30 min	19.2		20.4		0.6	
2.00 min	19.2		20.4		0.6	
2.30 min	19.1		20.5		0.5	
3.00 min	19.0		20.5		0.5	
3.30 min	18.9		20.5		0.4	
4.00 min	19.9		20.5		0.5	
4.30 min	19.9		20.6		0.4	
5.00 min	19.7		20.6		0.4	
Hydrogen sulphide (ppm)						
Initial (T=0)	0		0		0	
30 sec	0		0		0	
1.00 min	0		0		0	
1.30 min	0		0		0	
2.00 min	0		0		0	
2.30 min	0		0		0	
3.00 min	0		0		0	
3.30 min	0		0		0	
4.00 min	0		0		0	
4.30 min	0		0		0	
5.00 min	0		0		0	
Carbon-monoxide (ppm)						
Initial (T=0)	16		13		21	
30 sec	11		10		23	
1.00 min	9		9		24	
1.30 min	8		9		26	
2.00 min	7		9		27	
2.30 min	6		9		28	
3.00 min	6		9		28	
3.30 min	6		10		29	
4.00 min	5		10		29	
4.30 min	5		10		29	
5.00 min	5		10		30	
Balance (%)						
Initial (T=0)	80.2		79.8		69.4	
30 sec	80.1		79.7		69.4	
1.00 min	80.1		79.6		69.5	
1.30 min	80.1		79.5		69.6	
2.00 min	80.1		79.5		69.6	
2.30 min	80.1		79.4		69.7	
3.00 min	80.1		79.4		69.7	
3.30 min	80.1		79.4		69.8	
4.00 min	80.1		79.5		69.8	
4.30 min	80.2		79.5		69.9	
5.00 min	80.2		79.5		69.8	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client: Benedict
Project:
Location:

Project No.: 71459.03
Reporting Date:
Page No.: 1 of 1

Time *	Well ID					
	JK114A		JK116		JK117	
	12:27		12.45		13.00	
Atmospheric pressure (mb)						
Initial	1014		1014		1014	
% Methane						
Initial (T=0)	0.1	0.2	0.1	0.1	0.1	0.1
30 sec	0.0	0.2	0.1	0.2	11.7	0.4
1.00 min	0.0	0.2	0.1	0.2	11.7	0.5
1.30 min	0.0	0.3	0.1	0.2	11.7	0.5
2.00 min	0.0	0.3	0.1	0.3	11.7	0.4
2.30 min	0.0	0.3	0.1	0.3	11.9	0.4
3.00 min	0.0	0.3	0.1	0.2	12	0.5
3.30 min	0.0	0.3	0.1	0.2	12	0.5
4.00 min	0.0	0.2	0.1	0.2	12	0.6
4.30 min	0.0	0.3	0.1	0.3	12	0.5
5.00 min	0.0	0.2	0.1	0.2	12	0.5
% Carbon-di-oxide						
Initial (T=0)	0.0		9.7		6.8	
30 sec	0.0		9.3		1	
1.00 min	0.0		9.2		1.	
1.30 min	0.0		9.4		0.4	
2.00 min	0.0		9.4		0.4	
2.30 min	0.0		9.3		0.9	
3.00 min	0.0		9.4		0.9	
3.30 min	0.0		9.4		0.4	
4.00 min	0.0		9.4		0.9	
4.30 min	0.0		9.3		0.9	
5.00 min	0.0		9.3		0.9	
% Oxygen						
Initial (T=0)	20.2		10.9		7.2	
30 sec	20.4		10.9		0.4	
1.00 min	20.5		10.9		0.8	
1.30 min	20.5		10.8		0.8	
2.00 min	20.5		10.8		0.8	
2.30 min	20.6		10.8		0.6	
3.00 min	20.6		10.8		0.4	
3.30 min	20.6		10.8		0.4	
4.00 min	20.6		10.8		0.5	
4.30 min	20.6		10.8		0.6	
5.00 min	20.7		10.8		0.6	
Hydrogen sulphide (ppm)						
Initial (T=0)	0		0		30	
30 sec	0		0		0	
1.00 min	0		0		0	
1.30 min	0		0		0	
2.00 min	0		0		0	
2.30 min	0		0		0	
3.00 min	0		0		0	
3.30 min	0		0		0	
4.00 min	0		0		0	
4.30 min	0		0		0	
5.00 min	0		0		0	
Carbon-monoxide (ppm)						
Initial (T=0)	23		18		24	
30 sec	20		17		25	
1.00 min	17		17		26	
1.30 min	14		18		26	
2.00 min	13		18		24	
2.30 min	12		19		20	
3.00 min	11		19		30	
3.30 min	11		19		30	
4.00 min	10		19		30	
4.30 min	10		19		30	
5.00 min	10		20		30	
Balance (%)						
Initial (T=0)	79.7		79.7		86.2	
30 sec	79.6		79.8		85.5	
1.00 min	79.5		79.8		86.5	
1.30 min	79.5		79.8		86.5	
2.00 min	79.4		79.8		86.4	
2.30 min	79.4		79.8		86.4	
3.00 min	79.4		79.8		86.6	
3.30 min	79.4		79.8		86.7	
4.00 min	79.4		79.8		86.6	
4.30 min	79.3		79.8		86.5	
5.00 min	79.3		79.8		86.5	

Douglas Partners
Geotechnics / Environment / Groundwater

Tabulated Results for Landfill Gas Monitoring

Client: Benedict
Project:
Location:

Project No.: 71459.03
Reporting Date:
Page No.: 1 of 1

Time *	Well ID					
	BH223		BH224		BH225	
	13.15		13.41		14.00	
Atmospheric pressure (mb)						
Initial	1016		1013		1013	
% Methane						
Initial (T=0)	3.4	0.1	0.1	0.1	0.2	0.2
30 sec	3.4	0.0	0.1	0.2	0	0.2
1.00 min	3.4	0.0	0.0	0.2	0	0.1
1.30 min	3.4	0.0	0.0	0.2	0	0.1
2.00 min	3.4	0.1	0.0	0.3	0	0.2
2.30 min	3.5	0.0	0.0	0.2	0	0.1
3.00 min	3.5	0.1	0.1	0.2	0	0.1
3.30 min	3.5	0.0	0.1	0.2	0	0.2
4.00 min	3.6	0.1	0.0	0.2	0	0.2
4.30 min	3.6	0.0	0.1	0.2	0	0.2
5.00 min	3.7	0.1	0.1	0.2	0	0.2
% Carbon dioxide						
Initial (T=0)	9.9		9.9		11.7	
30 sec	9.9		10.2		12.1	
1.00 min	9.9		10.6		12.2	
1.30 min	9.9		11.2		12.4	
2.00 min	9.9		11.9		12.6	
2.30 min	10		12.5		12.9	
3.00 min	10		13.1		13.3	
3.30 min	10		13.5		13.3	
4.00 min	9.9		13.7		15.2	
4.30 min	9.9		14.1		15.7	
5.00 min	9.9		14.4		16.2	
% Oxygen						
Initial (T=0)	0.7		8.2		8.4	
30 sec	0.7		7.8		17.2	
1.00 min	0.7		7.2		17.2	
1.30 min	0.7		6.7		17.1	
2.00 min	0.7		5.9		16.9	
2.30 min	0.7		5.2		16.6	
3.00 min	0.6		4.5		16.3	
3.30 min	0.7		4.2		15	
4.00 min	0.7		4.6		14.4	
4.30 min	0.7		3.6		13.9	
5.00 min	0.6		3.2		13.4	
Hydrogen sulphide (ppm)						
Initial (T=0)	0		0		0	
30 sec	0		0		0	
1.00 min	0		0		0	
1.30 min	0		0		0	
2.00 min	0		0		0	
2.30 min	0		0		0	
3.00 min	0		0		0	
3.30 min	0		0		0	
4.00 min	0		0		0	
4.30 min	0		0		0	
5.00 min	0		0		0	
Carbon monoxide (ppm)						
Initial (T=0)	29		15		28	
30 sec	26		16		26	
1.00 min	25		16		16	
1.30 min	25		17		15	
2.00 min	24		18		14	
2.30 min	24		19		14	
3.00 min	24		20		13	
3.30 min	24		21		13	
4.00 min	24		21		13	
4.30 min	24		22		12	
5.00 min	24		22		12	
Balance (%)						
Initial (T=0)	86		81.4		81	
30 sec	86		82.0		80.6	
1.00 min	86		82.0		80.5	
1.30 min	86		82.1		80.5	
2.00 min	85.9		82.1		80.4	
2.30 min	85.9		82.1		80.4	
3.00 min	85.8		82.2		80.4	
3.30 min	85.9		82.2		80.4	
4.00 min	85.8		82.3		80.3	
4.30 min	85.8		82.3		80.3	
5.00 min	85.8		82.3		80.3	

Douglas Partners
Geotechnics | Environment | Groundwater

Tabulated Results for Landfill Gas Monitoring

Client: Benedict
Project:
Location: deep

Project No. 71459.03
Reporting Date:
Page No. 1 of 1

Time *	Well ID: JK103b					
	14:15					
Atmospheric pressure (mb)						
Initial	1011					
% Methane						
Initial (T=0)	2.1	0.2				
30 sec	2.7	0.2				
1.00 min	2.5	0.2				
1.30 min	3.9	0.2				
2.00 min	4.1	0.2				
2.30 min	4.2	0.2				
3.00 min	4.6	0.2				
3.30 min	4.5	0.3				
4.00 min	4.6	0.3				
4.30 min	4.4	0.2				
5.00 min	5.1	0.2				
% Carbon-di-oxide						
Initial (T=0)	1.2					
30 sec	1.6					
1.00 min	2					
1.30 min	2.1					
2.00 min	2.2					
2.30 min	2.2					
3.00 min	2.4					
3.30 min	2.3					
4.00 min	2.4					
4.30 min	2.5					
5.00 min	2.6					
% Oxygen						
Initial (T=0)	18.5					
30 sec	17.9					
1.00 min	17.2					
1.30 min	17.1					
2.00 min	17					
2.30 min	16.5					
3.00 min	16.7					
3.30 min	16.7					
4.00 min	16.7					
4.30 min	16.4					
5.00 min	16.2					
Hydrogen sulphide (ppm)						
Initial (T=0)	0					
30 sec	0					
1.00 min	0					
1.30 min	0					
2.00 min	0					
2.30 min	0					
3.00 min	0					
3.30 min	0					
4.00 min	0					
4.30 min	0					
5.00 min	0					
Carbon-monoxide (ppm)						
Initial (T=0)	19					
30 sec	17					
1.00 min	18					
1.30 min	18					
2.00 min	18					
2.30 min	19					
3.00 min	19					
3.30 min	19					
4.00 min	20					
4.30 min	20					
5.00 min	21					
Balance (%)						
Initial (T=0)	78.1					
30 sec	77.6					
1.00 min	77.1					
1.30 min	76.9					
2.00 min	76.6					
2.30 min	76.6					
3.00 min	76.3					
3.30 min	76.4					
4.00 min	76.3					
4.30 min	76.1					
5.00 min	75.4					

Appendix H

Laboratory Certificates of Analysis

Chain of Custody Documentation

12 Ashley Street, Chatswood, NSW 2067
tel: +61 2 9910 6200

email: sydney@envirolab.com.au
envirolab.com.au

Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 134222

Client:
Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: John Russell, Chris Bagia

Sample log in details:

Your Reference:	**71459.03, Moorebank**		
No. of samples:	74 Soils		
Date samples received / completed instructions received	11/9/2015	/	11/9/2015

This report supersedes the previous report R00 due to an amendment to client sample ID (#42)

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	18/09/15	/	17/02/16
Date of Preliminary Report:	Not Issued		

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Jacinta Hurst
Laboratory Manager

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	134222-1	134222-2	134222-3	134222-4	134222-5
Your Reference	---------- -	BH202	BH202	BH/MW215	BH/MW215	BH208
Depth	----------	0.9-1.35	1.9-2.35	0.9-1.35	1.9-2.35	1.9-2.35
Date Sampled		3/09/2015	3/09/2015	3/09/2015	3/09/2015	3/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	93	73	70	87	67

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	134222-6	134222-7	134222-8	134222-9	134222-10
Your Reference	---------- -	BH/MW218	BH/MW218	BH/MW218	BH/MW216	BH/MW216
Depth	----------	0.9-1.35	2.9-2.35	5.9-6.35	0.1-0.2	3.9-4.35
Date Sampled		3/09/2015	3/09/2015	4/09/2015	4/09/2015	4/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	16/09/2015	17/09/2015	17/09/2015	17/09/2015
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	91	82	88	69	93

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	134222-11	134222-12	134222-13	134222-14	134222-15
Your Reference	---------- -	BH/MW216	BH/MW223	BH/MW210	BH/MW210	JK107a
Depth	----------	5.9-6.35	2.0-2.45	0.1-0.2	2.0-2.45	0.1-0.2
Date Sampled		4/09/2015	4/09/2015	4/09/2015	4/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
TRHC6 - C9	mg/kg	<25	<25	<25	<25	<25
TRHC6 - C10	mg/kg	<25	<25	<25	<25	<25
vTPHC6 - C10 less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	86	87	80	90	93

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	134222-16	134222-17	134222-18	134222-19	134222-20
Your Reference	---------- -	JK107a	JK107a	JK107a	BH205	BH205
Depth	----------	1.9-2.35	7.9-8.35	8.9-9.35	0.9-1.35	2.9-3.35
Date Sampled		7/09/2015	7/09/2015	7/09/2015	7/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
TRHC6 - C9	mg/kg	<25	<25	<25	<25	<25
TRHC6 - C10	mg/kg	<25	<25	<25	<25	<25
vTPHC6 - C10 less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	90	93	83	95	96

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	134222-21	134222-22	134222-23	134222-24	134222-25
Your Reference	---------- -	BH205	JK103a	JK103a	JK103a	JK103a
Depth	----------	3.9-4.35	0.1-0.2	1.9-2.35	2.9-3.35	5.9-6.35
Date Sampled		7/09/2015	7/09/2015	7/09/2015	7/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
TRHC6 - C9	mg/kg	<25	<25	<25	<25	<25
TRHC6 - C10	mg/kg	<25	<25	<25	<25	<25
vTPHC6 - C10 less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	88	94	91	93	90

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	134222-26	134222-27	134222-28	134222-29	134222-30
Your Reference	---------- -	JK118a	JK118a	JK118a	BH211	BH211
Depth	----------	0.1-0.2	1.9-2.35	4.9-5.35	0.1-0.2	0.9-1.35
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	8/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
TRHC6 - C9	mg/kg	<25	<25	<25	<25	<25
TRHC6 - C10	mg/kg	<25	<25	<25	<25	<25
vTPHC6 - C10 less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	92	93	80	93	81

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	134222-31	134222-32	134222-33	134222-34	134222-35
Your Reference	---------- -	BH211	BH214	BH214	BH213	BH213
Depth	----------	2.9-2.35	0.1-0.2	2.2-2.65	0.1-0.2	2.9-3.35
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	8/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
TRHC6 - C9	mg/kg	<25	<25	<25	<25	<25
TRHC6 - C10	mg/kg	<25	<25	<25	<25	<25
vTPHC6 - C10 less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	94	94	84	95	93

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	134222-36	134222-37	134222-38	134222-39	134222-40
Your Reference	---------- -	BH221	BH221	BH221	BH221	BH222
Depth	----------	0.1-0.2	1.9-2.35	2.9-3.35	3.9-4.35	0.1-0.2
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
TRHC6 - C9	mg/kg	<25	<25	<25	<25	<25
TRHC6 - C10	mg/kg	<25	<25	<25	<25	<25
vTPHC6 - C10 less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	93	93	85	92	97

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	134222-41	134222-42	134222-43	134222-44	134222-45
Your Reference	---------- -	BH222	BH220	BH212	BH212	BH209
Depth	----------	0.9-1.35	0.1-0.2	0.1-0.2	2.9-3.35	0.1-0.2
Date Sampled		9/09/2015	9/09/2015	9/09/2015	9/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
TRHC6 - C9	mg/kg	<25	<25	<25	<25	<25
TRHC6 - C10	mg/kg	<25	<25	<25	<25	<25
vTPHC6 - C10 less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	100	91	71	90	94

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	134222-46	134222-47	134222-48	134222-49	134222-50
Your Reference	---------- -	BH209	BH209	BH209	BH204	BH204
Depth	----------	0.9-1.35	1.9-2.35	3.9-4.35	0.1-0.2	1.9-2.35
Date Sampled		9/09/2015	9/09/2015	9/09/2015	9/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
TRHC6 - C9	mg/kg	<25	<25	<25	<25	<25
TRHC6 - C10	mg/kg	<25	<25	<25	<25	<25
vTPHC6 - C10 less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	94	88	87	92	91

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	134222-51	134222-52	134222-53	134222-54	134222-55
Your Reference	---------- -	BH204	BH203	BH203	BH203	BH201
Depth	----------	3.9-4.35	0.1-0.2	0.9-1.35	2.9-3.35	0.1-0.2
Date Sampled		9/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
TRHC6 - C9	mg/kg	<25	<25	<25	<25	<25
TRHC6 - C10	mg/kg	<25	<25	<25	<25	<25
vTPHC6 - C10 less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	88	96	80	90	90

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	134222-56	134222-57	134222-59	134222-61	134222-62
Your Reference	---------- -	BH201	BH207	BH206	BH206	BH206
Depth	----------	0.9-1.35	0.1-0.2	0.1-0.2	2.35-2.9	4.35-4.9
Date Sampled		10/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
TRHC6 - C9	mg/kg	<25	<25	<25	<25	<25
TRHC6 - C10	mg/kg	<25	<25	<25	<25	<25
vTPHC6 - C10 less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	89	66	77	88	65

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	134222-63	134222-65	134222-66	134222-67	134222-69
Your Reference	---------- -	BH208	BD1/070815	BD2/080915	BD3/090915	TS1
Depth	----------	0.9-1.35	-	-	-	-
Date Sampled		10/09/2015	7/09/2015	8/09/2015	9/09/2015	1/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
TRHC6 - C9	mg/kg	<25	<25	<25	<25	[NA]
TRHC6 - C10	mg/kg	<25	<25	<25	<25	[NA]
vTPHC6 - C10 less BTEX (F1)	mg/kg	<25	<25	<25	<25	[NA]
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	101%
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	100%
Ethylbenzene	mg/kg	<1	<1	<1	<1	98%
m+p-xylene	mg/kg	<2	<2	<2	<2	101%
o-Xylene	mg/kg	<1	<1	<1	<1	100%
naphthalene	mg/kg	<1	<1	<1	<1	[NA]
Surrogate aaa-Trifluorotoluene	%	79	89	78	83	82

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	134222-70	134222-71	134222-72	134222-73	134222-74
Your Reference	---------- -	TB1	TS2	TB2	TS3	TB3
Depth	----------	-	-	-	-	-
Date Sampled		1/09/2015	1/09/2015	1/09/2015	1/09/2015	1/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
TRHC6 - C9	mg/kg	<25	[NA]	<25	[NA]	<25
TRHC6 - C10	mg/kg	<25	[NA]	<25	[NA]	<25
vTPHC6 - C10 less BTEX (F1)	mg/kg	<25	[NA]	<25	[NA]	<25
Benzene	mg/kg	<0.2	100%	<0.2	108%	<0.2
Toluene	mg/kg	<0.5	100%	<0.5	107%	<0.5
Ethylbenzene	mg/kg	<1	102%	<1	106%	<1
m+p-xylene	mg/kg	<2	103%	<2	105%	<2
o-Xylene	mg/kg	<1	101%	<1	106%	<1
naphthalene	mg/kg	<1	[NA]	<1	[NA]	<1
Surrogate aaa-Trifluorotoluene	%	93	86	82	82	97

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	134222-1	134222-2	134222-3	134222-4	134222-5
Your Reference	---------- -	BH202	BH202	BH/MW215	BH/MW215	BH208
Depth	----------	0.9-1.35	1.9-2.35	0.9-1.35	1.9-2.35	1.9-2.35
Date Sampled		3/09/2015	3/09/2015	3/09/2015	3/09/2015	3/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	16/09/2015	16/09/2015	15/09/2015	15/09/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	240	<100	<100	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	200	<100	<100	<100	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	330	<100	<100	<100	<100
Surrogate o-Terphenyl	%	89	92	93	84	85

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	134222-6	134222-7	134222-8	134222-9	134222-10
Your Reference	---------- -	BH/MW218	BH/MW218	BH/MW218	BH/MW216	BH/MW216
Depth	----------	0.9-1.35	2.9-2.35	5.9-6.35	0.1-0.2	3.9-4.35
Date Sampled		3/09/2015	3/09/2015	4/09/2015	4/09/2015	4/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	<100	<100	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100	<100	<100	<100	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	81	87	84	87	88

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	134222-11	134222-12	134222-13	134222-14	134222-15
Your Reference	---------- -	BH/MW216	BH/MW223	BH/MW210	BH/MW210	JK107a
Depth	----------	5.9-6.35	2.0-2.45	0.1-0.2	2.0-2.45	0.1-0.2
Date Sampled		4/09/2015	4/09/2015	4/09/2015	4/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	16/09/2015	15/09/2015	15/09/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	260	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	110	570	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100	100	680	<100	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	130	580	<100	<100
Surrogate o-Terphenyl	%	92	85	96	84	86

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	134222-16	134222-17	134222-18	134222-19	134222-20
Your Reference	---------- -	JK107a	JK107a	JK107a	BH205	BH205
Depth	----------	1.9-2.35	7.9-8.35	8.9-9.35	0.9-1.35	2.9-3.35
Date Sampled		7/09/2015	7/09/2015	7/09/2015	7/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	<100	<100	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100	<100	<100	<100	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	89	82	84	90	86

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	134222-21	134222-22	134222-23	134222-24	134222-25
Your Reference	---------- -	BH205	JK103a	JK103a	JK103a	JK103a
Depth	----------	3.9-4.35	0.1-0.2	1.9-2.35	2.9-3.35	5.9-6.35
Date Sampled		7/09/2015	7/09/2015	7/09/2015	7/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	16/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	17/09/2015	16/09/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	110	<100	460	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	550	<100	360	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100	460	<100	720	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	860	<100	240	<100
Surrogate o-Terphenyl	%	85	89	83	96	82

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	134222-26	134222-27	134222-28	134222-29	134222-30
Your Reference	---------- -	JK118a	JK118a	JK118a	BH211	BH211
Depth	----------	0.1-0.2	1.9-2.35	4.9-5.35	0.1-0.2	0.9-1.35
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	8/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	<100	<100	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100	<100	<100	<100	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	87	89	87	91	90

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	134222-31	134222-32	134222-33	134222-34	134222-35
Your Reference	---------- -	BH211	BH214	BH214	BH213	BH213
Depth	----------	2.9-2.35	0.1-0.2	2.2-2.65	0.1-0.2	2.9-3.35
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	8/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	<100	<100	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100	<100	<100	<100	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	88	87	84	88	82

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	134222-36	134222-37	134222-38	134222-39	134222-40
Your Reference	---------- -	BH221	BH221	BH221	BH221	BH222
Depth	----------	0.1-0.2	1.9-2.35	2.9-3.35	3.9-4.35	0.1-0.2
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	16/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	17/09/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	220	400
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	<100	<100	<100	590
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100	<100	110	270	890
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	<100	<100	<100	340
Surrogate o-Terphenyl	%	86	84	87	102	91

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	134222-41	134222-42	134222-43	134222-44	134222-45
Your Reference	----------	BH222	BH220	BH212	BH212	BH209
Depth	- ----------	0.9-1.35	0.1-0.2	0.1-0.2	2.9-3.35	0.1-0.2
Date Sampled		9/09/2015	9/09/2015	9/09/2015	9/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	15/09/2015	16/09/2015	16/09/2015	16/09/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	450	<100	230	100	160
TRHC$_{29}$ - C$_{36}$	mg/kg	790	<100	640	250	250
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	990	130	640	280	330
TRH>C$_{34}$-C$_{40}$	mg/kg	890	<100	840	160	170
Surrogate o-Terphenyl	%	117	90	96	92	96

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	134222-46	134222-47	134222-48	134222-49	134222-50
Your Reference	----------	BH209	BH209	BH209	BH204	BH204
Depth	- ----------	0.9-1.35	1.9-2.35	3.9-4.35	0.1-0.2	1.9-2.35
Date Sampled		9/09/2015	9/09/2015	9/09/2015	9/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	370	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	910	140	150	<100	120
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	990	140	120	110	170
TRH>C$_{34}$-C$_{40}$	mg/kg	1,100	150	130	<100	<100
Surrogate o-Terphenyl	%	96	91	92	94	91

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	134222-51	134222-52	134222-53	134222-54	134222-55
Your Reference	----------	BH204	BH203	BH203	BH203	BH201
	-					
Depth	----------	3.9-4.35	0.1-0.2	0.9-1.35	2.9-3.35	0.1-0.2
Date Sampled		9/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	140	<100	<100	200	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	150	110	<100	210	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	130	<100	<100	170	<100
Surrogate o-Terphenyl	%	94	92	88	87	91

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	134222-56	134222-57	134222-59	134222-61	134222-62
Your Reference	----------	BH201	BH207	BH206	BH206	BH206
	-					
Depth	----------	0.9-1.35	0.1-0.2	0.1-0.2	2.35-2.9	4.35-4.9
Date Sampled		10/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	850	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	110	1,200	<100	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	110	1,700	120	<100	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	130	1,300	<100	<100	<100
Surrogate o-Terphenyl	%	90	113	88	91	99

svTRH (C10-C40) in Soil					
Our Reference:	UNITS	134222-63	134222-65	134222-66	134222-67
Your Reference	---------- -	BH208	BD1/070815	BD2/080915	BD3/090915
Depth	----------	0.9-1.35	-	-	-
Date Sampled		10/09/2015	7/09/2015	8/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	<100	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100	<100	<100	110
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	<100	<100	<100
Surrogate o-Terphenyl	%	89	95	92	92

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- - ---------- 	134222-1 BH202 0.9-1.35 3/09/2015 Soil	134222-2 BH202 1.9-2.35 3/09/2015 Soil	134222-3 BH/MW215 0.9-1.35 3/09/2015 Soil	134222-4 BH/MW215 1.9-2.35 3/09/2015 Soil	134222-5 BH208 1.9-2.35 3/09/2015 Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	0.2
Phenanthrene	mg/kg	0.3	0.1	<0.1	<0.1	1
Anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	0.3
Fluoranthene	mg/kg	0.8	0.3	<0.1	<0.1	1.5
Pyrene	mg/kg	0.8	0.3	<0.1	<0.1	1.6
Benzo(a)anthracene	mg/kg	0.3	0.1	<0.1	<0.1	0.7
Chrysene	mg/kg	0.3	0.1	<0.1	<0.1	0.6
Benzo(b,j+k)fluoranthene	mg/kg	0.7	0.3	<0.2	<0.2	1
Benzo(a)pyrene	mg/kg	0.4	0.2	<0.05	<0.05	0.65
Indeno(1,2,3-c,d)pyrene	mg/kg	0.4	0.1	<0.1	<0.1	0.4
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.4	0.1	<0.1	<0.1	0.4
Benzo(a)pyrene TEQ calc (zero)	mg/kg	0.5	<0.5	<0.5	<0.5	0.9
Benzo(a)pyrene TEQ calc(half)	mg/kg	0.6	<0.5	<0.5	<0.5	0.9
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	0.6	<0.5	<0.5	<0.5	1
Total Positive PAHs	mg/kg	4.5	1.8	NIL (+)VE	NIL (+)VE	8.5
Surrogate p-Terphenyl-d14	%	94	99	100	99	97

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- - ---------- 	134222-6 BH/MW218 0.9-1.35 3/09/2015 Soil	134222-7 BH/MW218 2.9-2.35 3/09/2015 Soil	134222-8 BH/MW218 5.9-6.35 4/09/2015 Soil	134222-9 BH/MW216 0.1-0.2 4/09/2015 Soil	134222-10 BH/MW216 3.9-4.35 4/09/2015 Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	0.3	0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	0.5	0.2
Pyrene	mg/kg	<0.1	<0.1	<0.1	0.5	0.2
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	0.2	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	0.2	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	0.4	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05	0.2	0.07
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	0.2	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	NIL (+)VE	NIL (+)VE	NIL (+)VE	2.6	0.53
Surrogate p-Terphenyl-d14	%	104	101	105	101	101

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- - ---------- 	134222-11 BH/MW216 5.9-6.35 4/09/2015 Soil	134222-12 BH/MW223 2.0-2.45 4/09/2015 Soil	134222-13 BH/MW210 0.1-0.2 4/09/2015 Soil	134222-14 BH/MW210 2.0-2.45 4/09/2015 Soil	134222-15 JK107a 0.1-0.2 7/09/2015 Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	0.3	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	0.8	1.9	<0.1	0.3
Anthracene	mg/kg	<0.1	0.2	0.7	<0.1	<0.1
Fluoranthene	mg/kg	0.2	1.3	4.2	<0.1	0.5
Pyrene	mg/kg	0.2	1.2	4.4	<0.1	0.6
Benzo(a)anthracene	mg/kg	<0.1	0.6	2.0	<0.1	0.2
Chrysene	mg/kg	<0.1	0.6	2.2	<0.1	0.2
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	0.9	4.1	<0.2	0.4
Benzo(a)pyrene	mg/kg	0.1	0.51	2.8	<0.05	0.3
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	0.4	2.5	<0.1	0.2
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	0.5	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	0.4	2.4	<0.1	0.2
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	0.7	4.2	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	0.8	4.2	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	0.8	4.2	<0.5	<0.5
Total Positive PAHs	mg/kg	0.47	6.9	28	NIL (+)VE	2.8
Surrogate p-Terphenyl-d14	%	106	96	96	99	97

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- - ---------- 	134222-16 JK107a 1.9-2.35 7/09/2015 Soil	134222-17 JK107a 7.9-8.35 7/09/2015 Soil	134222-18 JK107a 8.9-9.35 7/09/2015 Soil	134222-19 BH205 0.9-1.35 7/09/2015 Soil	134222-20 BH205 2.9-3.35 7/09/2015 Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	0.07	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	0.33	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE
Surrogate p-Terphenyl-d14	%	104	100	109	100	103

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- - ---------- 	134222-21 BH205 3.9-4.35 7/09/2015 Soil	134222-22 JK103a 0.1-0.2 7/09/2015 Soil	134222-23 JK103a 1.9-2.35 7/09/2015 Soil	134222-24 JK103a 2.9-3.35 7/09/2015 Soil	134222-25 JK103a 5.9-6.35 7/09/2015 Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Naphthalene	mg/kg	<0.1	<0.1	<0.1	0.6	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	0.3	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	3.6	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	3.6	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	21	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	8.1	<0.1
Fluoranthene	mg/kg	<0.1	0.4	0.1	26	<0.1
Pyrene	mg/kg	<0.1	0.7	0.1	24	<0.1
Benzo(a)anthracene	mg/kg	<0.1	0.2	<0.1	13	<0.1
Chrysene	mg/kg	<0.1	0.3	<0.1	11	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	1	<0.2	5.1	<0.2
Benzo(a)pyrene	mg/kg	<0.05	0.56	0.08	13	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	0.8	<0.1	8.9	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	0.2	<0.1	1.7	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	0.8	<0.1	8.2	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	1	<0.5	17	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	1	<0.5	17	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	1	<0.5	17	<0.5
Total Positive PAHs	mg/kg	NIL (+)VE	5.0	0.38	150	NIL (+)VE
Surrogate p-Terphenyl-d14	%	96	92	97	97	98

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- - ---------- 	134222-26 JK118a 0.1-0.2 8/09/2015 Soil	134222-27 JK118a 1.9-2.35 8/09/2015 Soil	134222-28 JK118a 4.9-5.35 8/09/2015 Soil	134222-29 BH211 0.1-0.2 8/09/2015 Soil	134222-30 BH211 0.9-1.35 8/09/2015 Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.2	<0.1	<0.1	0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.4	<0.1	<0.1	0.2	<0.1
Pyrene	mg/kg	0.3	<0.1	<0.1	0.2	<0.1
Benzo(a)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	0.3	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	0.2	<0.05	<0.05	0.07	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	1.9	NIL (+)VE	NIL (+)VE	0.59	NIL (+)VE
Surrogate p-Terphenyl-d14	%	97	102	98	97	98

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- - ---------- 	134222-31 BH211 2.9-2.35 8/09/2015 Soil	134222-32 BH214 0.1-0.2 8/09/2015 Soil	134222-33 BH214 2.2-2.65 8/09/2015 Soil	134222-34 BH213 0.1-0.2 8/09/2015 Soil	134222-35 BH213 2.9-3.35 8/09/2015 Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	0.3	<0.1	0.4	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
Fluoranthene	mg/kg	<0.1	0.5	0.1	0.8	<0.1
Pyrene	mg/kg	<0.1	0.5	0.1	0.7	<0.1
Benzo(a)anthracene	mg/kg	<0.1	0.2	<0.1	0.3	<0.1
Chrysene	mg/kg	<0.1	0.2	<0.1	0.3	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	0.3	<0.2	0.5	<0.2
Benzo(a)pyrene	mg/kg	<0.05	0.2	0.06	0.3	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	0.1	<0.1	0.2	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	0.1	<0.1	0.2	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	NIL (+)VE	2.5	0.30	3.6	NIL (+)VE
Surrogate p-Terphenyl-d14	%	98	96	98	97	96

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- - ---------- 	134222-36 BH221 0.1-0.2 8/09/2015 Soil	134222-37 BH221 1.9-2.35 8/09/2015 Soil	134222-38 BH221 2.9-3.35 8/09/2015 Soil	134222-39 BH221 3.9-4.35 8/09/2015 Soil	134222-40 BH222 0.1-0.2 9/09/2015 Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	0.2	0.1	0.2
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.1	0.2	0.5	0.2	0.4
Pyrene	mg/kg	0.1	0.2	0.5	0.1	0.4
Benzo(a)anthracene	mg/kg	<0.1	<0.1	0.2	<0.1	0.2
Chrysene	mg/kg	<0.1	<0.1	0.2	<0.1	0.2
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	0.5	<0.2	0.2
Benzo(a)pyrene	mg/kg	0.09	0.09	0.3	0.06	0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	0.2	<0.1	0.2
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	0.1	0.3	<0.1	0.2
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	0.36	0.54	2.9	0.49	2.1
Surrogate p-Terphenyl-d14	%	97	95	95	96	95

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- - ---------- 	134222-41 BH222 0.9-1.35 9/09/2015 Soil	134222-42 BH220 0.1-0.2 9/09/2015 Soil	134222-43 BH212 0.1-0.2 9/09/2015 Soil	134222-44 BH212 2.9-3.35 9/09/2015 Soil	134222-45 BH209 0.1-0.2 9/09/2015 Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Naphthalene	mg/kg	2.5	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	1.1	<0.1	<0.1	<0.1	0.1
Acenaphthene	mg/kg	0.4	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	1.9	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	6.6	<0.1	0.5	0.3	1.3
Anthracene	mg/kg	1.6	<0.1	0.2	<0.1	0.4
Fluoranthene	mg/kg	6.2	0.1	1.2	0.6	2.3
Pyrene	mg/kg	5.5	0.1	1.3	0.7	2.2
Benzo(a)anthracene	mg/kg	2.8	<0.1	0.5	0.3	1.0
Chrysene	mg/kg	2.6	<0.1	0.6	0.3	1
Benzo(b,j+k)fluoranthene	mg/kg	5.2	<0.2	0.8	0.6	2
Benzo(a)pyrene	mg/kg	3.6	0.1	0.4	0.4	1.1
Indeno(1,2,3-c,d)pyrene	mg/kg	2.7	<0.1	0.7	0.3	0.9
Dibenzo(a,h)anthracene	mg/kg	0.7	<0.1	0.1	<0.1	0.2
Benzo(g,h,i)perylene	mg/kg	2.5	0.1	0.8	0.3	0.8
Benzo(a)pyrene TEQ calc (zero)	mg/kg	5.4	<0.5	0.7	0.6	1.7
Benzo(a)pyrene TEQ calc(half)	mg/kg	5.4	<0.5	0.7	0.6	1.7
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	5.4	<0.5	0.7	0.7	1.7
Total Positive PAHs	mg/kg	46	0.43	7.0	3.9	13
Surrogate p-Terphenyl-d14	%	95	95	93	98	91

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- - ---------- 	134222-46 BH209 0.9-1.35 9/09/2015 Soil	134222-47 BH209 1.9-2.35 9/09/2015 Soil	134222-48 BH209 3.9-4.35 9/09/2015 Soil	134222-49 BH204 0.1-0.2 9/09/2015 Soil	134222-50 BH204 1.9-2.35 9/09/2015 Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.2	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	0.6	0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	0.8	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	11	0.3	0.1	<0.1	0.1
Anthracene	mg/kg	2.7	0.3	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	21	2.1	0.2	<0.1	0.2
Pyrene	mg/kg	19	1.9	0.2	<0.1	0.2
Benzo(a)anthracene	mg/kg	9.2	0.7	<0.1	<0.1	<0.1
Chrysene	mg/kg	7.2	0.7	0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	15	1	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	9.5	0.86	0.1	<0.05	0.08
Indeno(1,2,3-c,d)pyrene	mg/kg	8.9	0.7	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	1.4	0.2	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	7.9	0.7	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	14	1.3	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	14	1.3	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	14	1.3	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	110	10	0.76	NIL (+)VE	0.51
Surrogate p-Terphenyl-d14	%	99	96	98	98	93

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- - ---------- 	134222-51 BH204 3.9-4.35 9/09/2015 Soil	134222-52 BH203 0.1-0.2 10/09/2015 Soil	134222-53 BH203 0.9-1.35 10/09/2015 Soil	134222-54 BH203 2.9-3.35 10/09/2015 Soil	134222-55 BH201 0.1-0.2 10/09/2015 Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.1	0.1	0.1	1.8	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	0.5	<0.1
Fluoranthene	mg/kg	0.3	0.3	0.2	2.8	<0.1
Pyrene	mg/kg	0.4	0.3	0.2	3.1	<0.1
Benzo(a)anthracene	mg/kg	0.2	0.1	<0.1	1.3	<0.1
Chrysene	mg/kg	0.2	0.1	0.1	1.3	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	0.3	0.2	0.2	2.2	<0.2
Benzo(a)pyrene	mg/kg	0.2	0.1	0.1	1.5	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	0.1	0.1	1.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	0.2	<0.1
Benzo(g,h,i)perylene	mg/kg	0.1	0.1	0.1	1.1	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	2.1	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	2.1	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	2.1	<0.5
Total Positive PAHs	mg/kg	1.9	1.6	1.2	17	NIL (+)VE
Surrogate p-Terphenyl-d14	%	91	92	101	92	98

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- - ---------- 	134222-56 BH201 0.9-1.35 10/09/2015 Soil	134222-57 BH207 0.1-0.2 10/09/2015 Soil	134222-58 BH207 0.9-1.35 10/09/2015 Soil	134222-59 BH206 0.1-0.2 10/09/2015 Soil	134222-60 BH206 0.9-1.35 10/09/2015 Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Naphthalene	mg/kg	<0.1	0.4	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	2.0	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	3.4	<0.1	0.4	<0.1
Fluorene	mg/kg	<0.1	5.1	<0.1	0.3	<0.1
Phenanthrene	mg/kg	<0.1	36	<0.1	2.3	<0.1
Anthracene	mg/kg	<0.1	9.5	<0.1	1	<0.1
Fluoranthene	mg/kg	0.1	44	<0.1	2.5	<0.1
Pyrene	mg/kg	0.1	38	<0.1	3.0	<0.1
Benzo(a)anthracene	mg/kg	<0.1	19	<0.1	1.2	<0.1
Chrysene	mg/kg	<0.1	15	<0.1	1.2	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	28	<0.2	2	<0.2
Benzo(a)pyrene	mg/kg	0.05	20	<0.05	1.1	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	15	<0.1	0.8	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	2.5	<0.1	0.2	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	12	<0.1	0.9	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	29	<0.5	1.7	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	29	<0.5	1.7	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	29	<0.5	1.7	<0.5
Total Positive PAHs	mg/kg	0.28	250	NIL (+)VE	17	NIL (+)VE
Surrogate p-Terphenyl-d14	%	93	98	100	97	97

PAHs in Soil						
Our Reference:	UNITS	134222-61	134222-62	134222-63	134222-64	134222-65
Your Reference	----------	BH206	BH206	BH208	BH208	BD1/070815
Depth	- ----------	2.35-2.9	4.35-4.9	0.9-1.35	3.9-4.35	-
Date Sampled		10/09/2015	10/09/2015	10/09/2015	10/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	0.2	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	0.3	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	0.3	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	0.2	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	0.3	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	0.2	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	0.2	<0.1	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	NIL (+)VE	NIL (+)VE	1.9	NIL (+)VE	NIL (+)VE
Surrogate p-Terphenyl-d14	%	98	103	99	98	103

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- - ---------- 	134222-66 BD2/080915 - 8/09/2015 Soil	134222-67 BD3/090915 - 9/09/2015 Soil	134222-68 BD5/100915 - 10/09/2015 Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015
Naphthalene	mg/kg	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.3	0.2	<0.1
Anthracene	mg/kg	0.2	<0.1	<0.1
Fluoranthene	mg/kg	1.2	0.5	0.1
Pyrene	mg/kg	1.2	0.6	0.1
Benzo(a)anthracene	mg/kg	0.6	0.2	<0.1
Chrysene	mg/kg	0.6	0.3	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	1	0.6	<0.2
Benzo(a)pyrene	mg/kg	0.77	0.4	0.08
Indeno(1,2,3-c,d)pyrene	mg/kg	0.5	0.3	<0.1
Dibenzo(a,h)anthracene	mg/kg	0.2	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.6	0.3	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	1.2	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	1.2	0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	1.2	0.6	<0.5
Total Positive PAHs	mg/kg	7.5	3.3	0.34
Surrogate p-Terphenyl-d14	%	97	98	98

Organochlorine Pesticides in soil						
Our Reference:	UNITS	134222-1	134222-2	134222-3	134222-4	134222-5
Your Reference	----------	BH202	BH202	BH/MW215	BH/MW215	BH208
	-					
Depth	----------	0.9-1.35	1.9-2.35	0.9-1.35	1.9-2.35	1.9-2.35
Date Sampled		3/09/2015	3/09/2015	3/09/2015	3/09/2015	3/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	94	102	99	96	96

Organochlorine Pesticides in soil						
Our Reference:	UNITS	134222-6	134222-7	134222-8	134222-9	134222-10
Your Reference	----------	BH/MW218	BH/MW218	BH/MW218	BH/MW216	BH/MW216
	-					
Depth	----------	0.9-1.35	2.9-2.35	5.9-6.35	0.1-0.2	3.9-4.35
Date Sampled		3/09/2015	3/09/2015	4/09/2015	4/09/2015	4/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	92	100	94	94	98

Organochlorine Pesticides in soil						
Our Reference:	UNITS	134222-11	134222-12	134222-13	134222-14	134222-15
Your Reference	----------	BH/MW216	BH/MW223	BH/MW210	BH/MW210	JK107a
Depth	- ----------	5.9-6.35	2.0-2.45	0.1-0.2	2.0-2.45	0.1-0.2
Date Sampled		4/09/2015	4/09/2015	4/09/2015	4/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	100	96	95	97	98

Organochlorine Pesticides in soil						
Our Reference:	UNITS	134222-16	134222-17	134222-18	134222-19	134222-20
Your Reference	----------	JK107a	JK107a	JK107a	BH205	BH205
	-					
Depth	----------	1.9-2.35	7.9-8.35	8.9-9.35	0.9-1.35	2.9-3.35
Date Sampled		7/09/2015	7/09/2015	7/09/2015	7/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	96	95	95	104	93

Organochlorine Pesticides in soil						
Our Reference:	UNITS	134222-21	134222-22	134222-23	134222-24	134222-25
Your Reference	----------	BH205	JK103a	JK103a	JK103a	JK103a
	-					
Depth	----------	3.9-4.35	0.1-0.2	1.9-2.35	2.9-3.35	5.9-6.35
Date Sampled		7/09/2015	7/09/2015	7/09/2015	7/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	18/09/2015	18/09/2015
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	0.2	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	0.2	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	0.3	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	0.2	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	93	96	94	99	95

Organochlorine Pesticides in soil						
Our Reference:	UNITS	134222-26	134222-27	134222-28	134222-29	134222-30
Your Reference	----------	JK118a	JK118a	JK118a	BH211	BH211
	-					
Depth	----------	0.1-0.2	1.9-2.35	4.9-5.35	0.1-0.2	0.9-1.35
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	8/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	18/09/2015	18/09/2015	18/09/2015	18/09/2015	18/09/2015
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	100	100	116	99	103

Organochlorine Pesticides in soil						
Our Reference:	UNITS	134222-31	134222-32	134222-33	134222-34	134222-35
Your Reference	----------	BH211	BH214	BH214	BH213	BH213
	-					
Depth	----------	2.9-2.35	0.1-0.2	2.2-2.65	0.1-0.2	2.9-3.35
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	8/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	18/09/2015	18/09/2015	18/09/2015	18/09/2015	18/09/2015
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	98	98	98	102	97

Organochlorine Pesticides in soil						
Our Reference:	UNITS	134222-36	134222-37	134222-38	134222-39	134222-40
Your Reference	----------	BH221	BH221	BH221	BH221	BH222
	-					
Depth	----------	0.1-0.2	1.9-2.35	2.9-3.35	3.9-4.35	0.1-0.2
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	18/09/2015	18/09/2015	18/09/2015	18/09/2015	18/09/2015
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	0.3	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	97	98	97	96	98

Organochlorine Pesticides in soil						
Our Reference:	UNITS	134222-41	134222-42	134222-43	134222-44	134222-45
Your Reference	----------	BH222	BH220	BH212	BH212	BH209
	-					
Depth	----------	0.9-1.35	0.1-0.2	0.1-0.2	2.9-3.35	0.1-0.2
Date Sampled		9/09/2015	9/09/2015	9/09/2015	9/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	100	113	109	102	112

Organochlorine Pesticides in soil						
Our Reference:	UNITS	134222-46	134222-47	134222-48	134222-49	134222-50
Your Reference	----------	BH209	BH209	BH209	BH204	BH204
Depth	- ----------	0.9-1.35	1.9-2.35	3.9-4.35	0.1-0.2	1.9-2.35
Date Sampled		9/09/2015	9/09/2015	9/09/2015	9/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	18/09/2015	18/09/2015	18/09/2015
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	0.2	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	98	98	111	125	101

Organochlorine Pesticides in soil						
Our Reference:	UNITS	134222-51	134222-52	134222-53	134222-54	134222-55
Your Reference	----------	BH204	BH203	BH203	BH203	BH201
	-					
Depth	----------	3.9-4.35	0.1-0.2	0.9-1.35	2.9-3.35	0.1-0.2
Date Sampled		9/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	18/09/2015	18/09/2015	18/09/2015	18/09/2015	18/09/2015
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	0.3	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	106	102	105	111	104

Organochlorine Pesticides in soil						
Our Reference:	UNITS	134222-56	134222-57	134222-59	134222-61	134222-62
Your Reference	----------	BH201	BH207	BH206	BH206	BH206
	-					
Depth	----------	0.9-1.35	0.1-0.2	0.1-0.2	2.35-2.9	4.35-4.9
Date Sampled		10/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	18/09/2015	18/09/2015	18/09/2015	18/09/2015	18/09/2015
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	109	96	111	98	101

Organochlorine Pesticides in soil					
Our Reference:	UNITS	134222-63	134222-65	134222-66	134222-67
Your Reference	----------	BH208	BD1/070815	BD2/080915	BD3/090915
	-				
Depth	----------	0.9-1.35	-	-	-
Date Sampled		10/09/2015	7/09/2015	8/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	18/09/2015	18/09/2015	18/09/2015	18/09/2015
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	106	111	103	109

Organophosphorus Pesticides						
Our Reference:	UNITS	134222-1	134222-2	134222-3	134222-4	134222-5
Your Reference	---------- -	BH202	BH202	BH/MW215	BH/MW215	BH208
Depth	----------	0.9-1.35	1.9-2.35	0.9-1.35	1.9-2.35	1.9-2.35
Date Sampled		3/09/2015	3/09/2015	3/09/2015	3/09/2015	3/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	94	102	99	96	96

Organophosphorus Pesticides						
Our Reference:	UNITS	134222-6	134222-7	134222-8	134222-9	134222-10
Your Reference	---------- -	BH/MW218	BH/MW218	BH/MW218	BH/MW216	BH/MW216
Depth	----------	0.9-1.35	2.9-2.35	5.9-6.35	0.1-0.2	3.9-4.35
Date Sampled		3/09/2015	3/09/2015	4/09/2015	4/09/2015	4/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	92	100	94	94	98

Organophosphorus Pesticides						
Our Reference:	UNITS	134222-11	134222-12	134222-13	134222-14	134222-15
Your Reference	---------- -	BH/MW216	BH/MW223	BH/MW210	BH/MW210	JK107a
Depth	----------	5.9-6.35	2.0-2.45	0.1-0.2	2.0-2.45	0.1-0.2
Date Sampled		4/09/2015	4/09/2015	4/09/2015	4/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	100	96	95	97	98

Organophosphorus Pesticides						
Our Reference:	UNITS	134222-16	134222-17	134222-18	134222-19	134222-20
Your Reference	---------- -	JK107a	JK107a	JK107a	BH205	BH205
Depth	----------	1.9-2.35	7.9-8.35	8.9-9.35	0.9-1.35	2.9-3.35
Date Sampled		7/09/2015	7/09/2015	7/09/2015	7/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	96	95	95	104	93

Organophosphorus Pesticides						
Our Reference:	UNITS	134222-21	134222-22	134222-23	134222-24	134222-25
Your Reference	---------- -	BH205	JK103a	JK103a	JK103a	JK103a
Depth	----------	3.9-4.35	0.1-0.2	1.9-2.35	2.9-3.35	5.9-6.35
Date Sampled		7/09/2015	7/09/2015	7/09/2015	7/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	93	96	94	99	95

Organophosphorus Pesticides						
Our Reference:	UNITS	134222-26	134222-27	134222-28	134222-29	134222-30
Your Reference	---------- -	JK118a	JK118a	JK118a	BH211	BH211
Depth	----------	0.1-0.2	1.9-2.35	4.9-5.35	0.1-0.2	0.9-1.35
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	8/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	100	100	116	99	103

Organophosphorus Pesticides						
Our Reference:	UNITS	134222-31	134222-32	134222-33	134222-34	134222-35
Your Reference	----------	BH211	BH214	BH214	BH213	BH213
	-					
Depth	----------	2.9-2.35	0.1-0.2	2.2-2.65	0.1-0.2	2.9-3.35
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	8/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	98	98	98	102	97

Organophosphorus Pesticides						
Our Reference:	UNITS	134222-36	134222-37	134222-38	134222-39	134222-40
Your Reference	----------	BH221	BH221	BH221	BH221	BH222
	-					
Depth	----------	0.1-0.2	1.9-2.35	2.9-3.35	3.9-4.35	0.1-0.2
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	97	98	97	96	98

Organophosphorus Pesticides						
Our Reference:	UNITS	134222-41	134222-42	134222-43	134222-44	134222-45
Your Reference	----------	BH222	BH220	BH212	BH212	BH209
Depth	- ----------	0.9-1.35	0.1-0.2	0.1-0.2	2.9-3.35	0.1-0.2
Date Sampled		9/09/2015	9/09/2015	9/09/2015	9/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	100	113	109	102	112

Organophosphorus Pesticides						
Our Reference:	UNITS	134222-46	134222-47	134222-48	134222-49	134222-50
Your Reference	----------	BH209	BH209	BH209	BH204	BH204
Depth	- ----------	0.9-1.35	1.9-2.35	3.9-4.35	0.1-0.2	1.9-2.35
Date Sampled		9/09/2015	9/09/2015	9/09/2015	9/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	18/09/2015	18/09/2015	18/09/2015
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	98	98	111	125	101

Organophosphorus Pesticides						
Our Reference:	UNITS	134222-51	134222-52	134222-53	134222-54	134222-55
Your Reference	---------- -	BH204	BH203	BH203	BH203	BH201
Depth	----------	3.9-4.35	0.1-0.2	0.9-1.35	2.9-3.35	0.1-0.2
Date Sampled		9/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	18/09/2015	18/09/2015	18/09/2015	18/09/2015	18/09/2015
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	106	102	105	111	104

Organophosphorus Pesticides						
Our Reference:	UNITS	134222-56	134222-57	134222-59	134222-61	134222-62
Your Reference	---------- -	BH201	BH207	BH206	BH206	BH206
Depth	----------	0.9-1.35	0.1-0.2	0.1-0.2	2.35-2.9	4.35-4.9
Date Sampled		10/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	18/09/2015	18/09/2015	18/09/2015	18/09/2015	18/09/2015
Azinphos-methyl (Guthion)	mg/kg	<0.1	0.6	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	109	96	111	98	101

Organophosphorus Pesticides					
Our Reference:	UNITS	134222-63	134222-65	134222-66	134222-67
Your Reference	----------	BH208	BD1/070815	BD2/080915	BD3/090915
Depth	----------	0.9-1.35	-	-	-
Date Sampled		10/09/2015	7/09/2015	8/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	18/09/2015	18/09/2015	18/09/2015	18/09/2015
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	106	111	103	109

PCBs in Soil						
Our Reference:	UNITS	134222-1	134222-2	134222-3	134222-4	134222-5
Your Reference	----------	BH202	BH202	BH/MW215	BH/MW215	BH208
	-					
Depth	----------	0.9-1.35	1.9-2.35	0.9-1.35	1.9-2.35	1.9-2.35
Date Sampled		3/09/2015	3/09/2015	3/09/2015	3/09/2015	3/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	94	102	99	96	96

PCBs in Soil						
Our Reference:	UNITS	134222-6	134222-7	134222-8	134222-9	134222-10
Your Reference	----------	BH/MW218	BH/MW218	BH/MW218	BH/MW216	BH/MW216
	-					
Depth	----------	0.9-1.35	2.9-2.35	5.9-6.35	0.1-0.2	3.9-4.35
Date Sampled		3/09/2015	3/09/2015	4/09/2015	4/09/2015	4/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	92	100	94	94	98

PCBs in Soil						
Our Reference:	UNITS	134222-11	134222-12	134222-13	134222-14	134222-15
Your Reference	----------	BH/MW216	BH/MW223	BH/MW210	BH/MW210	JK107a
Depth	- ----------	5.9-6.35	2.0-2.45	0.1-0.2	2.0-2.45	0.1-0.2
Date Sampled		4/09/2015	4/09/2015	4/09/2015	4/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	100	96	95	97	98

PCBs in Soil						
Our Reference:	UNITS	134222-16	134222-17	134222-18	134222-19	134222-20
Your Reference	----------	JK107a	JK107a	JK107a	BH205	BH205
Depth	- ----------	1.9-2.35	7.9-8.35	8.9-9.35	0.9-1.35	2.9-3.35
Date Sampled		7/09/2015	7/09/2015	7/09/2015	7/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	96	95	95	104	93

PCBs in Soil						
Our Reference:	UNITS	134222-21	134222-22	134222-23	134222-24	134222-25
Your Reference	----------	BH205	JK103a	JK103a	JK103a	JK103a
	-					
Depth	----------	3.9-4.35	0.1-0.2	1.9-2.35	2.9-3.35	5.9-6.35
Date Sampled		7/09/2015	7/09/2015	7/09/2015	7/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.5	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.5	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.5	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.5	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.5	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.5	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.5	<0.1
Surrogate TCLMX	%	93	96	94	99	95

PCBs in Soil						
Our Reference:	UNITS	134222-26	134222-27	134222-28	134222-29	134222-30
Your Reference	----------	JK118a	JK118a	JK118a	BH211	BH211
	-					
Depth	----------	0.1-0.2	1.9-2.35	4.9-5.35	0.1-0.2	0.9-1.35
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	8/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	100	100	116	99	103

PCBs in Soil						
Our Reference:	UNITS	134222-31	134222-32	134222-33	134222-34	134222-35
Your Reference	----------	BH211	BH214	BH214	BH213	BH213
	-					
Depth	----------	2.9-2.35	0.1-0.2	2.2-2.65	0.1-0.2	2.9-3.35
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	8/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	98	98	98	102	97

PCBs in Soil						
Our Reference:	UNITS	134222-36	134222-37	134222-38	134222-39	134222-40
Your Reference	----------	BH221	BH221	BH221	BH221	BH222
	-					
Depth	----------	0.1-0.2	1.9-2.35	2.9-3.35	3.9-4.35	0.1-0.2
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	97	98	97	96	98

PCBs in Soil						
Our Reference:	UNITS	134222-41	134222-42	134222-43	134222-44	134222-45
Your Reference	----------	BH222	BH220	BH212	BH212	BH209
	-					
Depth	----------	0.9-1.35	0.1-0.2	0.1-0.2	2.9-3.35	0.1-0.2
Date Sampled		9/09/2015	9/09/2015	9/09/2015	9/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	17/09/2015	17/09/2015	17/09/2015
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.2	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.2	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.2	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.2	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.2	<0.1
Aroclor 1254	mg/kg	<0.1	3.7	<0.1	<0.2	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.2	<0.1
Surrogate TCLMX	%	100	113	109	102	112

PCBs in Soil						
Our Reference:	UNITS	134222-46	134222-47	134222-48	134222-49	134222-50
Your Reference	----------	BH209	BH209	BH209	BH204	BH204
	-					
Depth	----------	0.9-1.35	1.9-2.35	3.9-4.35	0.1-0.2	1.9-2.35
Date Sampled		9/09/2015	9/09/2015	9/09/2015	9/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	17/09/2015	17/09/2015	18/09/2015	18/09/2015	18/09/2015
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<1
Surrogate TCLMX	%	98	98	111	125	101

PCBs in Soil						
Our Reference:	UNITS	134222-51	134222-52	134222-53	134222-54	134222-55
Your Reference	----------	BH204	BH203	BH203	BH203	BH201
	-					
Depth	----------	3.9-4.35	0.1-0.2	0.9-1.35	2.9-3.35	0.1-0.2
Date Sampled		9/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	18/09/2015	18/09/2015	18/09/2015	18/09/2015	18/09/2015
Aroclor 1016	mg/kg	<1	<0.1	<0.1	<0.5	<0.1
Aroclor 1221	mg/kg	<1	<0.1	<0.1	<0.5	<0.1
Aroclor 1232	mg/kg	<1	<0.1	<0.1	<0.5	<0.1
Aroclor 1242	mg/kg	<1	<0.1	<0.1	<0.5	<0.1
Aroclor 1248	mg/kg	<1	<0.1	<0.1	<0.5	<0.1
Aroclor 1254	mg/kg	<1	<0.1	<0.1	<0.5	<0.1
Aroclor 1260	mg/kg	<1	<0.1	<0.1	<0.5	<0.1
Surrogate TCLMX	%	106	102	105	111	104

PCBs in Soil						
Our Reference:	UNITS	134222-56	134222-57	134222-59	134222-61	134222-62
Your Reference	----------	BH201	BH207	BH206	BH206	BH206
	-					
Depth	----------	0.9-1.35	0.1-0.2	0.1-0.2	2.35-2.9	4.35-4.9
Date Sampled		10/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	18/09/2015	18/09/2015	18/09/2015	18/09/2015	18/09/2015
Aroclor 1016	mg/kg	<0.1	<1	<0.5	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<1	<0.5	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<1	<0.5	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<1	<0.5	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<1	<0.5	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<1	<0.5	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<1	<0.5	<0.1	<0.1
Surrogate TCLMX	%	109	96	111	98	101

PCBs in Soil					
Our Reference:	UNITS	134222-63	134222-65	134222-66	134222-67
Your Reference	----------	BH208	BD1/070815	BD2/080915	BD3/090915
	-				
Depth	----------	0.9-1.35	-	-	-
Date Sampled		10/09/2015	7/09/2015	8/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	18/09/2015	18/09/2015	18/09/2015	18/09/2015
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	106	111	103	109

Acid Extractable metals in soil						
Our Reference:	UNITS	134222-1	134222-2	134222-3	134222-4	134222-5
Your Reference	----------	BH202	BH202	BH/MW215	BH/MW215	BH208
	-					
Depth	----------	0.9-1.35	1.9-2.35	0.9-1.35	1.9-2.35	1.9-2.35
Date Sampled		3/09/2015	3/09/2015	3/09/2015	3/09/2015	3/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Arsenic	mg/kg	<4	6	<4	<4	<4
Cadmium	mg/kg	<0.4	0.5	<0.4	<0.4	<0.4
Chromium	mg/kg	45	26	9	4	18
Copper	mg/kg	47	50	10	17	21
Lead	mg/kg	13	170	28	19	55
Mercury	mg/kg	<0.1	0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	11	15	4	2	13
Zinc	mg/kg	32	140	50	11	470
Manganese	mg/kg	1,500	180	61	13	190

Acid Extractable metals in soil						
Our Reference:	UNITS	134222-6	134222-7	134222-8	134222-9	134222-10
Your Reference	----------	BH/MW218	BH/MW218	BH/MW218	BH/MW216	BH/MW216
	-					
Depth	----------	0.9-1.35	2.9-2.35	5.9-6.35	0.1-0.2	3.9-4.35
Date Sampled		3/09/2015	3/09/2015	4/09/2015	4/09/2015	4/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Arsenic	mg/kg	<4	5	5	<4	7
Cadmium	mg/kg	<0.4	<0.4	<0.4	0.8	<0.4
Chromium	mg/kg	4	14	15	13	21
Copper	mg/kg	2	46	7	28	26
Lead	mg/kg	4	37	11	54	66
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	0.1
Nickel	mg/kg	3	13	2	9	11
Zinc	mg/kg	13	64	3	130	83
Manganese	mg/kg	68	110	5	200	230

Acid Extractable metals in soil						
Our Reference:	UNITS	134222-11	134222-12	134222-13	134222-14	134222-15
Your Reference	----------	BH/MW216	BH/MW223	BH/MW210	BH/MW210	JK107a
	-					
Depth	----------	5.9-6.35	2.0-2.45	0.1-0.2	2.0-2.45	0.1-0.2
Date Sampled		4/09/2015	4/09/2015	4/09/2015	4/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Arsenic	mg/kg	17	5	<4	5	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	21	17	10	12	9
Copper	mg/kg	23	540	63	4	19
Lead	mg/kg	51	79	11	10	38
Mercury	mg/kg	<0.1	0.2	<0.1	<0.1	<0.1
Nickel	mg/kg	9	10	14	2	5
Zinc	mg/kg	170	110	33	5	79
Manganese	mg/kg	130	190	280	15	87

Acid Extractable metals in soil						
Our Reference:	UNITS	134222-16	134222-17	134222-18	134222-19	134222-20
Your Reference	----------	JK107a	JK107a	JK107a	BH205	BH205
	-					
Depth	----------	1.9-2.35	7.9-8.35	8.9-9.35	0.9-1.35	2.9-3.35
Date Sampled		7/09/2015	7/09/2015	7/09/2015	7/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Arsenic	mg/kg	10	<4	<4	<4	6
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	17	5	3	46	9
Copper	mg/kg	29	5	3	15	7
Lead	mg/kg	98	6	6	12	13
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	10	1	<1	19	2
Zinc	mg/kg	110	2	4	25	5
Manganese	mg/kg	89	2	3	92	8

Acid Extractable metals in soil						
Our Reference:	UNITS	134222-21	134222-22	134222-23	134222-24	134222-25
Your Reference	----------	BH205	JK103a	JK103a	JK103a	JK103a
	-					
Depth	----------	3.9-4.35	0.1-0.2	1.9-2.35	2.9-3.35	5.9-6.35
Date Sampled		7/09/2015	7/09/2015	7/09/2015	7/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Arsenic	mg/kg	8	<4	<4	<4	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	15	73	4	12	3
Copper	mg/kg	15	78	18	22	3
Lead	mg/kg	15	6	31	49	3
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	2	11	1	9	<1
Zinc	mg/kg	15	26	14	66	1
Manganese	mg/kg	9	2,300	51	170	1

Acid Extractable metals in soil						
Our Reference:	UNITS	134222-26	134222-27	134222-28	134222-29	134222-30
Your Reference	----------	JK118a	JK118a	JK118a	BH211	BH211
	-					
Depth	----------	0.1-0.2	1.9-2.35	4.9-5.35	0.1-0.2	0.9-1.35
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	8/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Arsenic	mg/kg	<4	<4	<4	<4	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	4	9	15	12	10
Copper	mg/kg	17	12	15	19	5
Lead	mg/kg	15	63	10	21	10
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	5	6	2	9	2
Zinc	mg/kg	25	87	9	54	4
Manganese	mg/kg	110	120	9	200	18

Acid Extractable metals in soil						
Our Reference:	UNITS	134222-31	134222-32	134222-33	134222-34	134222-35
Your Reference	----------	BH211	BH214	BH214	BH213	BH213
	-					
Depth	----------	2.9-2.35	0.1-0.2	2.2-2.65	0.1-0.2	2.9-3.35
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	8/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Arsenic	mg/kg	4	<4	<4	8	5
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	17	18	6	19	13
Copper	mg/kg	3	46	14	21	4
Lead	mg/kg	24	17	54	19	18
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	4	11	8	14	3
Zinc	mg/kg	6	48	33	43	27
Manganese	mg/kg	42	240	67	200	27

Acid Extractable metals in soil						
Our Reference:	UNITS	134222-36	134222-37	134222-38	134222-39	134222-40
Your Reference	----------	BH221	BH221	BH221	BH221	BH222
	-					
Depth	----------	0.1-0.2	1.9-2.35	2.9-3.35	3.9-4.35	0.1-0.2
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Arsenic	mg/kg	<4	4	7	17	<4
Cadmium	mg/kg	<0.4	<0.4	0.6	0.7	<0.4
Chromium	mg/kg	11	14	15	25	16
Copper	mg/kg	14	16	45	24	32
Lead	mg/kg	30	92	620	86	22
Mercury	mg/kg	0.1	<0.1	0.2	<0.1	<0.1
Nickel	mg/kg	4	6	9	8	26
Zinc	mg/kg	69	78	290	150	52
Manganese	mg/kg	110	120	180	130	560

Acid Extractable metals in soil						
Our Reference:	UNITS	134222-41	134222-42	134222-43	134222-44	134222-45
Your Reference	----------	BH222	BH220	BH212	BH212	BH209
	-					
Depth	----------	0.9-1.35	0.1-0.2	0.1-0.2	2.9-3.35	0.1-0.2
Date Sampled		9/09/2015	9/09/2015	9/09/2015	9/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Arsenic	mg/kg	<4	4	<4	6	6
Cadmium	mg/kg	<0.4	0.8	<0.4	0.6	<0.4
Chromium	mg/kg	12	16	28	16	18
Copper	mg/kg	85	47	67	41	82
Lead	mg/kg	22	190	16	130	98
Mercury	mg/kg	<0.1	0.2	<0.1	0.1	0.1
Nickel	mg/kg	12	11	11	9	13
Zinc	mg/kg	77	290	39	240	210
Manganese	mg/kg	220	610	800	120	270

Acid Extractable metals in soil						
Our Reference:	UNITS	134222-46	134222-47	134222-48	134222-49	134222-50
Your Reference	----------	BH209	BH209	BH209	BH204	BH204
	-					
Depth	----------	0.9-1.35	1.9-2.35	3.9-4.35	0.1-0.2	1.9-2.35
Date Sampled		9/09/2015	9/09/2015	9/09/2015	9/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Arsenic	mg/kg	<4	5	7	<4	5
Cadmium	mg/kg	<0.4	<0.4	0.4	<0.4	<0.4
Chromium	mg/kg	21	17	19	5	15
Copper	mg/kg	37	55	25	24	56
Lead	mg/kg	35	35	150	47	72
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	10	9	10	3	5
Zinc	mg/kg	75	66	140	83	140
Manganese	mg/kg	450	150	190	44	130

Acid Extractable metals in soil						
Our Reference:	UNITS	134222-51	134222-52	134222-53	134222-54	134222-55
Your Reference	---------- -	BH204	BH203	BH203	BH203	BH201
Depth	----------	3.9-4.35	0.1-0.2	0.9-1.35	2.9-3.35	0.1-0.2
Date Sampled		9/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Arsenic	mg/kg	7	<4	7	7	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4	0.5	0.4
Chromium	mg/kg	11	7	14	15	7
Copper	mg/kg	64	46	19	160	32
Lead	mg/kg	150	44	36	860	56
Mercury	mg/kg	0.1	<0.1	<0.1	0.2	<0.1
Nickel	mg/kg	16	5	6	14	5
Zinc	mg/kg	210	100	70	380	110
Manganese	mg/kg	80	87	40	150	61

Acid Extractable metals in soil						
Our Reference:	UNITS	134222-56	134222-57	134222-58	134222-59	134222-60
Your Reference	---------- -	BH201	BH207	BH207	BH206	BH206
Depth	----------	0.9-1.35	0.1-0.2	0.9-1.35	0.1-0.2	0.9-1.35
Date Sampled		10/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Arsenic	mg/kg	4	<4	5	5	8
Cadmium	mg/kg	1	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	15	25	15	17	15
Copper	mg/kg	79	53	18	30	22
Lead	mg/kg	110	16	21	140	16
Mercury	mg/kg	0.1	<0.1	<0.1	0.2	<0.1
Nickel	mg/kg	9	26	6	15	11
Zinc	mg/kg	170	40	55	140	30
Manganese	mg/kg	160	490	73	160	450

Acid Extractable metals in soil						
Our Reference:	UNITS	134222-61	134222-62	134222-63	134222-64	134222-65
Your Reference	----------	BH206	BH206	BH208	BH208	BD1/070815
	-					
Depth	----------	2.35-2.9	4.35-4.9	0.9-1.35	3.9-4.35	-
Date Sampled		10/09/2015	10/09/2015	10/09/2015	10/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Arsenic	mg/kg	<4	17	<4	7	8
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	0.6
Chromium	mg/kg	16	19	10	30	13
Copper	mg/kg	8	10	19	13	49
Lead	mg/kg	25	32	32	26	35
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	3	11	5	5	43
Zinc	mg/kg	9	30	44	16	160
Manganese	mg/kg	37	120	42	6	340

Acid Extractable metals in soil						
Our Reference:	UNITS	134222-66	134222-67	134222-68	134222-75	134222-76
Your Reference	----------	BD2/080915	BD3/090915	BD5/100915	BH222 - TRIPLICATE	BH204 - TRIPLICATE
	-					
Depth	----------	-	-	-	0.9-1.35	3.9-4.35
Date Sampled		8/09/2015	9/09/2015	10/09/2015	09/09/2015	09/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Arsenic	mg/kg	5	4	6	<4	6
Cadmium	mg/kg	<0.4	0.5	<0.4	<0.4	<0.4
Chromium	mg/kg	9	12	16	23	13
Copper	mg/kg	42	27	56	250	31
Lead	mg/kg	90	140	93	42	180
Mercury	mg/kg	0.1	0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	6	8	10	16	8
Zinc	mg/kg	75	170	250	160	150
Manganese	mg/kg	79	100	85	270	110

Acid Extractable metals in soil			
Our Reference:	UNITS	134222-77	134222-78
Your Reference	----------	BH206 - TRIPLICATE	BH/MW216 - TRIPLICATE
	-		
Depth	----------	2.35-2.9	5.9-6.35
Date Sampled		10/09/2015	04/09/2015
Type of sample		Soil	Soil
Date prepared	-	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015
Arsenic	mg/kg	<4	14
Cadmium	mg/kg	<0.4	<0.4
Chromium	mg/kg	16	18
Copper	mg/kg	10	18
Lead	mg/kg	35	43
Mercury	mg/kg	<0.1	<0.1
Nickel	mg/kg	2	7
Zinc	mg/kg	10	210
Manganese	mg/kg	49	74

Misc Soil - Inorg						
Our Reference:	UNITS	134222-1	134222-2	134222-3	134222-4	134222-5
Your Reference	----------	BH202	BH202	BH/MW215	BH/MW215	BH208
	-					
Depth	----------	0.9-1.35	1.9-2.35	0.9-1.35	1.9-2.35	1.9-2.35
Date Sampled		3/09/2015	3/09/2015	3/09/2015	3/09/2015	3/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Total Cyanide	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg						
Our Reference:	UNITS	134222-6	134222-7	134222-8	134222-9	134222-10
Your Reference	----------	BH/MW218	BH/MW218	BH/MW218	BH/MW216	BH/MW216
	-					
Depth	----------	0.9-1.35	2.9-2.35	5.9-6.35	0.1-0.2	3.9-4.35
Date Sampled		3/09/2015	3/09/2015	4/09/2015	4/09/2015	4/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Total Cyanide	mg/kg	<0.5	0.6	<0.5	<0.5	<0.5
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg						
Our Reference:	UNITS	134222-11	134222-12	134222-13	134222-14	134222-15
Your Reference	----------	BH/MW216	BH/MW223	BH/MW210	BH/MW210	JK107a
	-					
Depth	----------	5.9-6.35	2.0-2.45	0.1-0.2	2.0-2.45	0.1-0.2
Date Sampled		4/09/2015	4/09/2015	4/09/2015	4/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Total Cyanide	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg						
Our Reference:	UNITS	134222-16	134222-17	134222-18	134222-19	134222-20
Your Reference	----------	JK107a	JK107a	JK107a	BH205	BH205
	-					
Depth	----------	1.9-2.35	7.9-8.35	8.9-9.35	0.9-1.35	2.9-3.35
Date Sampled		7/09/2015	7/09/2015	7/09/2015	7/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Total Cyanide	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg						
Our Reference:	UNITS	134222-21	134222-22	134222-23	134222-24	134222-25
Your Reference	---------- -	BH205	JK103a	JK103a	JK103a	JK103a
Depth	----------	3.9-4.35	0.1-0.2	1.9-2.35	2.9-3.35	5.9-6.35
Date Sampled		7/09/2015	7/09/2015	7/09/2015	7/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Total Cyanide	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg						
Our Reference:	UNITS	134222-26	134222-27	134222-28	134222-29	134222-30
Your Reference	---------- -	JK118a	JK118a	JK118a	BH211	BH211
Depth	----------	0.1-0.2	1.9-2.35	4.9-5.35	0.1-0.2	0.9-1.35
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	8/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Total Cyanide	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg						
Our Reference:	UNITS	134222-31	134222-32	134222-33	134222-34	134222-35
Your Reference	---------- -	BH211	BH214	BH214	BH213	BH213
Depth	----------	2.9-2.35	0.1-0.2	2.2-2.65	0.1-0.2	2.9-3.35
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	8/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Total Cyanide	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg						
Our Reference:	UNITS	134222-36	134222-37	134222-38	134222-39	134222-40
Your Reference	---------- -	BH221	BH221	BH221	BH221	BH222
Depth	----------	0.1-0.2	1.9-2.35	2.9-3.35	3.9-4.35	0.1-0.2
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Total Cyanide	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg						
Our Reference:	UNITS	134222-41	134222-42	134222-43	134222-44	134222-45
Your Reference	----------	BH222	BH220	BH212	BH212	BH209
Depth	- ----------	0.9-1.35	0.1-0.2	0.1-0.2	2.9-3.35	0.1-0.2
Date Sampled		9/09/2015	9/09/2015	9/09/2015	9/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Total Cyanide	mg/kg	<0.5	<0.5	<0.5	0.5	<0.5
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg						
Our Reference:	UNITS	134222-46	134222-47	134222-48	134222-49	134222-50
Your Reference	----------	BH209	BH209	BH209	BH204	BH204
Depth	- ----------	0.9-1.35	1.9-2.35	3.9-4.35	0.1-0.2	1.9-2.35
Date Sampled		9/09/2015	9/09/2015	9/09/2015	9/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Total Cyanide	mg/kg	<0.5	4.4	<0.5	<0.5	<0.5
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg						
Our Reference:	UNITS	134222-51	134222-52	134222-53	134222-54	134222-55
Your Reference	----------	BH204	BH203	BH203	BH203	BH201
Depth	- ----------	3.9-4.35	0.1-0.2	0.9-1.35	2.9-3.35	0.1-0.2
Date Sampled		9/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Total Cyanide	mg/kg	<0.5	<0.5	<0.5	<0.5	0.6
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg						
Our Reference:	UNITS	134222-56	134222-57	134222-59	134222-61	134222-62
Your Reference	----------	BH201	BH207	BH206	BH206	BH206
Depth	- ----------	0.9-1.35	0.1-0.2	0.1-0.2	2.35-2.9	4.35-4.9
Date Sampled		10/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Total Cyanide	mg/kg	<0.5	<0.5	<0.5	<0.5	0.5
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg					
Our Reference:	UNITS	134222-63	134222-65	134222-66	134222-67
Your Reference	----------	BH208	BD1/070815	BD2/080915	BD3/090915
Depth	----------	0.9-1.35	-	-	-
Date Sampled		10/09/2015	7/09/2015	8/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Total Cyanide	mg/kg	<0.5	<0.5	<0.5	<0.5
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5

Moisture						
Our Reference:	UNITS	134222-1	134222-2	134222-3	134222-4	134222-5
Your Reference	----------	BH202	BH202	BH/MW215	BH/MW215	BH208
	-					
Depth	----------	0.9-1.35	1.9-2.35	0.9-1.35	1.9-2.35	1.9-2.35
Date Sampled		3/09/2015	3/09/2015	3/09/2015	3/09/2015	3/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Moisture	%	14	15	7.6	18	12

Moisture						
Our Reference:	UNITS	134222-6	134222-7	134222-8	134222-9	134222-10
Your Reference	----------	BH/MW218	BH/MW218	BH/MW218	BH/MW216	BH/MW216
	-					
Depth	----------	0.9-1.35	2.9-2.35	5.9-6.35	0.1-0.2	3.9-4.35
Date Sampled		3/09/2015	3/09/2015	4/09/2015	4/09/2015	4/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Moisture	%	14	20	19	9.7	20

Moisture						
Our Reference:	UNITS	134222-11	134222-12	134222-13	134222-14	134222-15
Your Reference	----------	BH/MW216	BH/MW223	BH/MW210	BH/MW210	JK107a
	-					
Depth	----------	5.9-6.35	2.0-2.45	0.1-0.2	2.0-2.45	0.1-0.2
Date Sampled		4/09/2015	4/09/2015	4/09/2015	4/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Moisture	%	31	11	5.3	15	21

Moisture						
Our Reference:	UNITS	134222-16	134222-17	134222-18	134222-19	134222-20
Your Reference	----------	JK107a	JK107a	JK107a	BH205	BH205
	-					
Depth	----------	1.9-2.35	7.9-8.35	8.9-9.35	0.9-1.35	2.9-3.35
Date Sampled		7/09/2015	7/09/2015	7/09/2015	7/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Moisture	%	23	16	17	4.2	15

Moisture						
Our Reference:	UNITS	134222-21	134222-22	134222-23	134222-24	134222-25
Your Reference	---------- -	BH205	JK103a	JK103a	JK103a	JK103a
Depth	----------	3.9-4.35	0.1-0.2	1.9-2.35	2.9-3.35	5.9-6.35
Date Sampled		7/09/2015	7/09/2015	7/09/2015	7/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Moisture	%	17	6.5	17	10	13

Moisture						
Our Reference:	UNITS	134222-26	134222-27	134222-28	134222-29	134222-30
Your Reference	---------- -	JK118a	JK118a	JK118a	BH211	BH211
Depth	----------	0.1-0.2	1.9-2.35	4.9-5.35	0.1-0.2	0.9-1.35
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	8/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Moisture	%	4.2	8.4	19	10	15

Moisture						
Our Reference:	UNITS	134222-31	134222-32	134222-33	134222-34	134222-35
Your Reference	---------- -	BH211	BH214	BH214	BH213	BH213
Depth	----------	2.9-2.35	0.1-0.2	2.2-2.65	0.1-0.2	2.9-3.35
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	8/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Moisture	%	18	9.0	9.1	7.7	16

Moisture						
Our Reference:	UNITS	134222-36	134222-37	134222-38	134222-39	134222-40
Your Reference	---------- -	BH221	BH221	BH221	BH221	BH222
Depth	----------	0.1-0.2	1.9-2.35	2.9-3.35	3.9-4.35	0.1-0.2
Date Sampled		8/09/2015	8/09/2015	8/09/2015	8/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Moisture	%	13	11	14	16	6.7

Moisture						
Our Reference:	UNITS	134222-41	134222-42	134222-43	134222-44	134222-45
Your Reference	----------	BH222	BH220	BH212	BH212	BH209
	-					
Depth	----------	0.9-1.35	0.1-0.2	0.1-0.2	2.9-3.35	0.1-0.2
Date Sampled		9/09/2015	9/09/2015	9/09/2015	9/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Moisture	%	8.1	11	8.6	21	12

Moisture						
Our Reference:	UNITS	134222-46	134222-47	134222-48	134222-49	134222-50
Your Reference	----------	BH209	BH209	BH209	BH204	BH204
	-					
Depth	----------	0.9-1.35	1.9-2.35	3.9-4.35	0.1-0.2	1.9-2.35
Date Sampled		9/09/2015	9/09/2015	9/09/2015	9/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Moisture	%	9.5	14	16	5.8	8.0

Moisture						
Our Reference:	UNITS	134222-51	134222-52	134222-53	134222-54	134222-55
Your Reference	----------	BH204	BH203	BH203	BH203	BH201
	-					
Depth	----------	3.9-4.35	0.1-0.2	0.9-1.35	2.9-3.35	0.1-0.2
Date Sampled		9/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Moisture	%	12	5.7	14	13	5.4

Moisture						
Our Reference:	UNITS	134222-56	134222-57	134222-58	134222-59	134222-60
Your Reference	----------	BH201	BH207	BH207	BH206	BH206
	-					
Depth	----------	0.9-1.35	0.1-0.2	0.9-1.35	0.1-0.2	0.9-1.35
Date Sampled		10/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Moisture	%	9.1	3.4	11	11	20

Moisture						
Our Reference:	UNITS	134222-61	134222-62	134222-63	134222-64	134222-65
Your Reference	----------	BH206	BH206	BH208	BH208	BD1/070815
	-					
Depth	----------	2.35-2.9	4.35-4.9	0.9-1.35	3.9-4.35	-
Date Sampled		10/09/2015	10/09/2015	10/09/2015	10/09/2015	7/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Moisture	%	19	33	15	24	22

Moisture						
Our Reference:	UNITS	134222-66	134222-67	134222-68	134222-70	134222-72
Your Reference	----------	BD2/080915	BD3/090915	BD5/100915	TB1	TB2
	-					
Depth	----------	-	-	-	-	-
Date Sampled		8/09/2015	9/09/2015	10/09/2015	1/09/2015	1/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/09/2015	14/09/2015	14/09/2015	14/09/2015	14/09/2015
Date analysed	-	15/09/2015	15/09/2015	15/09/2015	15/09/2015	15/09/2015
Moisture	%	16	16	9.7	0.9	1.2

Moisture		
Our Reference:	UNITS	134222-74
Your Reference	----------	TB3
	-	
Depth	----------	-
Date Sampled		1/09/2015
Type of sample		Soil
Date prepared	-	14/09/2015
Date analysed	-	15/09/2015
Moisture	%	1.2

Misc Inorg - Soil						
Our Reference:	UNITS	134222-6	134222-15	134222-22	134222-29	134222-40
Your Reference	----------	BH/MW218	JK107a	JK103a	BH211	BH222
	-					
Depth	----------	0.9-1.35	0.1-0.2	0.1-0.2	0.1-0.2	0.1-0.2
Date Sampled		3/09/2015	7/09/2015	7/09/2015	8/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
pH 1:5 soil:water	pH Units	9.9	8.3	9.7	10.2	9.2

Misc Inorg - Soil			
Our Reference:	UNITS	134222-52	134222-57
Your Reference	----------	BH203	BH207
	-		
Depth	----------	0.1-0.2	0.1-0.2
Date Sampled		10/09/2015	10/09/2015
Type of sample		Soil	Soil
Date prepared	-	15/09/2015	15/09/2015
Date analysed	-	15/09/2015	15/09/2015
pH 1:5 soil:water	pH Units	9.1	10.1

CEC Our Reference: Your Reference	UNITS ----------	134222-6 BH/MW218	134222-15 JK107a	134222-22 JK103a	134222-29 BH211	134222-40 BH222
Depth	-	0.9-1.35	0.1-0.2	0.1-0.2	0.1-0.2	0.1-0.2
Date Sampled	----------	3/09/2015	7/09/2015	7/09/2015	8/09/2015	9/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
Date analysed	-	16/09/2015	16/09/2015	16/09/2015	16/09/2015	16/09/2015
Exchangeable Ca	meq/100g	3.5	18	16	31	26
Exchangeable K	meq/100g	0.2	0.2	0.3	1.6	0.6
Exchangeable Mg	meq/100g	0.19	0.59	0.62	0.23	0.31
Exchangeable Na	meq/100g	0.39	0.31	0.39	2.6	0.31
Cation Exchange Capacity	meq/100g	4.3	19	18	36	27

CEC Our Reference: Your Reference	UNITS ----------	134222-52 BH203	134222-57 BH207
Depth	-	0.1-0.2	0.1-0.2
Date Sampled	----------	10/09/2015	10/09/2015
Type of sample		Soil	Soil
Date prepared	-	16/09/2015	16/09/2015
Date analysed	-	16/09/2015	16/09/2015
Exchangeable Ca	meq/100g	17	18
Exchangeable K	meq/100g	0.4	0.2
Exchangeable Mg	meq/100g	0.43	0.93
Exchangeable Na	meq/100g	1.2	0.78
Cation Exchange Capacity	meq/100g	19	20

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. For soil results:- 1. 'TEQ PQL' values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'TEQ zero' values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'TEQ half PQL' values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Inorg-014	Cyanide - free, total, weak acid dissociable by segmented flow analyser (in line dialysis with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-008	Moisture content determined by heating at 105+/-5 deg C for a minimum of 12 hours.
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Metals-009	Determination of exchangeable cations and cation exchange capacity in soil based on Rayment and Lyons 2011.

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			14/09/2015	134222-1	14/09/2015 || 14/09/2015	LCS-12	14/09/2015
Date analysed	-			17/09/2015	134222-1	17/09/2015 || 17/09/2015	LCS-12	17/09/2015
TRHC$_6$ - C$_9$	mg/kg	25	Org-016	<25	134222-1	<25 || <25	LCS-12	107%
TRHC$_6$ - C$_{10}$	mg/kg	25	Org-016	<25	134222-1	<25 || <25	LCS-12	107%
Benzene	mg/kg	0.2	Org-016	<0.2	134222-1	<0.2 || <0.2	LCS-12	102%
Toluene	mg/kg	0.5	Org-016	<0.5	134222-1	<0.5 || <0.5	LCS-12	108%
Ethylbenzene	mg/kg	1	Org-016	<1	134222-1	<1 || <1	LCS-12	108%
m+p-xylene	mg/kg	2	Org-016	<2	134222-1	<2 || <2	LCS-12	108%
o-Xylene	mg/kg	1	Org-016	<1	134222-1	<1 || <1	LCS-12	107%
naphthalene	mg/kg	1	Org-014	<1	134222-1	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%		Org-016	101	134222-1	93 || 96 || RPD: 3	LCS-12	102%

QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			14/09/2015	134222-1	14/09/2015 || 14/09/2015	LCS-12	14/09/2015
Date analysed	-			16/09/2015	134222-1	15/09/2015 || 15/09/2015	LCS-12	15/09/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	50	Org-003	<50	134222-1	<50 || <50	LCS-12	112%
TRHC$_{15}$ - C$_{28}$	mg/kg	100	Org-003	<100	134222-1	<100 || 160	LCS-12	107%
TRHC$_{29}$ - C$_{36}$	mg/kg	100	Org-003	<100	134222-1	240 || 540 || RPD: 77	LCS-12	110%
TRH>C$_{10}$-C$_{16}$	mg/kg	50	Org-003	<50	134222-1	<50 || <50	LCS-12	112%
TRH>C$_{16}$-C$_{34}$	mg/kg	100	Org-003	<100	134222-1	200 || 530 || RPD: 90	LCS-12	107%
TRH>C$_{34}$-C$_{40}$	mg/kg	100	Org-003	<100	134222-1	330 || 700 || RPD: 72	LCS-12	110%
Surrogate o-Terphenyl	%		Org-003	93	134222-1	89 || 95 || RPD: 7	LCS-12	86%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			14/09/2015	134222-1	14/09/2015 || 14/09/2015	LCS-12	14/09/2015
Date analysed	-			15/09/2015	134222-1	15/09/2015 || 15/09/2015	LCS-12	15/09/2015
Naphthalene	mg/kg	0.1	Org-012	<0.1	134222-1	<0.1 || <0.1	LCS-12	96%
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	Org-012	<0.1	134222-1	<0.1 || <0.1	LCS-12	101%
Phenanthrene	mg/kg	0.1	Org-012	<0.1	134222-1	0.3 || 0.6 || RPD: 67	LCS-12	107%
Anthracene	mg/kg	0.1	Org-012	<0.1	134222-1	0.1 || 0.2 || RPD: 67	[NR]	[NR]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	134222-1	0.8 || 1.3 || RPD: 48	LCS-12	107%
Pyrene	mg/kg	0.1	Org-012	<0.1	134222-1	0.8 || 1.4 || RPD: 55	LCS-12	125%
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	134222-1	0.3 || 0.5 || RPD: 50	[NR]	[NR]
Chrysene	mg/kg	0.1	Org-012	<0.1	134222-1	0.3 || 0.6 || RPD: 67	LCS-12	101%
Benzo(b,j+k) fluoranthene	mg/kg	0.2	Org-012	<0.2	134222-1	0.7 || 1 || RPD: 35	[NR]	[NR]

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	134222-1	0.4 || 0.68 || RPD: 52	LCS-12	110%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	134222-1	0.4 || 0.6 || RPD: 40	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	134222-1	<0.1 || 0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	134222-1	0.4 || 0.6 || RPD: 40	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012	105	134222-1	94 || 90 || RPD: 4	LCS-12	106%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			14/09/2015	134222-1	14/09/2015 || 14/09/2015	LCS-12	14/09/2015
Date analysed	-			17/09/2015	134222-1	16/09/2015 || 16/09/2015	LCS-12	16/09/2015
HCB	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	LCS-12	81%
gamma-BHC	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	LCS-12	94%
Heptachlor	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	LCS-12	92%
delta-BHC	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	LCS-12	96%
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	LCS-12	96%
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	LCS-12	97%
Dieldrin	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	LCS-12	103%
Endrin	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	LCS-12	103%
pp-DDD	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	LCS-12	101%
Endosulfan II	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	LCS-12	101%
Methoxychlor	mg/kg	0.1	Org-005	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%		Org-005	102	134222-1	94 || 94 || RPD: 0	LCS-12	94%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			14/09/2015	134222-1	14/09/2015 || 14/09/2015	LCS-12	14/09/2015
Date analysed	-			17/09/2015	134222-1	16/09/2015 || 16/09/2015	LCS-12	16/09/2015
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	134222-1	<0.1 || <0.1	LCS-12	110%
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	134222-1	<0.1 || <0.1	LCS-12	99%
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Diazinon	mg/kg	0.1	Org-008	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	134222-1	<0.1 || <0.1	LCS-12	89%
Dimethoate	mg/kg	0.1	Org-008	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	0.1	Org-008	<0.1	134222-1	<0.1 || <0.1	LCS-12	106%
Fenitrothion	mg/kg	0.1	Org-008	<0.1	134222-1	<0.1 || <0.1	LCS-12	118%
Malathion	mg/kg	0.1	Org-008	<0.1	134222-1	<0.1 || <0.1	LCS-12	106%
Parathion	mg/kg	0.1	Org-008	<0.1	134222-1	<0.1 || <0.1	LCS-12	106%
Ronnel	mg/kg	0.1	Org-008	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%		Org-008	102	134222-1	94 || 94 || RPD: 0	LCS-12	94%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			14/09/2015	134222-1	14/09/2015 || 14/09/2015	LCS-12	14/09/2015
Date analysed	-			17/09/2015	134222-1	16/09/2015 || 16/09/2015	LCS-12	16/09/2015
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	134222-1	<0.1 || <0.1	LCS-12	116%
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	134222-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		Org-006	102	134222-1	94 || 94 || RPD: 0	LCS-12	92%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			14/09/2015	134222-1	14/09/2015 || 14/09/2015	LCS-6	14/09/2015
Date analysed	-			15/09/2015	134222-1	15/09/2015 || 15/09/2015	LCS-6	15/09/2015
Arsenic	mg/kg	4	Metals-020 ICP-AES	<4	134222-1	<4 || <4	LCS-6	108%
Cadmium	mg/kg	0.4	Metals-020 ICP-AES	<0.4	134222-1	<0.4 || <0.4	LCS-6	105%
Chromium	mg/kg	1	Metals-020 ICP-AES	<1	134222-1	45 || 35 || RPD: 25	LCS-6	107%
Copper	mg/kg	1	Metals-020 ICP-AES	<1	134222-1	47 || 53 || RPD: 12	LCS-6	109%
Lead	mg/kg	1	Metals-020 ICP-AES	<1	134222-1	13 || 15 || RPD: 14	LCS-6	105%
Mercury	mg/kg	0.1	Metals-021 CV-AAS	<0.1	134222-1	<0.1 || <0.1	LCS-6	96%
Nickel	mg/kg	1	Metals-020 ICP-AES	<1	134222-1	11 || 11 || RPD: 0	LCS-6	101%
Zinc	mg/kg	1	Metals-020 ICP-AES	<1	134222-1	32 || 38 || RPD: 17	LCS-6	104%
Manganese	mg/kg	1	Metals-020 ICP-AES	<1	134222-1	1500 || 1200 || RPD: 22	LCS-6	119%
QUALITY CONTROL Misc Soil - Inorg	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			15/09/2015	134222-1	14/09/2015 || 14/09/2015	LCS-1	15/09/2015
Date analysed	-			15/09/2015	134222-1	15/09/2015 || 15/09/2015	LCS-1	15/09/2015
Total Cyanide	mg/kg	0.5	Inorg-014	<0.5	134222-1	<0.5 || <0.5	LCS-1	99%
Total Phenolics (as Phenol)	mg/kg	5	Inorg-031	<5	134222-1	<5 || <5	LCS-1	101%
QUALITY CONTROL Misc Inorg - Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			15/09/2015	134222-6	16/09/2015 || 16/09/2015	LCS-1	16/09/2015
Date analysed	-			15/09/2015	134222-6	16/09/2015 || 16/09/2015	LCS-1	16/09/2015
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	134222-6	9.9 || 9.9 || RPD: 0	LCS-1	103%
QUALITY CONTROL CEC	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			16/09/2015	[NT]	[NT]	LCS-1	16/09/2015
Date analysed	-			16/09/2015	[NT]	[NT]	LCS-1	16/09/2015
Exchangeable Ca	meq/100g	0.1	Metals-009	<0.1	[NT]	[NT]	LCS-1	92%
Exchangeable K	meq/100g	0.1	Metals-009	<0.1	[NT]	[NT]	LCS-1	94%

QUALITY CONTROL CEC	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Exchangeable Mg	meq/100 g	0.1	Metals-009	<0.1	[NT]	[NT]	LCS-1	90%
Exchangeable Na	meq/100 g	0.1	Metals-009	<0.1	[NT]	[NT]	LCS-1	103%
Cation Exchange Capacity	meq/100 g	1	Metals-009	[NT]	[NT]	[NT]	[NR]	[NR]

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-11	14/09/2015 || 14/09/2015	LCS-13	14/09/2015
Date analysed	-	134222-11	17/09/2015 || 17/09/2015	LCS-13	17/09/2015
TRHC$_6$ - C$_9$	mg/kg	134222-11	<25 || <25	LCS-13	114%
TRHC$_6$ - C$_{10}$	mg/kg	134222-11	<25 || <25	LCS-13	114%
Benzene	mg/kg	134222-11	<0.2 || <0.2	LCS-13	106%
Toluene	mg/kg	134222-11	<0.5 || <0.5	LCS-13	112%
Ethylbenzene	mg/kg	134222-11	<1 || <1	LCS-13	116%
m+p-xylene	mg/kg	134222-11	<2 || <2	LCS-13	117%
o-Xylene	mg/kg	134222-11	<1 || <1	LCS-13	114%
naphthalene	mg/kg	134222-11	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%	134222-11	86 || 83 || RPD: 4	LCS-13	102%

QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-11	14/09/2015 || 14/09/2015	LCS-13	14/09/2015
Date analysed	-	134222-11	15/09/2015 || 15/09/2015	LCS-13	16/09/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	134222-11	<50 || <50	LCS-13	111%
TRHC$_{15}$ - C$_{28}$	mg/kg	134222-11	<100 || <100	LCS-13	103%
TRHC$_{29}$ - C$_{36}$	mg/kg	134222-11	<100 || <100	LCS-13	92%
TRH>C$_{10}$-C$_{16}$	mg/kg	134222-11	<50 || <50	LCS-13	111%
TRH>C$_{16}$-C$_{34}$	mg/kg	134222-11	<100 || <100	LCS-13	103%
TRH>C$_{34}$-C$_{40}$	mg/kg	134222-11	<100 || <100	LCS-13	92%
Surrogate o-Terphenyl	%	134222-11	92 || 87 || RPD: 6	LCS-13	84%

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-11	14/09/2015 || 14/09/2015	LCS-13	14/09/2015
Date analysed	-	134222-11	15/09/2015 || 15/09/2015	LCS-13	15/09/2015
Naphthalene	mg/kg	134222-11	<0.1 || <0.1	LCS-13	91%
Acenaphthylene	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	134222-11	<0.1 || <0.1	LCS-13	87%
Phenanthrene	mg/kg	134222-11	<0.1 || <0.1	LCS-13	94%
Anthracene	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	134222-11	0.2 || 0.1 || RPD: 67	LCS-13	94%

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Pyrene	mg/kg	134222-11	0.2 || 0.1 || RPD: 67	LCS-13	100%
Benzo(a)anthracene	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Chrysene	mg/kg	134222-11	<0.1 || <0.1	LCS-13	93%
Benzo(b,j+k)fluoranthene	mg/kg	134222-11	<0.2 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	134222-11	0.1 || 0.06 || RPD: 50	LCS-13	109%
Indeno(1,2,3-c,d)pyrene	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d14	%	134222-11	106 || 103 || RPD: 3	LCS-13	102%
QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-11	14/09/2015 || 14/09/2015	LCS-13	14/09/2015
Date analysed	-	134222-11	16/09/2015 || 16/09/2015	LCS-13	17/09/2015
HCB	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	134222-11	<0.1 || <0.1	LCS-13	83%
gamma-BHC	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	134222-11	<0.1 || <0.1	LCS-13	94%
Heptachlor	mg/kg	134222-11	<0.1 || <0.1	LCS-13	87%
delta-BHC	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	134222-11	<0.1 || <0.1	LCS-13	97%
Heptachlor Epoxide	mg/kg	134222-11	<0.1 || <0.1	LCS-13	96%
gamma-Chlordane	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	134222-11	<0.1 || <0.1	LCS-13	97%
Dieldrin	mg/kg	134222-11	<0.1 || <0.1	LCS-13	103%
Endrin	mg/kg	134222-11	<0.1 || <0.1	LCS-13	100%
pp-DDD	mg/kg	134222-11	<0.1 || <0.1	LCS-13	100%
Endosulfan II	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	134222-11	<0.1 || <0.1	LCS-13	95%
Methoxychlor	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%	134222-11	100 || 96 || RPD: 4	LCS-13	96%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-11	14/09/2015 || 14/09/2015	LCS-13	14/09/2015
Date analysed	-	134222-11	16/09/2015 || 16/09/2015	LCS-13	17/09/2015
Azinphos-methyl (Guthion)	mg/kg	134222-11	<0.1 || <0.1	LCS-13	80%
Bromophos-ethyl	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	134222-11	<0.1 || <0.1	LCS-13	89%
Chlorpyriphos-methyl	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Diazinon	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Dichlorvos	mg/kg	134222-11	<0.1 || <0.1	LCS-13	79%
Dimethoate	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	134222-11	<0.1 || <0.1	LCS-13	93%
Fenitrothion	mg/kg	134222-11	<0.1 || <0.1	LCS-13	107%
Malathion	mg/kg	134222-11	<0.1 || <0.1	LCS-13	87%
Parathion	mg/kg	134222-11	<0.1 || <0.1	LCS-13	94%
Ronnel	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%	134222-11	100 || 96 || RPD: 4	LCS-13	96%
QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-11	14/09/2015 || 14/09/2015	LCS-13	14/09/2015
Date analysed	-	134222-11	16/09/2015 || 16/09/2015	LCS-13	17/09/2015
Aroclor 1016	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Aroclor 1221	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Aroclor 1232	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Aroclor 1242	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Aroclor 1248	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Aroclor 1254	mg/kg	134222-11	<0.1 || <0.1	LCS-13	106%
Aroclor 1260	mg/kg	134222-11	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%	134222-11	100 || 96 || RPD: 4	LCS-13	99%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	134222-11	14/09/2015 || 14/09/2015	134222-2	14/09/2015
Date analysed	-	134222-11	15/09/2015 || 15/09/2015	134222-2	15/09/2015
Arsenic	mg/kg	134222-11	17 || 13 || RPD: 27	134222-2	103%
Cadmium	mg/kg	134222-11	<0.4 || <0.4	134222-2	88%
Chromium	mg/kg	134222-11	21 || 17 || RPD: 21	134222-2	76%
Copper	mg/kg	134222-11	23 || 16 || RPD: 36	134222-2	102%
Lead	mg/kg	134222-11	51 || 34 || RPD: 40	134222-2	89%
Mercury	mg/kg	134222-11	<0.1 || <0.1	134222-2	119%
Nickel	mg/kg	134222-11	9 || 6 || RPD: 40	134222-2	91%
Zinc	mg/kg	134222-11	170 || 150 || RPD: 12	134222-2	##
Manganese	mg/kg	134222-11	130 || 70 || RPD: 60	134222-2	#

QUALITY CONTROL Misc Soil - Inorg	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	134222-11	14/09/2015 || 14/09/2015	LCS-2	15/09/2015
Date analysed	-	134222-11	15/09/2015 || 15/09/2015	LCS-2	15/09/2015
Total Cyanide	mg/kg	134222-11	<0.5 || <0.5	LCS-2	98%
Total Phenolics (as Phenol)	mg/kg	134222-11	<5 || <5	LCS-2	103%
QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-21	14/09/2015 || 14/09/2015	LCS-14	14/09/2015
Date analysed	-	134222-21	17/09/2015 || 17/09/2015	LCS-14	17/09/2015
$TRHC_6$ - C_9	mg/kg	134222-21	<25 || <25	LCS-14	99%
$TRHC_6$ - C_{10}	mg/kg	134222-21	<25 || <25	LCS-14	99%
Benzene	mg/kg	134222-21	<0.2 || <0.2	LCS-14	92%
Toluene	mg/kg	134222-21	<0.5 || <0.5	LCS-14	96%
Ethylbenzene	mg/kg	134222-21	<1 || <1	LCS-14	101%
m+p-xylene	mg/kg	134222-21	<2 || <2	LCS-14	102%
o-Xylene	mg/kg	134222-21	<1 || <1	LCS-14	100%
naphthalene	mg/kg	134222-21	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%	134222-21	88 || 94 || RPD: 7	LCS-14	89%
QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-21	14/09/2015 || 14/09/2015	LCS-14	14/09/2015
Date analysed	-	134222-21	16/09/2015 || 16/09/2015	LCS-14	15/09/2015
$TRHC_{10}$ - C_{14}	mg/kg	134222-21	<50 || <50	LCS-14	115%
$TRHC_{15}$ - C_{28}	mg/kg	134222-21	<100 || <100	LCS-14	108%
$TRHC_{29}$ - C_{36}	mg/kg	134222-21	<100 || <100	LCS-14	96%
$TRH>C_{10}$-C_{16}	mg/kg	134222-21	<50 || <50	LCS-14	115%
$TRH>C_{16}$-C_{34}	mg/kg	134222-21	<100 || <100	LCS-14	108%
$TRH>C_{34}$-C_{40}	mg/kg	134222-21	<100 || <100	LCS-14	96%
Surrogate o-Terphenyl	%	134222-21	85 || 84 || RPD: 1	LCS-14	85%
QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-21	14/09/2015 || 14/09/2015	LCS-14	14/09/2015
Date analysed	-	134222-21	15/09/2015 || 15/09/2015	LCS-14	15/09/2015
Naphthalene	mg/kg	134222-21	<0.1 || <0.1	LCS-14	94%
Acenaphthylene	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	134222-21	<0.1 || <0.1	LCS-14	88%
Phenanthrene	mg/kg	134222-21	<0.1 || <0.1	LCS-14	97%
Anthracene	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	134222-21	<0.1 || <0.1	LCS-14	97%
Pyrene	mg/kg	134222-21	<0.1 || <0.1	LCS-14	101%

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Benzo(a)anthracene	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Chrysene	mg/kg	134222-21	<0.1 || <0.1	LCS-14	94%
Benzo(b,j+k)fluoranthene	mg/kg	134222-21	<0.2 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	134222-21	<0.05 || <0.05	LCS-14	112%
Indeno(1,2,3-c,d)pyrene	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d14	%	134222-21	96 || 94 || RPD: 2	LCS-14	93%
QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-21	14/09/2015 || 14/09/2015	LCS-14	14/09/2015
Date analysed	-	134222-21	17/09/2015 || 17/09/2015	LCS-14	17/09/2015
HCB	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	134222-21	<0.1 || <0.1	LCS-14	91%
gamma-BHC	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	134222-21	<0.1 || <0.1	LCS-14	93%
Heptachlor	mg/kg	134222-21	<0.1 || <0.1	LCS-14	96%
delta-BHC	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	134222-21	<0.1 || <0.1	LCS-14	107%
Heptachlor Epoxide	mg/kg	134222-21	<0.1 || <0.1	LCS-14	105%
gamma-Chlordane	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	134222-21	<0.1 || <0.1	LCS-14	97%
Dieldrin	mg/kg	134222-21	<0.1 || <0.1	LCS-14	114%
Endrin	mg/kg	134222-21	<0.1 || <0.1	LCS-14	111%
pp-DDD	mg/kg	134222-21	<0.1 || <0.1	LCS-14	99%
Endosulfan II	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	134222-21	<0.1 || <0.1	LCS-14	101%
Methoxychlor	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%	134222-21	93 || 95 || RPD: 2	LCS-14	98%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-21	14/09/2015 || 14/09/2015	LCS-14	14/09/2015
Date analysed	-	134222-21	17/09/2015 || 17/09/2015	LCS-14	17/09/2015
Azinphos-methyl (Guthion)	mg/kg	134222-21	<0.1 || <0.1	LCS-14	82%
Bromophos-ethyl	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	134222-21	<0.1 || <0.1	LCS-14	92%
Chlorpyriphos-methyl	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Diazinon	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Dichlorvos	mg/kg	134222-21	<0.1 || <0.1	LCS-14	89%
Dimethoate	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	134222-21	<0.1 || <0.1	LCS-14	106%
Fenitrothion	mg/kg	134222-21	<0.1 || <0.1	LCS-14	111%
Malathion	mg/kg	134222-21	<0.1 || <0.1	LCS-14	101%
Parathion	mg/kg	134222-21	<0.1 || <0.1	LCS-14	105%
Ronnel	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%	134222-21	93 || 95 || RPD: 2	LCS-14	98%
QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-21	14/09/2015 || 14/09/2015	LCS-14	14/09/2015
Date analysed	-	134222-21	17/09/2015 || 17/09/2015	LCS-14	17/09/2015
Aroclor 1016	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Aroclor 1221	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Aroclor 1232	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Aroclor 1242	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Aroclor 1248	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Aroclor 1254	mg/kg	134222-21	<0.1 || <0.1	LCS-14	100%
Aroclor 1260	mg/kg	134222-21	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%	134222-21	93 || 95 || RPD: 2	LCS-14	83%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	134222-21	14/09/2015 || 14/09/2015	LCS-7	14/09/2015
Date analysed	-	134222-21	15/09/2015 || 15/09/2015	LCS-7	15/09/2015
Arsenic	mg/kg	134222-21	8 || 7 || RPD: 13	LCS-7	108%
Cadmium	mg/kg	134222-21	<0.4 || <0.4	LCS-7	103%
Chromium	mg/kg	134222-21	15 || 14 || RPD: 7	LCS-7	106%
Copper	mg/kg	134222-21	15 || 13 || RPD: 14	LCS-7	109%
Lead	mg/kg	134222-21	15 || 18 || RPD: 18	LCS-7	105%
Mercury	mg/kg	134222-21	<0.1 || <0.1	LCS-7	96%
Nickel	mg/kg	134222-21	2 || 3 || RPD: 40	LCS-7	101%
Zinc	mg/kg	134222-21	15 || 13 || RPD: 14	LCS-7	104%
Manganese	mg/kg	134222-21	9 || 9 || RPD: 0	LCS-7	117%

QUALITY CONTROL Misc Soil - Inorg	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	134222-21	14/09/2015 || 14/09/2015	LCS-3	15/09/2015
Date analysed	-	134222-21	15/09/2015 || 15/09/2015	LCS-3	15/09/2015
Total Cyanide	mg/kg	134222-21	<0.5 || <0.5	LCS-3	94%
Total Phenolics (as Phenol)	mg/kg	134222-21	<5 || <5	LCS-3	100%
QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-31	14/09/2015 || 14/09/2015	LCS-15	14/09/2015
Date analysed	-	134222-31	17/09/2015 || 17/09/2015	LCS-15	16/09/2015
TRH C_6 - C_9	mg/kg	134222-31	<25 || <25	LCS-15	111%
TRH C_6 - C_{10}	mg/kg	134222-31	<25 || <25	LCS-15	111%
Benzene	mg/kg	134222-31	<0.2 || <0.2	LCS-15	103%
Toluene	mg/kg	134222-31	<0.5 || <0.5	LCS-15	111%
Ethylbenzene	mg/kg	134222-31	<1 || <1	LCS-15	113%
m+p-xylene	mg/kg	134222-31	<2 || <2	LCS-15	115%
o-Xylene	mg/kg	134222-31	<1 || <1	LCS-15	113%
naphthalene	mg/kg	134222-31	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%	134222-31	94 || 91 || RPD: 3	LCS-15	103%
QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-31	14/09/2015 || 14/09/2015	LCS-15	14/09/2015
Date analysed	-	134222-31	16/09/2015 || 16/09/2015	LCS-15	16/09/2015
TRH C_{10} - C_{14}	mg/kg	134222-31	<50 || <50	LCS-15	102%
TRH C_{15} - C_{28}	mg/kg	134222-31	<100 || <100	LCS-15	97%
TRH C_{29} - C_{36}	mg/kg	134222-31	<100 || <100	LCS-15	101%
TRH >C_{10}-C_{16}	mg/kg	134222-31	<50 || <50	LCS-15	102%
TRH >C_{16}-C_{34}	mg/kg	134222-31	<100 || <100	LCS-15	97%
TRH >C_{34}-C_{40}	mg/kg	134222-31	<100 || <100	LCS-15	101%
Surrogate o-Terphenyl	%	134222-31	88 || 88 || RPD: 0	LCS-15	82%
QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-31	14/09/2015 || 14/09/2015	LCS-15	14/09/2015
Date analysed	-	134222-31	15/09/2015 || 15/09/2015	LCS-15	15/09/2015
Naphthalene	mg/kg	134222-31	<0.1 || <0.1	LCS-15	93%
Acenaphthylene	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	134222-31	<0.1 || <0.1	LCS-15	87%
Phenanthrene	mg/kg	134222-31	<0.1 || <0.1	LCS-15	96%
Anthracene	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	134222-31	<0.1 || <0.1	LCS-15	94%
Pyrene	mg/kg	134222-31	<0.1 || <0.1	LCS-15	99%

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Benzo(a)anthracene	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Chrysene	mg/kg	134222-31	<0.1 || <0.1	LCS-15	96%
Benzo(b,j+k)fluoranthene	mg/kg	134222-31	<0.2 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	134222-31	<0.05 || <0.05	LCS-15	113%
Indeno(1,2,3-c,d)pyrene	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d14	%	134222-31	98 || 96 || RPD: 2	LCS-15	108%
QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-31	14/09/2015 || 14/09/2015	LCS-15	14/09/2015
Date analysed	-	134222-31	18/09/2015 || 18/09/2015	LCS-15	18/09/2015
HCB	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	134222-31	<0.1 || <0.1	LCS-15	122%
gamma-BHC	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	134222-31	<0.1 || <0.1	LCS-15	103%
Heptachlor	mg/kg	134222-31	<0.1 || <0.1	LCS-15	100%
delta-BHC	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	134222-31	<0.1 || <0.1	LCS-15	188%
Heptachlor Epoxide	mg/kg	134222-31	<0.1 || <0.1	LCS-15	98%
gamma-Chlordane	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	134222-31	<0.1 || <0.1	LCS-15	89%
Dieldrin	mg/kg	134222-31	<0.1 || <0.1	LCS-15	116%
Endrin	mg/kg	134222-31	<0.1 || <0.1	LCS-15	102%
pp-DDD	mg/kg	134222-31	<0.1 || <0.1	LCS-15	110%
Endosulfan II	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	134222-31	<0.1 || <0.1	LCS-15	103%
Methoxychlor	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%	134222-31	98 || 98 || RPD: 0	LCS-15	93%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-31	14/09/2015 || 14/09/2015	LCS-15	14/09/2015
Date analysed	-	134222-31	17/09/2015 || 17/09/2015	LCS-15	18/09/2015
Azinphos-methyl (Guthion)	mg/kg	134222-31	<0.1 || <0.1	LCS-15	101%
Bromophos-ethyl	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	134222-31	<0.1 || <0.1	LCS-15	96%
Chlorpyriphos-methyl	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Diazinon	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Dichlorvos	mg/kg	134222-31	<0.1 || <0.1	LCS-15	109%
Dimethoate	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	134222-31	<0.1 || <0.1	LCS-15	101%
Fenitrothion	mg/kg	134222-31	<0.1 || <0.1	LCS-15	88%
Malathion	mg/kg	134222-31	<0.1 || <0.1	LCS-15	111%
Parathion	mg/kg	134222-31	<0.1 || <0.1	LCS-15	121%
Ronnel	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%	134222-31	98 || 98 || RPD: 0	LCS-15	99%
QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-31	14/09/2015 || 14/09/2015	LCS-15	14/09/2015
Date analysed	-	134222-31	17/09/2015 || 17/09/2015	LCS-15	18/09/2015
Aroclor 1016	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Aroclor 1221	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Aroclor 1232	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Aroclor 1242	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Aroclor 1248	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Aroclor 1254	mg/kg	134222-31	<0.1 || <0.1	LCS-15	102%
Aroclor 1260	mg/kg	134222-31	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%	134222-31	98 || 98 || RPD: 0	LCS-15	91%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	134222-31	14/09/2015 || 14/09/2015	134222-22	14/09/2015
Date analysed	-	134222-31	15/09/2015 || 15/09/2015	134222-22	15/09/2015
Arsenic	mg/kg	134222-31	4 || <4	134222-22	84%
Cadmium	mg/kg	134222-31	<0.4 || <0.4	134222-22	83%
Chromium	mg/kg	134222-31	17 || 20 || RPD: 16	134222-22	82%
Copper	mg/kg	134222-31	3 || 3 || RPD: 0	134222-22	125%
Lead	mg/kg	134222-31	24 || 21 || RPD: 13	134222-22	81%
Mercury	mg/kg	134222-31	<0.1 || <0.1	134222-22	95%
Nickel	mg/kg	134222-31	4 || 5 || RPD: 22	134222-22	76%
Zinc	mg/kg	134222-31	6 || 9 || RPD: 40	134222-22	86%
Manganese	mg/kg	134222-31	42 || 33 || RPD: 24	134222-22	#

QUALITY CONTROL Misc Soil - Inorg	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	134222-31	14/09/2015 || 14/09/2015	LCS-4	15/09/2015
Date analysed	-	134222-31	15/09/2015 || 15/09/2015	LCS-4	15/09/2015
Total Cyanide	mg/kg	134222-31	<0.5 || <0.5	LCS-4	97%
Total Phenolics (as Phenol)	mg/kg	134222-31	<5 || <5	LCS-4	100%
QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-41	14/09/2015 || 14/09/2015	134222-2	14/09/2015
Date analysed	-	134222-41	17/09/2015 || 17/09/2015	134222-2	16/09/2015
TRH C_6 - C_9	mg/kg	134222-41	<25 || <25	134222-2	99%
TRH C_6 - C_{10}	mg/kg	134222-41	<25 || <25	134222-2	99%
Benzene	mg/kg	134222-41	<0.2 || <0.2	134222-2	93%
Toluene	mg/kg	134222-41	<0.5 || <0.5	134222-2	97%
Ethylbenzene	mg/kg	134222-41	<1 || <1	134222-2	100%
m+p-xylene	mg/kg	134222-41	<2 || <2	134222-2	102%
o-Xylene	mg/kg	134222-41	<1 || <1	134222-2	99%
naphthalene	mg/kg	134222-41	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%	134222-41	100 || 101 || RPD: 1	134222-2	89%
QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-41	14/09/2015 || 14/09/2015	134222-2	14/09/2015
Date analysed	-	134222-41	16/09/2015 || 16/09/2015	134222-2	16/09/2015
TRH C_{10} - C_{14}	mg/kg	134222-41	<50 || <50	134222-2	114%
TRH C_{15} - C_{28}	mg/kg	134222-41	450 || 270 || RPD: 50	134222-2	124%
TRH C_{29} - C_{36}	mg/kg	134222-41	790 || 480 || RPD: 49	134222-2	#
TRH >C_{10}-C_{16}	mg/kg	134222-41	<50 || <50	134222-2	114%
TRH >C_{16}-C_{34}	mg/kg	134222-41	990 || 590 || RPD: 51	134222-2	124%
TRH >C_{34}-C_{40}	mg/kg	134222-41	890 || 590 || RPD: 41	134222-2	#
Surrogate o-Terphenyl	%	134222-41	117 || 91 || RPD: 25	134222-2	128%
QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-41	14/09/2015 || 14/09/2015	134222-2	14/09/2015
Date analysed	-	134222-41	15/09/2015 || 15/09/2015	134222-2	15/09/2015
Naphthalene	mg/kg	134222-41	2.5 || 1.1 || RPD: 78	134222-2	94%
Acenaphthylene	mg/kg	134222-41	1.1 || 0.9 || RPD: 20	[NR]	[NR]
Acenaphthene	mg/kg	134222-41	0.4 || 0.3 || RPD: 29	[NR]	[NR]
Fluorene	mg/kg	134222-41	1.9 || 1.6 || RPD: 17	134222-2	100%
Phenanthrene	mg/kg	134222-41	6.6 || 6.1 || RPD: 8	134222-2	104%
Anthracene	mg/kg	134222-41	1.6 || 1.7 || RPD: 6	[NR]	[NR]
Fluoranthene	mg/kg	134222-41	6.2 || 5.9 || RPD: 5	134222-2	102%
Pyrene	mg/kg	134222-41	5.5 || 5.2 || RPD: 6	134222-2	120%

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Benzo(a)anthracene	mg/kg	134222-41	2.8 || 2.9 || RPD: 4	[NR]	[NR]
Chrysene	mg/kg	134222-41	2.6 || 2.6 || RPD: 0	134222-2	97%
Benzo(b,j+k)fluoranthene	mg/kg	134222-41	5.2 || 4.8 || RPD: 8	[NR]	[NR]
Benzo(a)pyrene	mg/kg	134222-41	3.6 || 3.2 || RPD: 12	134222-2	109%
Indeno(1,2,3-c,d)pyrene	mg/kg	134222-41	2.7 || 2.3 || RPD: 16	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	134222-41	0.7 || 0.6 || RPD: 15	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	134222-41	2.5 || 2.1 || RPD: 17	[NR]	[NR]
Surrogate p-Terphenyl-d14	%	134222-41	95 || 96 || RPD: 1	134222-2	99%
QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-41	14/09/2015 || 14/09/2015	134222-2	14/09/2015
Date analysed	-	134222-41	17/09/2015 || 17/09/2015	134222-2	16/09/2015
HCB	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	134222-41	<0.1 || <0.1	134222-2	89%
gamma-BHC	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	134222-41	<0.1 || <0.1	134222-2	112%
Heptachlor	mg/kg	134222-41	<0.1 || <0.1	134222-2	96%
delta-BHC	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	134222-41	<0.1 || <0.1	134222-2	102%
Heptachlor Epoxide	mg/kg	134222-41	<0.1 || <0.1	134222-2	83%
gamma-Chlordane	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	134222-41	<0.1 || <0.1	134222-2	100%
Dieldrin	mg/kg	134222-41	<0.1 || <0.1	134222-2	107%
Endrin	mg/kg	134222-41	<0.1 || <0.1	134222-2	107%
pp-DDD	mg/kg	134222-41	<0.1 || <0.1	134222-2	105%
Endosulfan II	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	134222-41	<0.1 || <0.1	134222-2	108%
Methoxychlor	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%	134222-41	100 || 102 || RPD: 2	134222-2	106%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-41	14/09/2015 || 14/09/2015	134222-2	14/09/2015
Date analysed	-	134222-41	17/09/2015 || 17/09/2015	134222-2	16/09/2015
Azinphos-methyl (Guthion)	mg/kg	134222-41	<0.1 || <0.1	134222-2	99%
Bromophos-ethyl	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	134222-41	<0.1 || <0.1	134222-2	97%
Chlorpyriphos-methyl	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Diazinon	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Dichlorvos	mg/kg	134222-41	<0.1 || <0.1	134222-2	93%
Dimethoate	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	134222-41	<0.1 || <0.1	134222-2	101%
Fenitrothion	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Malathion	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Parathion	mg/kg	134222-41	<0.1 || <0.1	134222-2	94%
Ronnel	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%	134222-41	100 || 102 || RPD: 2	134222-2	106%
QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-41	14/09/2015 || 14/09/2015	134222-2	14/09/2015
Date analysed	-	134222-41	17/09/2015 || 17/09/2015	134222-2	16/09/2015
Aroclor 1016	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Aroclor 1221	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Aroclor 1232	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Aroclor 1242	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Aroclor 1248	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Aroclor 1254	mg/kg	134222-41	<0.1 || 0.1	134222-2	110%
Aroclor 1260	mg/kg	134222-41	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%	134222-41	100 || 102 || RPD: 2	134222-2	84%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	134222-41	14/09/2015 || 14/09/2015	LCS-8	14/09/2015
Date analysed	-	134222-41	15/09/2015 || 15/09/2015	LCS-8	15/09/2015
Arsenic	mg/kg	134222-41	<4 || <4	LCS-8	109%
Cadmium	mg/kg	134222-41	<0.4 || <0.4	LCS-8	105%
Chromium	mg/kg	134222-41	12 || 27 || RPD: 77	LCS-8	107%
Copper	mg/kg	134222-41	85 || 98 || RPD: 14	LCS-8	111%
Lead	mg/kg	134222-41	22 || 36 || RPD: 48	LCS-8	107%
Mercury	mg/kg	134222-41	<0.1 || <0.1	LCS-8	96%
Nickel	mg/kg	134222-41	12 || 13 || RPD: 8	LCS-8	102%
Zinc	mg/kg	134222-41	77 || 95 || RPD: 21	LCS-8	104%
Manganese	mg/kg	134222-41	220 || 500 || RPD: 78	LCS-8	117%

QUALITY CONTROL Misc Soil - Inorg	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	134222-41	14/09/2015 || 14/09/2015	134222-2	15/09/2015
Date analysed	-	134222-41	15/09/2015 || 15/09/2015	134222-2	15/09/2015
Total Cyanide	mg/kg	134222-41	<0.5 || <0.5	134222-2	94%
Total Phenolics (as Phenol)	mg/kg	134222-41	<5 || <5	134222-2	98%
QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-51	14/09/2015 || 14/09/2015	134222-22	14/09/2015
Date analysed	-	134222-51	17/09/2015 || 17/09/2015	134222-22	17/09/2015
$TRHC_6$ - C_9	mg/kg	134222-51	<25 || <25	134222-22	92%
$TRHC_6$ - C_{10}	mg/kg	134222-51	<25 || <25	134222-22	92%
Benzene	mg/kg	134222-51	<0.2 || <0.2	134222-22	89%
Toluene	mg/kg	134222-51	<0.5 || <0.5	134222-22	92%
Ethylbenzene	mg/kg	134222-51	<1 || <1	134222-22	93%
m+p-xylene	mg/kg	134222-51	<2 || <2	134222-22	93%
o-Xylene	mg/kg	134222-51	<1 || <1	134222-22	90%
naphthalene	mg/kg	134222-51	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%	134222-51	88 || 85 || RPD: 3	134222-22	90%
QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-51	14/09/2015 || 14/09/2015	134222-22	14/09/2015
Date analysed	-	134222-51	16/09/2015 || 16/09/2015	134222-22	16/09/2015
$TRHC_{10}$ - C_{14}	mg/kg	134222-51	<50 || <50	134222-22	114%
$TRHC_{15}$ - C_{28}	mg/kg	134222-51	<100 || <100	134222-22	116%
$TRHC_{29}$ - C_{36}	mg/kg	134222-51	140 || 100 || RPD: 33	134222-22	#
$TRH>C_{10}$-C_{16}	mg/kg	134222-51	<50 || <50	134222-22	114%
$TRH>C_{16}$-C_{34}	mg/kg	134222-51	150 || 110 || RPD: 31	134222-22	116%
$TRH>C_{34}$-C_{40}	mg/kg	134222-51	130 || <100	134222-22	#
Surrogate o-Terphenyl	%	134222-51	94 || 92 || RPD: 2	134222-22	79%
QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-51	14/09/2015 || 14/09/2015	134222-22	14/09/2015
Date analysed	-	134222-51	15/09/2015 || 15/09/2015	134222-22	15/09/2015
Naphthalene	mg/kg	134222-51	<0.1 || <0.1	134222-22	90%
Acenaphthylene	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	134222-51	<0.1 || <0.1	134222-22	87%
Phenanthrene	mg/kg	134222-51	0.1 || 0.4 || RPD: 120	134222-22	92%
Anthracene	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	134222-51	0.3 || 0.4 || RPD: 29	134222-22	89%
Pyrene	mg/kg	134222-51	0.4 || 0.5 || RPD: 22	134222-22	89%

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Benzo(a)anthracene	mg/kg	134222-51	0.2 || 0.2 || RPD: 0	[NR]	[NR]
Chrysene	mg/kg	134222-51	0.2 || 0.2 || RPD: 0	134222-22	89%
Benzo(b,j+k)fluoranthene	mg/kg	134222-51	0.3 || 0.3 || RPD: 0	[NR]	[NR]
Benzo(a)pyrene	mg/kg	134222-51	0.2 || 0.2 || RPD: 0	134222-22	91%
Indeno(1,2,3-c,d)pyrene	mg/kg	134222-51	0.1 || 0.1 || RPD: 0	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	134222-51	0.1 || 0.2 || RPD: 67	[NR]	[NR]
Surrogate p-Terphenyl-d14	%	134222-51	91 || 97 || RPD: 6	134222-22	92%
QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-51	14/09/2015 || 14/09/2015	134222-22	14/09/2015
Date analysed	-	134222-51	18/09/2015 || 18/09/2015	134222-22	17/09/2015
HCB	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	134222-51	<0.1 || <0.1	134222-22	83%
gamma-BHC	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	134222-51	<0.1 || <0.1	134222-22	88%
Heptachlor	mg/kg	134222-51	<0.1 || <0.1	134222-22	86%
delta-BHC	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	134222-51	<0.1 || <0.1	134222-22	94%
Heptachlor Epoxide	mg/kg	134222-51	<0.1 || <0.1	134222-22	93%
gamma-Chlordane	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	134222-51	<0.1 || <0.1	134222-22	94%
Dieldrin	mg/kg	134222-51	<0.1 || <0.1	134222-22	100%
Endrin	mg/kg	134222-51	<0.1 || <0.1	134222-22	99%
pp-DDD	mg/kg	134222-51	<0.1 || <0.1	134222-22	97%
Endosulfan II	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	134222-51	<0.1 || <0.1	134222-22	96%
Methoxychlor	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%	134222-51	106 || 127 || RPD: 18	134222-22	94%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-51	14/09/2015 || 14/09/2015	134222-22	14/09/2015
Date analysed	-	134222-51	18/09/2015 || 18/09/2015	134222-22	17/09/2015
Azinphos-methyl (Guthion)	mg/kg	134222-51	<0.1 || <0.1	134222-22	83%
Bromophos-ethyl	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	134222-51	<0.1 || <0.1	134222-22	87%
Chlorpyriphos-methyl	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
Diazinon	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
Dichlorvos	mg/kg	134222-51	<0.1 || <0.1	134222-22	80%
Dimethoate	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	134222-51	<0.1 || <0.1	134222-22	95%
Fenitrothion	mg/kg	134222-51	<0.1 || <0.1	134222-22	87%
Malathion	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
Parathion	mg/kg	134222-51	<0.1 || <0.1	134222-22	87%
Ronnel	mg/kg	134222-51	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%	134222-51	106 || 127 || RPD: 18	134222-22	94%
QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-51	14/09/2015 || 14/09/2015	134222-22	14/09/2015
Date analysed	-	134222-51	18/09/2015 || 18/09/2015	134222-22	17/09/2015
Aroclor 1016	mg/kg	134222-51	<1 || <1	[NR]	[NR]
Aroclor 1221	mg/kg	134222-51	<1 || <1	[NR]	[NR]
Aroclor 1232	mg/kg	134222-51	<1 || <1	[NR]	[NR]
Aroclor 1242	mg/kg	134222-51	<1 || <1	[NR]	[NR]
Aroclor 1248	mg/kg	134222-51	<1 || <1	[NR]	[NR]
Aroclor 1254	mg/kg	134222-51	<1 || <1	134222-22	100%
Aroclor 1260	mg/kg	134222-51	<1 || <1	[NR]	[NR]
Surrogate TCLMX	%	134222-51	106 || 127 || RPD: 18	134222-22	99%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	134222-51	14/09/2015 || 14/09/2015	134222-42	14/09/2015
Date analysed	-	134222-51	15/09/2015 || 15/09/2015	134222-42	15/09/2015
Arsenic	mg/kg	134222-51	7 || 13 || RPD: 60	134222-42	100%
Cadmium	mg/kg	134222-51	<0.4 || 0.4	134222-42	97%
Chromium	mg/kg	134222-51	11 || 13 || RPD: 17	134222-42	97%
Copper	mg/kg	134222-51	64 || 29 || RPD: 75	134222-42	122%
Lead	mg/kg	134222-51	150 || 160 || RPD: 6	134222-42	74%
Mercury	mg/kg	134222-51	0.1 || 0.1 || RPD: 0	134222-42	113%
Nickel	mg/kg	134222-51	16 || 10 || RPD: 46	134222-42	93%
Zinc	mg/kg	134222-51	210 || 200 || RPD: 5	134222-42	87%
Manganese	mg/kg	134222-51	80 || 88 || RPD: 10	134222-42	#

QUALITY CONTROL Misc Soil - Inorg	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	134222-51	14/09/2015 || 14/09/2015	134222-22	15/09/2015
Date analysed	-	134222-51	15/09/2015 || 15/09/2015	134222-22	15/09/2015
Total Cyanide	mg/kg	134222-51	<0.5 || <0.5	134222-22	93%
Total Phenolics (as Phenol)	mg/kg	134222-51	<5 || <5	134222-22	108%
QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-61	14/09/2015 || 14/09/2015	134222-42	14/09/2015
Date analysed	-	134222-61	17/09/2015 || 17/09/2015	134222-42	17/09/2015
TRHC_6 - C_9	mg/kg	134222-61	<25 || <25	134222-42	111%
TRHC_6 - C_{10}	mg/kg	134222-61	<25 || <25	134222-42	111%
Benzene	mg/kg	134222-61	<0.2 || <0.2	134222-42	105%
Toluene	mg/kg	134222-61	<0.5 || <0.5	134222-42	109%
Ethylbenzene	mg/kg	134222-61	<1 || <1	134222-42	113%
m+p-xylene	mg/kg	134222-61	<2 || <2	134222-42	114%
o-Xylene	mg/kg	134222-61	<1 || <1	134222-42	112%
naphthalene	mg/kg	134222-61	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%	134222-61	88 || 77 || RPD: 13	134222-42	94%
QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-61	14/09/2015 || 14/09/2015	134222-42	14/09/2015
Date analysed	-	134222-61	16/09/2015 || 16/09/2015	134222-42	16/09/2015
TRHC_{10} - C_{14}	mg/kg	134222-61	<50 || <50	134222-42	109%
TRHC_{15} - C_{28}	mg/kg	134222-61	<100 || <100	134222-42	97%
TRHC_{29} - C_{36}	mg/kg	134222-61	<100 || <100	134222-42	123%
TRH>C_{10}-C_{16}	mg/kg	134222-61	<50 || <50	134222-42	109%
TRH>C_{16}-C_{34}	mg/kg	134222-61	<100 || <100	134222-42	97%
TRH>C_{34}-C_{40}	mg/kg	134222-61	<100 || <100	134222-42	123%
Surrogate o-Terphenyl	%	134222-61	91 || 88 || RPD: 3	134222-42	81%
QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-61	14/09/2015 || 14/09/2015	134222-42	14/09/2015
Date analysed	-	134222-61	15/09/2015 || 15/09/2015	134222-42	15/09/2015
Naphthalene	mg/kg	134222-61	<0.1 || <0.1	134222-42	89%
Acenaphthylene	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	134222-61	<0.1 || <0.1	134222-42	90%
Phenanthrene	mg/kg	134222-61	<0.1 || <0.1	134222-42	95%
Anthracene	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	134222-61	<0.1 || <0.1	134222-42	95%
Pyrene	mg/kg	134222-61	<0.1 || <0.1	134222-42	98%

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Benzo(a)anthracene	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Chrysene	mg/kg	134222-61	<0.1 || <0.1	134222-42	92%
Benzo(b,j+k)fluoranthene	mg/kg	134222-61	<0.2 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	134222-61	<0.05 || <0.05	134222-42	110%
Indeno(1,2,3-c,d)pyrene	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d14	%	134222-61	98 || 98 || RPD: 0	134222-42	95%
QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-61	14/09/2015 || 14/09/2015	134222-42	14/09/2015
Date analysed	-	134222-61	18/09/2015 || 18/09/2015	134222-42	17/09/2015
HCB	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	134222-61	<0.1 || <0.1	134222-42	96%
gamma-BHC	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	134222-61	<0.1 || <0.1	134222-42	94%
Heptachlor	mg/kg	134222-61	<0.1 || <0.1	134222-42	99%
delta-BHC	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	134222-61	<0.1 || <0.1	134222-42	110%
Heptachlor Epoxide	mg/kg	134222-61	<0.1 || <0.1	134222-42	109%
gamma-Chlordane	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	134222-61	<0.1 || <0.1	134222-42	100%
Dieldrin	mg/kg	134222-61	<0.1 || <0.1	134222-42	120%
Endrin	mg/kg	134222-61	<0.1 || <0.1	134222-42	117%
pp-DDD	mg/kg	134222-61	<0.1 || <0.1	134222-42	102%
Endosulfan II	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	134222-61	<0.1 || <0.1	134222-42	106%
Methoxychlor	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%	134222-61	98 || 98 || RPD: 0	134222-42	111%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-61	14/09/2015 || 14/09/2015	134222-42	14/09/2015
Date analysed	-	134222-61	18/09/2015 || 18/09/2015	134222-42	17/09/2015
Azinphos-methyl (Guthion)	mg/kg	134222-61	<0.1 || <0.1	134222-42	77%
Bromophos-ethyl	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	134222-61	<0.1 || <0.1	134222-42	88%
Chlorpyriphos-methyl	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Diazinon	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Dichlorvos	mg/kg	134222-61	<0.1 || <0.1	134222-42	100%
Dimethoate	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	134222-61	<0.1 || <0.1	134222-42	107%
Fenitrothion	mg/kg	134222-61	<0.1 || <0.1	134222-42	110%
Malathion	mg/kg	134222-61	<0.1 || <0.1	134222-42	102%
Parathion	mg/kg	134222-61	<0.1 || <0.1	134222-42	94%
Ronnel	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%	134222-61	98 || 98 || RPD: 0	134222-42	111%

QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-61	14/09/2015 || 14/09/2015	134222-42	14/09/2015
Date analysed	-	134222-61	18/09/2015 || 18/09/2015	134222-42	17/09/2015
Aroclor 1016	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Aroclor 1221	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Aroclor 1232	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Aroclor 1242	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Aroclor 1248	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Aroclor 1254	mg/kg	134222-61	<0.1 || <0.1	134222-42	#
Aroclor 1260	mg/kg	134222-61	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%	134222-61	98 || 98 || RPD: 0	134222-42	94%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	134222-61	14/09/2015 || 14/09/2015	LCS-9	14/09/2015
Date analysed	-	134222-61	15/09/2015 || 15/09/2015	LCS-9	15/09/2015
Arsenic	mg/kg	134222-61	<4 || <4	LCS-9	109%
Cadmium	mg/kg	134222-61	<0.4 || <0.4	LCS-9	105%
Chromium	mg/kg	134222-61	16 || 15 || RPD: 6	LCS-9	107%
Copper	mg/kg	134222-61	8 || 12 || RPD: 40	LCS-9	112%
Lead	mg/kg	134222-61	25 || 26 || RPD: 4	LCS-9	105%
Mercury	mg/kg	134222-61	<0.1 || <0.1	LCS-9	95%
Nickel	mg/kg	134222-61	3 || 2 || RPD: 40	LCS-9	102%
Zinc	mg/kg	134222-61	9 || 15 || RPD: 50	LCS-9	104%
Manganese	mg/kg	134222-61	37 || 49 || RPD: 28	LCS-9	122%

QUALITY CONTROL Misc Soil - Inorg	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	134222-61	14/09/2015 || 14/09/2015	134222-42	15/09/2015
Date analysed	-	134222-61	15/09/2015 || 15/09/2015	134222-42	15/09/2015
Total Cyanide	mg/kg	134222-61	<0.5 || <0.5	134222-42	88%
Total Phenolics (as Phenol)	mg/kg	134222-61	<5 || <5	134222-42	100%
QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	134222-67	14/09/2015 || 14/09/2015	134222-62	14/09/2015
Date analysed	-	134222-67	17/09/2015 || 17/09/2015	134222-62	17/09/2015
$TRHC_6$ - C_9	mg/kg	134222-67	<25 || <25	134222-62	91%
$TRHC_6$ - C_{10}	mg/kg	134222-67	<25 || <25	134222-62	91%
Benzene	mg/kg	134222-67	<0.2 || <0.2	134222-62	85%
Toluene	mg/kg	134222-67	<0.5 || <0.5	134222-62	89%
Ethylbenzene	mg/kg	134222-67	<1 || <1	134222-62	94%
m+p-xylene	mg/kg	134222-67	<2 || <2	134222-62	94%
o-Xylene	mg/kg	134222-67	<1 || <1	134222-62	93%
naphthalene	mg/kg	134222-67	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%	134222-67	83 || 94 || RPD: 12	134222-62	79%
QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	134222-62	14/09/2015
Date analysed	-	[NT]	[NT]	134222-62	16/09/2015
$TRHC_{10}$ - C_{14}	mg/kg	[NT]	[NT]	134222-62	116%
$TRHC_{15}$ - C_{28}	mg/kg	[NT]	[NT]	134222-62	117%
$TRHC_{29}$ - C_{36}	mg/kg	[NT]	[NT]	134222-62	127%
$TRH>C_{10}$-C_{16}	mg/kg	[NT]	[NT]	134222-62	116%
$TRH>C_{16}$-C_{34}	mg/kg	[NT]	[NT]	134222-62	117%
$TRH>C_{34}$-C_{40}	mg/kg	[NT]	[NT]	134222-62	127%
Surrogate o-Terphenyl	%	[NT]	[NT]	134222-62	86%
QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	134222-62	14/09/2015
Date analysed	-	[NT]	[NT]	134222-62	15/09/2015
Naphthalene	mg/kg	[NT]	[NT]	134222-62	91%
Acenaphthylene	mg/kg	[NT]	[NT]	[NR]	[NR]
Acenaphthene	mg/kg	[NT]	[NT]	[NR]	[NR]
Fluorene	mg/kg	[NT]	[NT]	134222-62	88%
Phenanthrene	mg/kg	[NT]	[NT]	134222-62	96%
Anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Fluoranthene	mg/kg	[NT]	[NT]	134222-62	94%
Pyrene	mg/kg	[NT]	[NT]	134222-62	99%

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Benzo(a)anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Chrysene	mg/kg	[NT]	[NT]	134222-62	94%
Benzo(b,j+k)fluoranthene	mg/kg	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	mg/kg	[NT]	[NT]	134222-62	107%
Indeno(1,2,3-c,d)pyrene	mg/kg	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%	[NT]	[NT]	134222-62	97%
QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	134222-62	14/09/2015
Date analysed	-	[NT]	[NT]	134222-62	18/09/2015
HCB	mg/kg	[NT]	[NT]	[NR]	[NR]
alpha-BHC	mg/kg	[NT]	[NT]	134222-62	108%
gamma-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
beta-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
Heptachlor	mg/kg	[NT]	[NT]	134222-62	116%
delta-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
Aldrin	mg/kg	[NT]	[NT]	134222-62	109%
Heptachlor Epoxide	mg/kg	[NT]	[NT]	134222-62	96%
gamma-Chlordane	mg/kg	[NT]	[NT]	[NR]	[NR]
alpha-chlordane	mg/kg	[NT]	[NT]	[NR]	[NR]
Endosulfan I	mg/kg	[NT]	[NT]	[NR]	[NR]
pp-DDE	mg/kg	[NT]	[NT]	134222-62	93%
Dieldrin	mg/kg	[NT]	[NT]	134222-62	104%
Endrin	mg/kg	[NT]	[NT]	134222-62	102%
pp-DDD	mg/kg	[NT]	[NT]	134222-62	98%
Endosulfan II	mg/kg	[NT]	[NT]	[NR]	[NR]
pp-DDT	mg/kg	[NT]	[NT]	[NR]	[NR]
Endrin Aldehyde	mg/kg	[NT]	[NT]	[NR]	[NR]
Endosulfan Sulphate	mg/kg	[NT]	[NT]	134222-62	99%
Methoxychlor	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCMX	%	[NT]	[NT]	134222-62	95%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	134222-62	14/09/2015
Date analysed	-	[NT]	[NT]	134222-62	18/09/2015
Azinphos-methyl (Guthion)	mg/kg	[NT]	[NT]	134222-62	96%
Bromophos-ethyl	mg/kg	[NT]	[NT]	[NR]	[NR]
Chlorpyriphos	mg/kg	[NT]	[NT]	134222-62	94%
Chlorpyriphos-methyl	mg/kg	[NT]	[NT]	[NR]	[NR]
Diazinon	mg/kg	[NT]	[NT]	[NR]	[NR]
Dichlorvos	mg/kg	[NT]	[NT]	134222-62	123%
Dimethoate	mg/kg	[NT]	[NT]	134222-62	86%
Ethion	mg/kg	[NT]	[NT]	134222-62	87%
Fenitrothion	mg/kg	[NT]	[NT]	134222-62	118%
Malathion	mg/kg	[NT]	[NT]	134222-62	81%
Parathion	mg/kg	[NT]	[NT]	134222-62	121%
Ronnel	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCMX	%	[NT]	[NT]	134222-62	117%
QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	134222-62	14/09/2015
Date analysed	-	[NT]	[NT]	134222-62	18/09/2015
Aroclor 1016	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1221	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1232	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1242	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1248	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1254	mg/kg	[NT]	[NT]	134222-62	97%
Aroclor 1260	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%	[NT]	[NT]	134222-62	85%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	LCS-10	14/09/2015
Date analysed	-	[NT]	[NT]	LCS-10	15/09/2015
Arsenic	mg/kg	[NT]	[NT]	LCS-10	110%
Cadmium	mg/kg	[NT]	[NT]	LCS-10	103%
Chromium	mg/kg	[NT]	[NT]	LCS-10	107%
Copper	mg/kg	[NT]	[NT]	LCS-10	110%
Lead	mg/kg	[NT]	[NT]	LCS-10	104%
Mercury	mg/kg	[NT]	[NT]	LCS-10	95%
Nickel	mg/kg	[NT]	[NT]	LCS-10	102%
Zinc	mg/kg	[NT]	[NT]	LCS-10	104%
Manganese	mg/kg	[NT]	[NT]	LCS-10	120%

QUALITY CONTROL Misc Soil - Inorg	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	134222-62	15/09/2015
Date analysed	-	[NT]	[NT]	134222-62	15/09/2015
Total Cyanide	mg/kg	[NT]	[NT]	134222-62	99%
Total Phenolics (as Phenol)	mg/kg	[NT]	[NT]	134222-62	96%
QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	LCS-16	14/09/2015
Date analysed	-	[NT]	[NT]	LCS-16	17/09/2015
TRHC_6 - C_9	mg/kg	[NT]	[NT]	LCS-16	101%
TRHC_6 - C_{10}	mg/kg	[NT]	[NT]	LCS-16	101%
Benzene	mg/kg	[NT]	[NT]	LCS-16	90%
Toluene	mg/kg	[NT]	[NT]	LCS-16	96%
Ethylbenzene	mg/kg	[NT]	[NT]	LCS-16	105%
m+p-xylene	mg/kg	[NT]	[NT]	LCS-16	108%
o-Xylene	mg/kg	[NT]	[NT]	LCS-16	105%
naphthalene	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%	[NT]	[NT]	LCS-16	101%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	134222-62	14/09/2015
Date analysed	-	[NT]	[NT]	134222-62	15/09/2015
Arsenic	mg/kg	[NT]	[NT]	134222-62	94%
Cadmium	mg/kg	[NT]	[NT]	134222-62	94%
Chromium	mg/kg	[NT]	[NT]	134222-62	96%
Copper	mg/kg	[NT]	[NT]	134222-62	104%
Lead	mg/kg	[NT]	[NT]	134222-62	85%
Mercury	mg/kg	[NT]	[NT]	134222-62	90%
Nickel	mg/kg	[NT]	[NT]	134222-62	90%
Zinc	mg/kg	[NT]	[NT]	134222-62	81%
Manganese	mg/kg	[NT]	[NT]	134222-62	##

Report Comments:

Acid Extractable Metals in Soil: The laboratory RPD acceptance criteria has been exceeded for 134222-11 for Mn. Therefore a triplicate result has been issued as laboratory sample number 134222-78.

Acid Extractable Metals in Soil: The laboratory RPD acceptance criteria has been exceeded for 134222-41 for Cr and Mn. Therefore a triplicate result has been issued as laboratory sample number 134222-75.

Acid Extractable Metals in Soil: The laboratory RPD acceptance criteria has been exceeded for 134222-51 for Cu. Therefore a triplicate result has been issued as laboratory sample number 134222-76.

Acid Extractable Metals in Soil: The laboratory RPD acceptance criteria has been exceeded for 134222-61 for Zn. Therefore a triplicate result has been issued as laboratory sample number 134222-77.

METALS_S: ## Percent recovery is not possible to report due to the inhomogeneous nature of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

METALS_S: # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

PAH in soil: The RPD for duplicate results is accepted due to the non homogenous nature of the sample/s.

sTRH in soil: The RPD for duplicate results is accepted due to the non homogenous nature of the sample/s.
Percent recovery is not possible to report as the high concentration of analytes in the sample/s have caused interference.

OP/PCB in soil: PQL has been raised due to interference from analytes(other than those being tested) in the sample/s.

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NR: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

CHAIN OF CUSTODY

Douglas Partners
Geotechnics / Environment / Groundwater

Client: Douglas Partners	**Project Number** 71459.03	**To:**	Envirolab Services
Contact Person: Chris Bagia	**Project Name:** Moorebank	**Contact Person:**	Aileen Hie
Project Mgr: John Russell	**PO No.:**	**Address:**	12 Ashley Street
	lab Quote No. :		Chatswood NSW 2068
Address: 96 Hermitage Road West Ryde NSW 2114	**Date results required:** 17/09/15 (for 14 day holding time) **Or choose:** standard *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*	**Phone:**	02 9910 6200
		Fax:	02 9910 6201
		Email:	ahie@envirolab.com.au
Phone: 9809 0666 **Mob:** 0422 000 434	**Report format:** esdat / PDF / Excel	**Laboratory Report No:**	
Email: john.russell@douglaspartners.com.au	**Comments:**	**Lab Comments:**	

134222

Sample information						Tests Required											Comments
Lab Sample ID	Field Sample ID	Depth	Date sampled	Container Type	Type of sample	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn, Mn	TRH	BTEX	PAH	OCP	OPP	PCB	Phenols	pH / CEC		Combo	Provide as much information about the sample as you can
27	BH202	0.9-1.35	3/09/2015	1 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
28	BH202	1.9-2.35	3/09/2015	2 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
29	BH/MW215	0.9-1.35	3/09/2015	3 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
30	BH/MW215	1.9-2.35	3/09/2015	4 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
31	~~BH/MW215~~	~~5.9-6.35~~	3/09/2015	5 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
32	BH/MW218	0.9-1.35	3/09/2015	6 g	s	X	X	X	X	X	X	X	X	X		8 (+Mn)	
33	BH/MW218	2.9-2.35	3/09/2015	7 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
34	BH/MW218	5.9-6.35	4/09/2015	8 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
35	BH/MW216	0.1-0.2	4/09/2015	9 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
36	BH/MW216	3.9-4.35	4/09/2015	10 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
37	BH/MW216	5.9-6.35	4/09/2015	11 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
38 CoW	BH/MW223	2.0-2.45	4/09/2015	12 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
39	BH/MW210	0.1-0.2	4/09/2015	13 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
40	BH/MW210	2.0-2.45	4/09/2015	14 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
41	JK107a	0.1-0.2	7/09/2015	15 g	s	X	X	X	X	X	X	X	X	X		8 (+Mn)	
42	JK107a	1.9-2.35	7/09/2015	16 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
43	JK107a	7.9-8.35	7/09/2015	17 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
44	JK107a	8.9-9.35	7/09/2015	18 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
45	BH205	0.9-1.35	7/09/2015	19 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
46	BH205	2.9-3.35	7/09/2015	20 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
47	BH205	3.9-4.35	7/09/2015	21 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
48	JK103a	0.1-0.2	7/09/2015	22 g	s	X	X	X	X	X	X	X	X	X		8 (+Mn)	
49	JK103a	1.9-2.35	7/09/2015	23 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
50	JK103a	2.9-3.35	7/09/2015	24 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
51	JK103a	5.9-6.35	7/09/2015	25 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	

BH208/1.9-2.35

Relinquished by: Douglas Partners	**Sample Receipt**	***Lab use only:***
Courier (by whom) HUNTER EXPRESS	**Received by (Company):** EnS	**Samples Received: Cool or Ambient (circle one)**
Condition of Sample at dispatch Cool or Ambient (circle)	**Print Name:** P. Roy	**Temperature Received at:** (if applicable)
Temperature (if Applicable):	**Date & Time:** 11/9/15 17:00	**Transported by: Hand delivered / courier**
Print Name: John Russell	**Signature:** PR	
Date & Time 11/09/15; 3pm		
Signature:		

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 134222
Date Received: 11/9/2015
Time Received: 17:00
Received by: PR
Temp: Cool/Ambient 16.2
Cooling: Ice/Icepack
Security: Intact/Broken/None

2 1

CHAIN OF CUSTODY

Douglas Partners
Geotechnics / Environment / Groundwater

Client: Douglas Partners	**Project Number** 71459.03	**To:**	Envirolab Services
Contact Person: Chris Bagia	**Project Name:** Moorebank	**Contact Person:**	Aileen Hie
Project Mgr: John Russell	**PO No.:**	**Address:**	12 Ashley Street
	lab Quote No. :		Chatswood NSW 2068
Address: 96 Hermitage Road West Ryde NSW 2114	**Date results required:** 17/09/15 (for 14 day holding time) **Or choose:** standard *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*	**Phone:**	02 9910 6200
		Fax:	02 9910 6201
		Email:	ahie@envirolab.com.au
Phone: 9809 0666 **Mob:** 0422 000 434	**Report format:** esdat / PDF / Excel	**Laboratory Report No:**	
Email: john.russell@douglaspartners.com.au	**Comments:**	**Lab Comments:**	

134222

Sample information						Tests Required											Comments
Lab Sample ID	Field Sample ID	Depth	Date sampled	Container Type	Type of sample	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn, Mn	TRH	BTEX	PAH	OCP	OPP	PCB	Phenols	pH / CEC		Combo	Provide as much information about the sample as you can
1	JK118a	0.1-0.2	8/09/2015	26 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
2	JK118a	1.9-2.35	8/09/2015	27 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
3	JK118a	4.9-5.35	8/09/2015	28 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
4	BH211	0.1-0.2	8/09/2015	29 g	s	X	X	X	X	X	X	X	X	X		8 (+Mn)	
5	BH211	0.9-1.35	8/09/2015	30 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
6	BH211	2.9-2.35	8/09/2015	31 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
7	BH214	0.1-0.2	8/09/2015	32 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
8	BH214	2.2-2.65	8/09/2015	33 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
9	BH213	0.1-0.2	8/09/2015	34 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
10	BH213	2.9-3.35	8/09/2015	35 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
11	BH221	0.1-0.2	8/09/2015	36 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
12	BH221	1.9-2.35	8/09/2015	37 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
(29-335) 13	BH221	3.9-4.35	8/09/2015	38 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
14	BH221	3.9-4.35	8/09/2015	39 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
15	BH222	0.1-0.2	9/09/2015	40 g	s	X	X	X	X	X	X	X	X	X		8 (+Mn)	
16	BH222	0.9-1.35	9/09/2015	41 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
17	BH220	0.1-0.2	9/09/2015	42 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
18	BH212	0.1-0.2	9/09/2015	43 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
19	BH212	2.9-3.35	9/09/2015	44 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
20	BH209	0.1-0.2	9/09/2015	45 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
09-1.35 21	BH209	0.1-0.2	9/09/2015	46 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
22	BH209	1.9-2.35	9/09/2015	47 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
23	BH209	3.9-4.35	9/09/2015	48 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
24	BH204	0.1-0.2	9/09/2015	49 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
25	BH204	1.9-2.35	9/09/2015	50 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
26	BH204	3.9-4.35	9/09/2015	57 g	s	X	X	X	X	X	X	X	X			8 (+Mn)	

Relinquished by: Douglas Partners	**Sample Receipt**	***Lab use only:***
Courier (by whom) HUNTER EXPRESS	**Received by (Company):** ECS	**Samples Received: Cool or Ambient (circle one)**
Condition of Sample at dispatch Cool or Ambient (circle)	**Print Name:** P. Ray	**Temperature Received at:** (if applicable)
Temperature (if Applicable):	**Date & Time:** 11/9/15 17:00	**Transported by: Hand delivered / courier**
Print Name: John Russell	**Signature:**	
Date & Time 11/09/15; 3pm		
Signature:		

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

ENVIROLAB

Job No: 134222
Date Received: 11/9/15
Time Received: 17:00
Received by: RL
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

16.2.

8 2

CHAIN OF CUSTODY

Douglas Partners
Geotechnics / Environment / Groundwater

Client: Douglas Partners	**Project Number** 71459.03	**To:** Envirolab Services
Contact Person: Chris Bagia	**Project Name:** Moorebank	**Contact Person:** Aileen Hie
Project Mgr: John Russell	**PO No.:**	**Address:** 12 Ashley Street
	lab Quote No. :	Chatswood NSW 2068
Address: 96 Hermitage Road	**Date results required:** 17/09/15 (for 14 day holding time)	**Phone:** 02 9910 6200
West Ryde NSW 2114	**Or choose:** standard	**Fax:** 02 9910 6201
	Note: Inform lab in advance if urgent turnaround is required - surcharges apply	**Email:** ahie@envirolab.com.au
Phone: 9809 0666 **Mob:** 0422 000 434	**Report format:** esdat / PDF / Excel	**Laboratory Report No:**
Email: john.russell@douglaspartners.com.au	**Comments:**	**Lab Comments:**
134222		

Sample information						Tests Required											Comments
Lab Sample ID	Field Sample ID	Depth	Date sampled	Container Type	Type of sample	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn, Mn	TRH	BTEX	PAH	OCP	OPP	PCB	Phenols	pH / CEC		Combo	Provide as much information about the sample as you can
52	BH203	0.1-0.2	10/09/2015	g	s	X	X	X	X	X	X	X	X	X		8 (+Mn)	
53	BH203	0.9-1.35	10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
54	BH203	2.9-3.35	10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
55	BH201	0.1-0.2	10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
56	BH201	0.9-1.35	10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
57	BH207	0.1-0.2	10/09/2015	g	s	X	X	X	X	X	X	X	X	X		8 (+Mn)	
58	BH207	0.9-1.35	10/09/2015	g	s	X			X								
59	BH206	0.1-0.2	10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
60	BH206	0.9-1.35	10/09/2015	g	s	X			X								
61	BH206	2.9-2.35	10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
62	BH206	4.9-4.35	10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
63	BH208	0.9-1.35	10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
64	BH208	3.9-4.35	10/09/2015	g	s	X			X								
65	BD1/070815		7/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
66	BD2/080915		8/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
67	BD3/090915		9/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
—	BD4/100915		10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	Please send to ALS
68	BD5/100915		10/09/2015	g	s	X			X								
—	BD6/100915		10/09/2015	g	s	X			X								Please send to ALS
—	BD7/100915		10/09/2015	g	s	X			X								Please send to ALS
69	TS1	prepared on	1/09/2015				X	X									
70	TB1	prepared on	1/09/2015				X	X									
71	TS2	prepared on	1/09/2015				X	X									
72	TB2	prepared on	1/09/2015				X	X									
73	TS3	prepared on	1/09/2015				X	X									
74	TB3	prepared on	1/09/2015				X	X									

Relinquished by: Douglas Partners	**Sample Receipt**	***Lab use only:***
Courier (by whom) HUNTER EXPRESS	**Received by (Company):** EJS	**Samples Received: Cool or Ambient (circle one)**
Condition of Sample at dispatch Cool or Ambient (circle)	**Print Name:** P.Ray	**Temperature Received at:** (if applicable)
Temperature (if Applicable):	**Date & Time:** 11/9/2015 1700	**Transported by: Hand delivered / courier**
Print Name: John Russell	**Signature:**	
Date & Time 11/09/15; 3pm		
Signature:		

Aileen Hie

From: John Russell <John.Russell@douglaspartners.com.au>
Sent: Friday, 11 September 2015 4:27 PM
To: Aileen Hie; Geoff Weir
Subject: samples
Attachments: 11092015161454-0001.pdf

Geoff / Aileen

I've just sent a batch of ~70 soil samples for project **71459.03**. The PO is attached.

I noticed some typos on the COC when I was packing the samples. Can you please amend as follows:

- Sample BH/MW215/5.9-6.35, the sample will be missing. Please add sample BH208/1.9-2.35 instead;
- Sample BH221/3.9-4.35 is listed twice, additional sample is actually BH221/2.9-3.35; and
- Sample BH209/0.1-0.2 is listed twice, additional sample is actually BH209/0.9-1.35.

Thanks

John Russell | Associate
Douglas Partners Pty Ltd | ABN 75 053 980 117 | www.douglaspartners.com.au
96 Hermitage Road West Ryde NSW 2114 | PO Box 472 West Ryde NSW 1685
P: 02 9809 0666 | F: 02 9809 4095 | M: 0422 000 434 | E: John.Russell@douglaspartners.com.au

This email is confidential. If you are not the intended recipient, please notify us immediately and be aware that any disclosure, copying, distribution or use of the contents of this information is prohibited. Please note that the company does not make any commitment through emails not confirmed by fax or letter.

This email has been scanned by the Symantec Email Security.cloud service.
For more information please visit http://www.symanteccloud.com

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

SAMPLE RECEIPT ADVICE

Client Details	
Client	Douglas Partners Pty Ltd
Attention	John Russell, Chris Bagia

Sample Login Details	
Your Reference	71459.03, Moorebank
Envirolab Reference	134222
Date Sample Received	11/09/2015
Date Instructions Received	11/09/2015
Date Results Expected to be Reported	18/09/2015

Sample Condition	
Samples received in appropriate condition for analysis	YES
No. of Samples Provided	74 Soils
Turnaround Time Requested	Standard
Temperature on receipt (°C)	16.2
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments
Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	Phone: 02 9910 6200
Fax: 02 9910 6201	Fax: 02 9910 6201
Email: ahie@envirolabservices.com.au	Email: jhurst@envirolabservices.com.au

Sample and Testing Details on following page

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

Sample Id	vTRH(C6-C10)/BTEXN in Soil	svTRH (C10-C40) in Soil	PAHs in Soil	Organochlorine Pesticides in soil	Organophosphorus Pesticides	PCBs in Soil	Acid Extractable metals in soil	Misc Soil - Inorg	pH 1:5 soil:water	CEC
BH202-0.9-1.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH202-1.9-2.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH/MW215-0.9-1.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH/MW215-1.9-2.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH208-1.9-2.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH/MW218-0.9-1.35	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BH/MW218-2.9-2.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH/MW218-5.9-6.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH/MW216-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓		
BH/MW216-3.9-4.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH/MW216-5.9-6.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH/MW223-2.0-2.45	✓	✓	✓	✓	✓	✓	✓	✓		
BH/MW210-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓		
BH/MW210-2.0-2.45	✓	✓	✓	✓	✓	✓	✓	✓		
JK107a-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
JK107a-1.9-2.35	✓	✓	✓	✓	✓	✓	✓	✓		
JK107a-7.9-8.35	✓	✓	✓	✓	✓	✓	✓	✓		
JK107a-8.9-9.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH205-0.9-1.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH205-2.9-3.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH205-3.9-4.35	✓	✓	✓	✓	✓	✓	✓	✓		

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

JK103a-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
JK103a-1.9-2.35	✓	✓	✓	✓	✓	✓	✓	✓		
JK103a-2.9-3.35	✓	✓	✓	✓	✓	✓	✓	✓		
JK103a-5.9-6.35	✓	✓	✓	✓	✓	✓	✓	✓		
JK118a-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓		
JK118a-1.9-2.35	✓	✓	✓	✓	✓	✓	✓	✓		
JK118a-4.9-5.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH211-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BH211-0.9-1.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH211-2.9-2.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH214-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓		
BH214-2.2-2.65	✓	✓	✓	✓	✓	✓	✓	✓		
BH213-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓		
BH213-2.9-3.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH221-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓		
BH221-1.9-2.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH221-2.9-3.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH221-3.9-4.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH222-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BH222-0.9-1.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH222-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓		
BH212-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓		
BH212-2.9-3.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH209-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓		
BH209-0.9-1.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH209-1.9-2.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH209-3.9-4.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH204-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓		
BH204-1.9-2.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH204-3.9-4.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH203-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BH203-0.9-1.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH203-2.9-3.35	✓	✓	✓	✓	✓	✓	✓	✓		

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

BH201-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓		
BH201-0.9-1.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH207-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BH207-0.9-1.35			✓				✓			
BH206-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓		
BH206-0.9-1.35			✓				✓			
BH206-2.35-2.9	✓	✓	✓	✓	✓	✓	✓	✓		
BH206-4.35-4.9	✓	✓	✓	✓	✓	✓	✓	✓		
BH208-0.9-1.35	✓	✓	✓	✓	✓	✓	✓	✓		
BH208-3.9-4.35			✓				✓			
BD1/070815	✓	✓	✓	✓	✓	✓	✓	✓		
BD2/080915	✓	✓	✓	✓	✓	✓	✓	✓		
BD3/090915	✓	✓	✓	✓	✓	✓	✓	✓		
BD5/100915			✓				✓			
TS1	✓									
TB1	✓									
TS2	✓									
TB2	✓									
TS3	✓									
TB3	✓									

12 Ashley Street, Chatswood, NSW 2067
tel: +61 2 9910 6200

email: sydney@envirolab.com.au
envirolab.com.au

Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 135866

Client:
Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: John Russell, Chris Bagia

Sample log in details:

Your Reference:	**71459.03, Moorebank**		
No. of samples:	2 Soils		
Date samples received / completed instructions received	14/10/15	/	14/10/15

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	21/10/15	/	20/10/15
Date of Preliminary Report:	Not Issued		

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Jacinta Hurst
Laboratory Manager

vTRH(C6-C10)/BTEXN in Soil			
Our Reference:	UNITS	135866-1	135866-2
Your Reference	----------	SS217	SS219
Date Sampled	----------	14/10/2015	14/10/2015
Type of sample		Soil	Soil
Date extracted	-	15/10/2015	15/10/2015
Date analysed	-	15/10/2015	16/10/2015
TRHC$_6$ - C$_9$	mg/kg	<25	<25
TRHC$_6$ - C$_{10}$	mg/kg	<25	<25
vTPHC$_6$ - C$_{10}$ less BTEX (F1)	mg/kg	<25	<25
Benzene	mg/kg	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1
m+p-xylene	mg/kg	<2	<2
o-Xylene	mg/kg	<1	<1
naphthalene	mg/kg	<1	<1
Surrogate aaa-Trifluorotoluene	%	97	94

svTRH (C10-C40) in Soil			
Our Reference:	UNITS	135866-1	135866-2
Your Reference	----------	SS217	SS219
Date Sampled	----------	14/10/2015	14/10/2015
Type of sample		Soil	Soil
Date extracted	-	15/10/2015	15/10/2015
Date analysed	-	15/10/2015	15/10/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	<100
Surrogate o-Terphenyl	%	87	90

PAHs in Soil			
Our Reference:	UNITS	135866-1	135866-2
Your Reference	----------	SS217	SS219
Date Sampled	----------	14/10/2015	14/10/2015
Type of sample		Soil	Soil
Date extracted	-	15/10/2015	15/10/2015
Date analysed	-	15/10/2015	15/10/2015
Naphthalene	mg/kg	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	0.4
Anthracene	mg/kg	<0.1	0.1
Fluoranthene	mg/kg	0.2	0.6
Pyrene	mg/kg	0.2	0.6
Benzo(a)anthracene	mg/kg	0.1	0.3
Chrysene	mg/kg	0.2	0.3
Benzo(b,j+k)fluoranthene	mg/kg	0.3	0.5
Benzo(a)pyrene	mg/kg	0.1	0.3
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.1	0.2
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5
Total Positive PAHs	mg/kg	1.3	3.4
Surrogate p-Terphenyl-d14	%	93	90

Organochlorine Pesticides in soil			
Our Reference:	UNITS	135866-1	135866-2
Your Reference	----------	SS217	SS219
Date Sampled	----------	14/10/2015	14/10/2015
Type of sample		Soil	Soil
Date extracted	-	15/10/2015	15/10/2015
Date analysed	-	16/10/2015	16/10/2015
HCB	mg/kg	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1
Surrogate TCMX	%	122	129

Organophosphorus Pesticides			
Our Reference:	UNITS	135866-1	135866-2
Your Reference	----------	SS217	SS219
Date Sampled	----------	14/10/2015	14/10/2015
Type of sample		Soil	Soil
Date extracted	-	15/10/2015	15/10/2015
Date analysed	-	16/10/2015	16/10/2015
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1
Surrogate TCMX	%	122	129

PCBs in Soil			
Our Reference:	UNITS	135866-1	135866-2
Your Reference	----------	SS217	SS219
Date Sampled	----------	14/10/2015	14/10/2015
Type of sample		Soil	Soil
Date extracted	-	15/10/2015	15/10/2015
Date analysed	-	16/10/2015	16/10/2015
Aroclor 1016	mg/kg	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1
Surrogate TCLMX	%	122	129

Acid Extractable metals in soil			
Our Reference:	UNITS	135866-1	135866-2
Your Reference	----------	SS217	SS219
Date Sampled	----------	14/10/2015	14/10/2015
Type of sample		Soil	Soil
Date prepared	-	15/10/2015	15/10/2015
Date analysed	-	15/10/2015	15/10/2015
Arsenic	mg/kg	5	<4
Cadmium	mg/kg	<0.4	<0.4
Chromium	mg/kg	9	9
Copper	mg/kg	18	24
Lead	mg/kg	25	45
Mercury	mg/kg	<0.1	<0.1
Nickel	mg/kg	6	7
Zinc	mg/kg	55	80
Manganese	mg/kg	120	120

Misc Soil - Inorg			
Our Reference:	UNITS	135866-1	135866-2
Your Reference	----------	SS217	SS219
Date Sampled	----------	14/10/2015	14/10/2015
Type of sample		Soil	Soil
Date prepared	-	15/10/2015	15/10/2015
Date analysed	-	15/10/2015	15/10/2015
Total Phenolics (as Phenol)	mg/kg	<5	<5

Moisture			
Our Reference:	UNITS	135866-1	135866-2
Your Reference	----------	SS217	SS219
Date Sampled	----------	14/10/2015	14/10/2015
Type of sample		Soil	Soil
Date prepared	-	15/10/2015	15/10/2015
Date analysed	-	16/10/2015	16/10/2015
Moisture	%	5.1	7.8

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. For soil results:- 1. 'TEQ PQL' values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'TEQ zero' values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'TEQ half PQL' values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-008	Moisture content determined by heating at 105+/-5 deg C for a minimum of 12 hours.

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			15/10/2015	[NT]	[NT]	LCS-1	15/10/2015
Date analysed	-			15/10/2015	[NT]	[NT]	LCS-1	15/10/2015
TRH C_6 - C_9	mg/kg	25	Org-016	<25	[NT]	[NT]	LCS-1	100%
TRH C_6 - C_{10}	mg/kg	25	Org-016	<25	[NT]	[NT]	LCS-1	100%
Benzene	mg/kg	0.2	Org-016	<0.2	[NT]	[NT]	LCS-1	94%
Toluene	mg/kg	0.5	Org-016	<0.5	[NT]	[NT]	LCS-1	99%
Ethylbenzene	mg/kg	1	Org-016	<1	[NT]	[NT]	LCS-1	100%
m+p-xylene	mg/kg	2	Org-016	<2	[NT]	[NT]	LCS-1	103%
o-Xylene	mg/kg	1	Org-016	<1	[NT]	[NT]	LCS-1	102%
naphthalene	mg/kg	1	Org-014	<1	[NT]	[NT]	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%		Org-016	97	[NT]	[NT]	LCS-1	101%

QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			15/10/2015	[NT]	[NT]	LCS-1	15/10/2015
Date analysed	-			15/10/2015	[NT]	[NT]	LCS-1	15/10/2015
TRH C_{10} - C_{14}	mg/kg	50	Org-003	<50	[NT]	[NT]	LCS-1	99%
TRH C_{15} - C_{28}	mg/kg	100	Org-003	<100	[NT]	[NT]	LCS-1	85%
TRH C_{29} - C_{36}	mg/kg	100	Org-003	<100	[NT]	[NT]	LCS-1	79%
TRH >C_{10}-C_{16}	mg/kg	50	Org-003	<50	[NT]	[NT]	LCS-1	99%
TRH >C_{16}-C_{34}	mg/kg	100	Org-003	<100	[NT]	[NT]	LCS-1	85%
TRH >C_{34}-C_{40}	mg/kg	100	Org-003	<100	[NT]	[NT]	LCS-1	79%
Surrogate o-Terphenyl	%		Org-003	90	[NT]	[NT]	LCS-1	100%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			15/10/2015	[NT]	[NT]	LCS-1	15/10/2015
Date analysed	-			15/10/2015	[NT]	[NT]	LCS-1	15/10/2015
Naphthalene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	LCS-1	97%
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Fluorene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	LCS-1	99%
Phenanthrene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	LCS-1	98%
Anthracene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	LCS-1	91%
Pyrene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	LCS-1	101%
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Chrysene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	LCS-1	118%
Benzo(b,j+k) fluoranthene	mg/kg	0.2	Org-012	<0.2	[NT]	[NT]	[NR]	[NR]

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	[NT]	[NT]	LCS-1	111%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012	96	[NT]	[NT]	LCS-1	93%
QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			15/10/2015	[NT]	[NT]	LCS-1	15/10/2015
Date analysed	-			16/10/2015	[NT]	[NT]	LCS-1	16/10/2015
HCB	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	102%
gamma-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
beta-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	82%
Heptachlor	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	89%
delta-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
Aldrin	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	92%
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	89%
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
pp-DDE	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	85%
Dieldrin	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	119%
Endrin	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	106%
pp-DDD	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	93%
Endosulfan II	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
pp-DDT	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	LCS-1	95%
Methoxychlor	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NR]	[NR]
Surrogate TCMX	%		Org-005	105	[NT]	[NT]	LCS-1	123%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			15/10/2015	[NT]	[NT]	LCS-1	15/10/2015
Date analysed	-			16/10/2015	[NT]	[NT]	LCS-1	16/10/2015
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	LCS-1	69%
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NR]	[NR]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	LCS-1	91%
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NR]	[NR]
Diazinon	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NR]	[NR]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	LCS-1	95%
Dimethoate	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NR]	[NR]
Ethion	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	LCS-1	100%
Fenitrothion	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	LCS-1	118%
Malathion	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	LCS-1	93%
Parathion	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	LCS-1	114%
Ronnel	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NR]	[NR]
Surrogate TCMX	%		Org-008	105	[NT]	[NT]	LCS-1	123%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			15/10/2015	[NT]	[NT]	LCS-1	15/10/2015
Date analysed	-			16/10/2015	[NT]	[NT]	LCS-1	16/10/2015
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	LCS-1	114%
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%		Org-006	105	[NT]	[NT]	LCS-1	106%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			15/10/2015	[NT]	[NT]	LCS-3	15/10/2015
Date analysed	-			15/10/2015	[NT]	[NT]	LCS-3	15/10/2015
Arsenic	mg/kg	4	Metals-020 ICP-AES	<4	[NT]	[NT]	LCS-3	108%
Cadmium	mg/kg	0.4	Metals-020 ICP-AES	<0.4	[NT]	[NT]	LCS-3	107%
Chromium	mg/kg	1	Metals-020 ICP-AES	<1	[NT]	[NT]	LCS-3	104%
Copper	mg/kg	1	Metals-020 ICP-AES	<1	[NT]	[NT]	LCS-3	116%
Lead	mg/kg	1	Metals-020 ICP-AES	<1	[NT]	[NT]	LCS-3	102%
Mercury	mg/kg	0.1	Metals-021 CV-AAS	<0.1	[NT]	[NT]	LCS-3	106%
Nickel	mg/kg	1	Metals-020 ICP-AES	<1	[NT]	[NT]	LCS-3	101%
Zinc	mg/kg	1	Metals-020 ICP-AES	<1	[NT]	[NT]	LCS-3	101%
Manganese	mg/kg	1	Metals-020 ICP-AES	<1	[NT]	[NT]	LCS-3	106%
QUALITY CONTROL Misc Soil - Inorg	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			15/10/2015	[NT]	[NT]	LCS-1	15/10/2015
Date analysed	-			15/10/2015	[NT]	[NT]	LCS-1	15/10/2015
Total Phenolics (as Phenol)	mg/kg	5	Inorg-031	<5	[NT]	[NT]	LCS-1	104%

Report Comments:

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NA: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

CHAIN OF CUSTODY

Douglas Partners
Geotechnics / Environment / Groundwater

Client: Douglas Partners	**Project Number** 71459.03	**To:**	Envirolab Services
Contact Person: John Russell	**Project Name:** Moorebank	**Contact Person:**	Aileen Hie
Project Mgr: John Russell	**PO No.:**	**Address:**	12 Ashley Street
	lab Quote No. :		Chatswood NSW 2068
Address: 96 Hermitage Road West Ryde NSW 2114	**Date results required:** Standard **Or choose:** standard *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*	**Phone:**	02 9910 6200
		Fax:	02 9910 6201
		Email:	ahie@envirolab.com.au
Phone: 9809 0666 **Mob:** 0422 000 434	**Report format:** esdat / PDF / Excel	**Laboratory Report No:**	
Email: john.russell@douglaspartners.com.au	**Comments:**	**Lab Comments:**	

Sample information						Tests Required											Comments
Lab Sample ID	Field Sample ID	Depth	Date sampled	Container Type	Type of sample	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn, Mn	TRH	BTEX	PAH	OCP	OPP	PCB	Phenols	pH / CEC		Combo	Provide as much information about the sample as you can
1	SS217		14/10/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
2	SS219		14/10/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	

ENVIROLAB
Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 135866
Date Received: 14/10/15
Time Received: 14:00
Received by: D.F
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Relinquished by: Douglas Partners	**Sample Receipt**	***Lab use only:***
Courier (by whom) HUNTER EXPRESS	**Received by (Company):** Douglas Partners Env Field	**Samples Received: Cool or Ambient (circle one)**
Condition of Sample at dispatch Cool or Ambient (circle)	**Print Name:**	**Temperature Received at:** (if applicable)
Temperature (if Applicable):	**Date & Time:** 14/10/15 14:00	**Transported by: Hand delivered / courier**
Print Name: John Russell	**Signature:**	
Date & Time 14/10/2015		
Signature:		

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

SAMPLE RECEIPT ADVICE

Client Details	
Client	Douglas Partners Pty Ltd
Attention	John Russell, Chris Bagia

Sample Login Details	
Your Reference	71459.03, Moorebank
Envirolab Reference	135866
Date Sample Received	14/10/2015
Date Instructions Received	14/10/2015
Date Results Expected to be Reported	21/10/2015

Sample Condition	
Samples received in appropriate condition for analysis	YES
No. of Samples Provided	2 Soils
Turnaround Time Requested	Standard
Temperature on receipt (°C)	9.6
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments
Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	Phone: 02 9910 6200
Fax: 02 9910 6201	Fax: 02 9910 6201
Email: ahie@envirolabservices.com.au	Email: jhurst@envirolabservices.com.au

Sample and Testing Details on following page

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

Sample Id	*vTRH(C6-C10)/BTEXN in Soil*	*svTRH (C10-C40) in Soil*	*PAHs in Soil*	*Organochlorine Pesticides in soil*	*Organophosphorus Pesticides*	*PCBs in Soil*	*Acid Extractable metals in soil*	*Misc Soil - Inorg*
SS217	✓	✓	✓	✓	✓	✓	✓	✓
SS219	✓	✓	✓	✓	✓	✓	✓	✓

12 Ashley Street, Chatswood, NSW 2067
tel: +61 2 9910 6200

email: sydney@envirolab.com.au
envirolab.com.au

Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 134222-B

Client:
Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: John Russell, Chris Bagia

Sample log in details:

Your Reference:	**71459.03, Moorebank**
No. of samples:	Additional Testing on 6 Soils
Date samples received / completed instructions received	11/9/2015 / 08/10/15

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	15/10/15 / 15/10/15
Date of Preliminary Report:	Not Issued

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Jacinta Hurst
Laboratory Manager

Metals in TCLP USEPA1311						
Our Reference:	UNITS	134222-B-24	134222-B-38	134222-B-41	134222-B-46	134222-B-54
Your Reference	----------	JK103a	BH221	BH222	BH209	BH203
Depth	----------	2.9-3.35	2.9-3.35	0.9-1.35	0.9-1.35	2.9-3.35
Date Sampled		7/09/2015	8/09/2015	9/09/2015	9/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	11/10/2015	15/10/2015	11/10/2015	11/10/2015	15/10/2015
Date analysed	-	[NA]	15/10/2015	[NA]	[NA]	15/10/2015
pH of soil for fluid# determ.	pH units	9.3	9.3	8.8	9.2	8.6
pH of soil for fluid # determ. (acid)	pH units	1.6	1.7	1.6	1.6	1.7
Extraction fluid used	-	1	1	1	1	1
pH of final Leachate	pH units	5.1	6.3	5.7	5.6	5.6
Arsenic in TCLP	mg/L	[NA]	<0.05	[NA]	[NA]	<0.05
Cadmium in TCLP	mg/L	[NA]	<0.01	[NA]	[NA]	0.01
Chromium in TCLP	mg/L	[NA]	<0.01	[NA]	[NA]	<0.01
Copper in TCLP	mg/L	[NA]	<0.01	[NA]	[NA]	0.04
Lead in TCLP	mg/L	[NA]	0.2	[NA]	[NA]	1.0
Mercury in TCLP	mg/L	[NA]	<0.0005	[NA]	[NA]	<0.0005
Nickel in TCLP	mg/L	[NA]	<0.02	[NA]	[NA]	<0.02
Zinc in TCLP	mg/L	[NA]	1.1	[NA]	[NA]	1.8

Metals in TCLP USEPA1311		
Our Reference:	UNITS	134222-B-57
Your Reference	----------	BH207
Depth	----------	0.1-0.2
Date Sampled		10/09/2015
Type of sample		Soil
Date extracted	-	11/10/2015
pH of soil for fluid# determ.	pH units	9.5
pH of soil for fluid # determ. (acid)	pH units	1.6
Extraction fluid used	-	1
pH of final Leachate	pH units	5.2

PAHs in TCLP (USEPA 1311)					
Our Reference:	UNITS	134222-B-24	134222-B-41	134222-B-46	134222-B-57
Your Reference	----------	JK103a	BH222	BH209	BH207
Depth	----------	2.9-3.35	0.9-1.35	0.9-1.35	0.1-0.2
Date Sampled		7/09/2015	9/09/2015	9/09/2015	10/09/2015
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015
Date analysed	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015
Naphthalene in TCLP	mg/L	0.004	<0.001	<0.001	<0.001
Acenaphthylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Acenaphthene in TCLP	mg/L	0.010	<0.001	<0.001	<0.001
Fluorene in TCLP	mg/L	0.005	<0.001	<0.001	<0.001
Phenanthrene in TCLP	mg/L	0.006	<0.001	<0.001	<0.001
Anthracene in TCLP	mg/L	0.001	<0.001	<0.001	<0.001
Fluoranthene in TCLP	mg/L	0.002	<0.001	<0.001	<0.001
Pyrene in TCLP	mg/L	0.001	<0.001	<0.001	<0.001
Benzo(a)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Chrysene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Benzo(bjk)fluoranthene in TCLP	mg/L	<0.002	<0.002	<0.002	<0.002
Benzo(a)pyrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Dibenzo(a,h)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Benzo(g,h,i)perylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Total +ve PAH's	mg/L	0.029	NIL (+)VE	NIL (+)VE	NIL (+)VE
Surrogate p-Terphenyl-d14	%	101	118	104	110

Method ID	Methodology Summary
Inorg-004	Toxicity Characteristic Leaching Procedure (TCLP) based upon AS 4439 and USEPA 1311. Additional information as required in AS4439.3 section 11 can be provided on request.
EXTRACT.7	Toxicity Characteristic Leaching Procedure (TCLP).
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Org-012	Leachates are extracted with Dichloromethane and analysed by GC-MS.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.

QUALITY CONTROL Metals in TCLP USEPA1311	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			15/10/2015	[NT]	[NT]	LCS-W1	15/10/2015
Date analysed	-			15/10/2015	[NT]	[NT]	LCS-W1	15/10/2015
Arsenic in TCLP	mg/L	0.05	Metals-020 ICP-AES	<0.05	[NT]	[NT]	LCS-W1	114%
Cadmium in TCLP	mg/L	0.01	Metals-020 ICP-AES	<0.01	[NT]	[NT]	LCS-W1	117%
Chromium in TCLP	mg/L	0.01	Metals-020 ICP-AES	<0.01	[NT]	[NT]	LCS-W1	110%
Copper in TCLP	mg/L	0.01	Metals-020 ICP-AES	<0.01	[NT]	[NT]	LCS-W1	107%
Lead in TCLP	mg/L	0.03	Metals-020 ICP-AES	<0.03	[NT]	[NT]	LCS-W1	107%
Mercury in TCLP	mg/L	0.0005	Metals-021 CV-AAS	<0.0005	[NT]	[NT]	LCS-W1	114%
Nickel in TCLP	mg/L	0.02	Metals-020 ICP-AES	<0.02	[NT]	[NT]	LCS-W1	107%
Zinc in TCLP	mg/L	0.02	Metals-020 ICP-AES	<0.02	[NT]	[NT]	LCS-W1	114%

QUALITY CONTROL PAHs in TCLP (USEPA 1311)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			12/10/2015	[NT]	[NT]	LCS-W4	12/10/2015
Date analysed	-			12/10/2015	[NT]	[NT]	LCS-W4	12/10/2015
Naphthalene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W4	111%
Acenaphthylene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Acenaphthene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Fluorene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W4	105%
Phenanthrene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W4	128%
Anthracene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Fluoranthene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W4	120%
Pyrene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W4	122%
Benzo(a)anthracene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Chrysene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W4	115%
Benzo(bjk)fluoranthene in TCLP	mg/L	0.002	Org-012	<0.002	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W4	128%
Indeno(1,2,3-c,d)pyrene -TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012	78	[NT]	[NT]	LCS-W4	87%

Report Comments:

Samples requested and analysed out of holding time for TCLP PAH.

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NA: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Aileen Hie

From: John Russell <John.Russell@douglaspartners.com.au>
Sent: Thursday, 8 October 2015 10:55 AM
To: Nancy Zhang; Aileen Hie
Subject: RE: Results for Registration 134222 71459.03, Moorebank
Attachments: 08102015095430-0001.pdf

Nancy / Aileen

Can we please get the following additional testing done on some of these samples:

TCLP on PAH

JK103a	24	0	7/09/2015	Soil	2.9-3.35
BH222	41	0	9/09/2015	Soil	0.9-1.35
BH209	46	0	9/09/2015	Soil	0.9-1.35
BH207	57	0	10/09/2015	Soil	0.1-0.2

Envirolab Ref: 134222B
Due: 15/10/15
Std T/A.

TCLP on Metals

BH221	38	0	8/09/2015	Soil	2.9-3.35
BH203	54	0	10/09/2015	Soil	2.9-3.35

PO is attached.

Thanks

John Russell | Associate
Douglas Partners Pty Ltd | ABN 75 053 980 117 | www.douglaspartners.com.au
96 Hermitage Road West Ryde NSW 2114 | PO Box 472 West Ryde NSW 1685
P: 02 9809 0666 | F: 02 9809 4095 | M: 0422 000 434 | E: John.Russell@douglaspartners.com.au

This email is confidential. If you are not the intended recipient, please notify us immediately and be aware that any disclosure, copying, distribution or use of the contents of this information is prohibited. Please note that the company does not make any commitment through emails not confirmed by fax or letter.

From: Nancy Zhang [mailto:NZhang@envirolab.com.au]
Sent: Friday, 18 September 2015 6:03 PM
To: John Russell
Subject: Results for Registration 134222 71459.03, Moorebank

Please refer to attached for:
a copy of the Certificate of Analysis
a copy of the Invoice
a copy of the COC
an excel file containing the results

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1531108**	Page	: 1 of 7
Client	: **DOUGLAS PARTNERS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR JOHN RUSSELL	Contact	: Jenny Bevan
Address	: PO BOX 472 96 HERMITAGE ROAD WEST RYDE NSW, AUSTRALIA 1685	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: john.russell@douglaspartners.com.au	E-mail	: jenny.bevan@alsglobal.com
Telephone	: ----	Telephone	: 07 3552 8657
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: 71459.03 MOOREBANK	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 14-Sep-2015 15:20
C-O-C number	: ----	Date Analysis Commenced	: 14-Sep-2015
Sampler	: ----	Issue Date	: 17-Sep-2015 16:11
Site	: ----		
		No. of samples received	: 3
Quote number	: ----	No. of samples analysed	: 3

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Pabi Subba	Senior Organic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Raymond Commodore	Instrument Chemist	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	BD4/100915	BD6/100915	BD7/100915	----	----
			Client sampling date / time	[10-Sep-2015]	[10-Sep-2015]	[10-Sep-2015]	----	----
Compound	CAS Number	LOR	Unit	ES1531108-001	ES1531108-002	ES1531108-003	--------	--------
				Result	Result	Result	Result	Result
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1	%	16.3	18.2	21.9	----	----
EG005T: Total Metals by ICP-AES								
Manganese	7439-96-5	5	mg/kg	254	152	<5	----	----
Arsenic	7440-38-2	5	mg/kg	9	6	10	----	----
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	----	----
Chromium	7440-47-3	2	mg/kg	18	8	30	----	----
Copper	7440-50-8	5	mg/kg	23	15	13	----	----
Lead	7439-92-1	5	mg/kg	25	14	27	----	----
Nickel	7440-02-0	2	mg/kg	6	7	2	----	----
Zinc	7440-66-6	5	mg/kg	35	15	11	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	----	----	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	----	----	----	----
beta-BHC	319-85-7	0.05	mg/kg	<0.05	----	----	----	----
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	----	----	----	----
delta-BHC	319-86-8	0.05	mg/kg	<0.05	----	----	----	----
Heptachlor	76-44-8	0.05	mg/kg	<0.05	----	----	----	----
Aldrin	309-00-2	0.05	mg/kg	<0.05	----	----	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	----	----	----	----
^ Total Chlordane (sum)	----	0.05	mg/kg	<0.05	----	----	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	----	----	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	----	----	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	----	----	----	----
Dieldrin	60-57-1	0.05	mg/kg	<0.05	----	----	----	----
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	----	----	----	----
Endrin	72-20-8	0.05	mg/kg	<0.05	----	----	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	----	----	----	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	----	----	----	----
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	----	----	----	----
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	BD4/100915	BD6/100915	BD7/100915	----	----
				Client sampling date / time	[10-Sep-2015]	[10-Sep-2015]	[10-Sep-2015]	----	----
Compound	CAS Number	LOR	Unit		ES1531108-001	ES1531108-002	ES1531108-003	--------	--------
					Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued									
Endosulfan sulfate	1031-07-8	0.05	mg/kg		<0.05	----	----	----	----
4.4`-DDT	50-29-3	0.2	mg/kg		<0.2	----	----	----	----
Endrin ketone	53494-70-5	0.05	mg/kg		<0.05	----	----	----	----
Methoxychlor	72-43-5	0.2	mg/kg		<0.2	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg		<0.05	----	----	----	----
^ Sum of DDD + DDE + DDT	----	0.05	mg/kg		<0.05	----	----	----	----
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		<0.05	----	----	----	----
Demeton-S-methyl	919-86-8	0.05	mg/kg		<0.05	----	----	----	----
Monocrotophos	6923-22-4	0.2	mg/kg		<0.2	----	----	----	----
Dimethoate	60-51-5	0.05	mg/kg		<0.05	----	----	----	----
Diazinon	333-41-5	0.05	mg/kg		<0.05	----	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		<0.05	----	----	----	----
Parathion-methyl	298-00-0	0.2	mg/kg		<0.2	----	----	----	----
Malathion	121-75-5	0.05	mg/kg		<0.05	----	----	----	----
Fenthion	55-38-9	0.05	mg/kg		<0.05	----	----	----	----
Chlorpyrifos	2921-88-2	0.05	mg/kg		<0.05	----	----	----	----
Parathion	56-38-2	0.2	mg/kg		<0.2	----	----	----	----
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		<0.05	----	----	----	----
Chlorfenvinphos	470-90-6	0.05	mg/kg		<0.05	----	----	----	----
Bromophos-ethyl	4824-78-6	0.05	mg/kg		<0.05	----	----	----	----
Fenamiphos	22224-92-6	0.05	mg/kg		<0.05	----	----	----	----
Prothiofos	34643-46-4	0.05	mg/kg		<0.05	----	----	----	----
Ethion	563-12-2	0.05	mg/kg		<0.05	----	----	----	----
Carbophenothion	786-19-6	0.05	mg/kg		<0.05	----	----	----	----
Azinphos Methyl	86-50-0	0.05	mg/kg		<0.05	----	----	----	----
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	0.5	mg/kg		<0.5	----	----	----	----
2-Chlorophenol	95-57-8	0.5	mg/kg		<0.5	----	----	----	----
2-Methylphenol	95-48-7	0.5	mg/kg		<0.5	----	----	----	----
3- & 4-Methylphenol	1319-77-3	1	mg/kg		<1	----	----	----	----
2-Nitrophenol	88-75-5	0.5	mg/kg		<0.5	----	----	----	----
2.4-Dimethylphenol	105-67-9	0.5	mg/kg		<0.5	----	----	----	----
2.4-Dichlorophenol	120-83-2	0.5	mg/kg		<0.5	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	BD4/100915	BD6/100915	BD7/100915	----	----
				Client sampling date / time	[10-Sep-2015]	[10-Sep-2015]	[10-Sep-2015]	----	----
Compound	CAS Number	LOR	Unit		ES1531108-001	ES1531108-002	ES1531108-003	--------	--------
					Result	Result	Result	Result	Result
EP075(SIM)A: Phenolic Compounds - Continued									
2.6-Dichlorophenol	87-65-0	0.5	mg/kg		<0.5	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg		<0.5	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg		<0.5	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg		<0.5	----	----	----	----
Pentachlorophenol	87-86-5	2	mg/kg		<2	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
Acenaphthylene	208-96-8	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
Acenaphthene	83-32-9	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
Fluorene	86-73-7	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
Phenanthrene	85-01-8	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
Anthracene	120-12-7	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
Fluoranthene	206-44-0	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
Pyrene	129-00-0	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
Benz(a)anthracene	56-55-3	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
Chrysene	218-01-9	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg		<0.5	<0.5	<0.5	----	----
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg		**0.6**	**0.6**	**0.6**	----	----
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg		**1.2**	**1.2**	**1.2**	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<10	----	----	----	----
C10 - C14 Fraction	----	50	mg/kg		<50	----	----	----	----
C15 - C28 Fraction	----	100	mg/kg		<100	----	----	----	----
C29 - C36 Fraction	----	100	mg/kg		<100	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	mg/kg		<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		<10	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	BD4/100915	BD6/100915	BD7/100915	----	----
				Client sampling date / time	[10-Sep-2015]	[10-Sep-2015]	[10-Sep-2015]	----	----
Compound	CAS Number	LOR	Unit		ES1531108-001	ES1531108-002	ES1531108-003	--------	--------
					Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued									
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	10	mg/kg		<10	----	----	----	----
>C10 - C16 Fraction	>C10_C16	50	mg/kg		<50	----	----	----	----
>C16 - C34 Fraction	----	100	mg/kg		<100	----	----	----	----
>C34 - C40 Fraction	----	100	mg/kg		<100	----	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg		<50	----	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	50	mg/kg		<50	----	----	----	----
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	----	----	----	----
Toluene	108-88-3	0.5	mg/kg		<0.5	----	----	----	----
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	----	----	----	----
ortho-Xylene	95-47-6	0.5	mg/kg		<0.5	----	----	----	----
^ **Sum of BTEX**	----	0.2	mg/kg		<0.2	----	----	----	----
^ **Total Xylenes**	1330-20-7	0.5	mg/kg		<0.5	----	----	----	----
Naphthalene	91-20-3	1	mg/kg		<1	----	----	----	----
EP066S: PCB Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%		**77.0**	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		**92.2**	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		**75.2**	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.5	%		**93.2**	**94.8**	**92.8**	----	----
2-Chlorophenol-D4	93951-73-6	0.5	%		**93.5**	**95.0**	**93.1**	----	----
2.4.6-Tribromophenol	118-79-6	0.5	%		**66.9**	**72.8**	**77.9**	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.5	%		**85.2**	**83.5**	**83.5**	----	----
Anthracene-d10	1719-06-8	0.5	%		**116**	**114**	**117**	----	----
4-Terphenyl-d14	1718-51-0	0.5	%		**80.8**	**84.4**	**81.9**	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		**114**	----	----	----	----
Toluene-D8	2037-26-5	0.2	%		**122**	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	BD4/100915	BD6/100915	BD7/100915	----	----
				Client sampling date / time	[10-Sep-2015]	[10-Sep-2015]	[10-Sep-2015]	----	----
Compound	CAS Number	LOR	Unit		ES1531108-001	ES1531108-002	ES1531108-003	--------	--------
					Result	Result	Result	Result	Result
EP080S: TPH(V)/BTEX Surrogates - Continued									
4-Bromofluorobenzene	460-00-4	0.2	%		**127**	----	----	----	----

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **ES1531108**	Page	: 1 of 11
Client	: **DOUGLAS PARTNERS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR JOHN RUSSELL	Contact	: Jenny Bevan
Address	: PO BOX 472 96 HERMITAGE ROAD WEST RYDE NSW, AUSTRALIA 1685	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: john.russell@douglaspartners.com.au	E-mail	: jenny.bevan@alsglobal.com
Telephone	: ----	Telephone	: 07 3552 8657
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: 71459.03 MOOREBANK	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 14-Sep-2015
C-O-C number	: ----	Date Analysis Commenced	: 14-Sep-2015
Sampler	: ----	Issue Date	: 17-Sep-2015
Site	: ----	No. of samples received	: 3
Quote number	: ----	No. of samples analysed	: 3

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out ir compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Pabi Subba	Senior Organic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Raymond Commodore	Instrument Chemist	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA055: Moisture Content (QC Lot: 213199)									
ES1531077-005	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1	%	12.9	12.8	0.00	0% - 50%
EW1511692-003	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1	%	19.8	19.6	1.10	0% - 50%
EA055: Moisture Content (QC Lot: 214352)									
ES1530881-002	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1	%	11.5	11.8	2.55	0% - 50%
ES1531127-005	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1	%	20.6	20.3	1.40	0% - 20%
EG005T: Total Metals by ICP-AES (QC Lot: 213241)									
ES1530957-027	Anonymous	EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	12	7	47.8	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	6	3	52.4	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	14	10	32.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	8	<5	44.5	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	6	<5	25.9	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	26	15	52.7	No Limit
ES1531032-005	Anonymous	EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	14	17	13.5	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	8	10	19.9	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	5	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	12	12	0.00	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	26	30	12.9	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	82	75	9.03	0% - 50%
		EG005T: Zinc	7440-66-6	5	mg/kg	14	18	23.4	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 213242)									
ES1531032-005	Anonymous	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP066: Polychlorinated Biphenyls (PCB) (QC Lot: 215406)									
ES1531108-001	BD4/100915	EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP068A: Organochlorine Pesticides (OC) (QC Lot: 215405)									
ES1531108-001	BD4/100915	EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP068A: Organochlorine Pesticides (OC) (QC Lot: 215405) - continued									
ES1531108-001	BD4/100915	EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
EP068B: Organophosphorus Pesticides (OP) (QC Lot: 215405)									
ES1531108-001	BD4/100915	EP068: Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Bromophos-ethyl	4824-78-6	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Carbophenothion	786-19-6	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Dichlorvos	62-73-7	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Ethion	563-12-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Prothiofos	34643-46-4	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP068: Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP068: Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
EP075(SIM)A: Phenolic Compounds (QC Lot: 215408)									
ES1531108-001	BD4/100915	EP075(SIM): 2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP075(SIM)A: Phenolic Compounds (QC Lot: 215408) - continued									
ES1531108-001	BD4/100915	EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.00	No Limit
		EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	<2	0.00	No Limit
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 215408)									
ES1531108-001	BD4/100915	EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 214548)									
ES1530944-021	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
ES1530944-032	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 215407)									
ES1531108-001	BD4/100915	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 214548)									
ES1530944-021	Anonymous	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
ES1530944-032	Anonymous	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 215407)									
ES1531108-001	BD4/100915	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 215407) - continued									
ES1531108-001	BD4/100915	EP071: >C10 - C16 Fraction	>C10_C16	50	mg/kg	<50	<50	0.00	No Limit
EP080: BTEXN (QC Lot: 214548)									
ES1530944-021	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit
ES1530944-032	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005T: Total Metals by ICP-AES (QCLot: 213241)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	21.7 mg/kg	104	92	130
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	4.64 mg/kg	97.8	87	121
EG005T: Chromium	7440-47-3	2	mg/kg	<2	43.9 mg/kg	80.0	80	136
EG005T: Copper	7440-50-8	5	mg/kg	<5	32 mg/kg	98.4	93	127
EG005T: Lead	7439-92-1	5	mg/kg	<5	40 mg/kg	99.8	86	124
EG005T: Manganese	7439-96-5	5	mg/kg	<5	130 mg/kg	101	97	131
EG005T: Nickel	7440-02-0	2	mg/kg	<2	55 mg/kg	93.1	93	131
EG005T: Zinc	7440-66-6	5	mg/kg	<5	60.8 mg/kg	96.4	81	133
EG035T: Total Recoverable Mercury by FIMS (QCLot: 213242)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	2.57 mg/kg	83.3	70	105
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 215406)								
EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	1 mg/kg	111	57	117
EP068A: Organochlorine Pesticides (OC) (QCLot: 215405)								
EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	0.5 mg/kg	95.1	76	120
EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	0.5 mg/kg	93.9	69	117
EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	0.5 mg/kg	82.2	67	127
EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	0.5 mg/kg	92.3	68	118
EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	0.5 mg/kg	95.2	71	113
EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	0.5 mg/kg	88.6	69	119
EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	0.5 mg/kg	91.0	69	119
EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	0.5 mg/kg	92.7	76	120
EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	0.5 mg/kg	92.8	67	121
EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	0.5 mg/kg	88.2	65	113
EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	0.5 mg/kg	92.7	66	118
EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	0.5 mg/kg	86.8	60	124
EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	0.5 mg/kg	89.3	67	123
EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	0.5 mg/kg	85.6	57	115
EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	0.5 mg/kg	89.4	65	123
EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	0.5 mg/kg	86.6	71	115
EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	0.5 mg/kg	85.2	68	116
EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	0.5 mg/kg	90.1	68	116
EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	0.5 mg/kg	92.0	66	122
EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	0.5 mg/kg	79.4	65	129
EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	0.5 mg/kg	90.4	68	120

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP068B: Organophosphorus Pesticides (OP) (QCLot: 215405)								
EP068: Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	0.5 mg/kg	68.2	42	126
EP068: Bromophos-ethyl	4824-78-6	0.05	mg/kg	<0.05	0.5 mg/kg	90.0	68	116
EP068: Carbophenothion	786-19-6	0.05	mg/kg	<0.05	0.5 mg/kg	88.5	67	123
EP068: Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	0.5 mg/kg	99.8	70	118
EP068: Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	0.5 mg/kg	89.6	68	114
EP068: Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	0.5 mg/kg	88.3	55	119
EP068: Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	0.5 mg/kg	84.9	64	128
EP068: Diazinon	333-41-5	0.05	mg/kg	<0.05	0.5 mg/kg	87.9	73	117
EP068: Dichlorvos	62-73-7	0.05	mg/kg	<0.05	0.5 mg/kg	92.0	56	126
EP068: Dimethoate	60-51-5	0.05	mg/kg	<0.05	0.5 mg/kg	88.2	64	124
EP068: Ethion	563-12-2	0.05	mg/kg	<0.05	0.5 mg/kg	93.1	70	118
EP068: Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	0.5 mg/kg	83.8	64	120
EP068: Fenthion	55-38-9	0.05	mg/kg	<0.05	0.5 mg/kg	91.8	71	115
EP068: Malathion	121-75-5	0.05	mg/kg	<0.05	0.5 mg/kg	85.2	70	120
EP068: Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	0.5 mg/kg	76.0	54	122
EP068: Parathion	56-38-2	0.2	mg/kg	<0.2	0.5 mg/kg	84.8	68	122
EP068: Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	0.5 mg/kg	82.6	69	123
EP068: Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	0.5 mg/kg	90.3	69	115
EP068: Prothiofos	34643-46-4	0.05	mg/kg	<0.05	0.5 mg/kg	92.6	68	116
EP075(SIM)A: Phenolic Compounds (QCLot: 215408)								
EP075(SIM): 2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	6 mg/kg	79.6	69	112
EP075(SIM): 2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	6 mg/kg	81.1	57	111
EP075(SIM): 2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	6 mg/kg	88.7	68	112
EP075(SIM): 2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	6 mg/kg	95.9	69	117
EP075(SIM): 2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	6 mg/kg	96.6	73	117
EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	6 mg/kg	100	74	116
EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	6 mg/kg	98.6	72	116
EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	6 mg/kg	82.2	60	117
EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	12 mg/kg	99.3	69	123
EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	6 mg/kg	87.5	76	114
EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	12 mg/kg	37.0	10	57
EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	6 mg/kg	97.7	74	116
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 215408)								
EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	6 mg/kg	104	79	123
EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	6 mg/kg	101	77	123
EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	6 mg/kg	95.1	79	123
EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	6 mg/kg	90.1	73	121
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	6 mg/kg	97.9	76	122

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 215408) - continued								
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	6 mg/kg	89.7	70	118
EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	6 mg/kg	103	72	114
EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	6 mg/kg	100	77	123
EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	6 mg/kg	90.2	81	123
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	6 mg/kg	100	72	113
EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	6 mg/kg	99.4	79	123
EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	6 mg/kg	104	77	123
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	6 mg/kg	99.9	71	113
EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	6 mg/kg	104	80	124
EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	6 mg/kg	103	79	123
EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	6 mg/kg	104	79	125
EP080/071: Total Petroleum Hydrocarbons (QCLot: 214548)								
EP080: C6 - C9 Fraction	----	10	mg/kg	<10	26 mg/kg	95.7	68	128
EP080/071: Total Petroleum Hydrocarbons (QCLot: 215407)								
EP071: C10 - C14 Fraction	----	50	mg/kg	<50	200 mg/kg	101	71	131
EP071: C15 - C28 Fraction	----	100	mg/kg	<100	300 mg/kg	102	74	138
EP071: C29 - C36 Fraction	----	100	mg/kg	<100	200 mg/kg	99.0	64	128
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 214548)								
EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	31 mg/kg	97.2	68	128
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 215407)								
EP071: >C10 - C16 Fraction	>C10_C16	50	mg/kg	<50	250 mg/kg	103	70	130
EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	350 mg/kg	112	74	138
EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	150 mg/kg	93.1	63	131
EP080: BTEXN (QCLot: 214548)								
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	1 mg/kg	82.0	62	116
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	1 mg/kg	90.3	58	118
EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	2 mg/kg	95.1	60	120
EP080: Naphthalene	91-20-3	1	mg/kg	<1	1 mg/kg	80.8	62	138
EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	1 mg/kg	92.3	60	120
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	1 mg/kg	92.9	62	128

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Matrix Spike (MS) Report

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005T: Total Metals by ICP-AES (QCLot: 213241)							
ES1531032-001	Anonymous	EG005T: Arsenic	7440-38-2	50 mg/kg	84.2	70	130
		EG005T: Cadmium	7440-43-9	50 mg/kg	95.9	70	130
		EG005T: Chromium	7440-47-3	50 mg/kg	85.4	70	130
		EG005T: Copper	7440-50-8	250 mg/kg	94.5	70	130
		EG005T: Lead	7439-92-1	250 mg/kg	91.0	70	130
		EG005T: Nickel	7440-02-0	50 mg/kg	93.0	70	130
		EG005T: Zinc	7440-66-6	250 mg/kg	87.3	70	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 213242)							
ES1531032-005	Anonymous	EG035T: Mercury	7439-97-6	5 mg/kg	109	70	130
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 215406)							
ES1531108-001	BD4/100915	EP066: Total Polychlorinated biphenyls	----	1 mg/kg	96.0	70	130
EP068A: Organochlorine Pesticides (OC) (QCLot: 215405)							
ES1531108-001	BD4/100915	EP068: 4.4`-DDT	50-29-3	2 mg/kg	96.7	70	130
		EP068: Aldrin	309-00-2	0.5 mg/kg	94.8	70	130
		EP068: Dieldrin	60-57-1	0.5 mg/kg	78.3	70	130
		EP068: Endrin	72-20-8	2 mg/kg	90.3	70	130
		EP068: gamma-BHC	58-89-9	0.5 mg/kg	86.1	70	130
		EP068: Heptachlor	76-44-8	0.5 mg/kg	76.6	70	130
EP068B: Organophosphorus Pesticides (OP) (QCLot: 215405)							
ES1531108-001	BD4/100915	EP068: Bromophos-ethyl	4824-78-6	0.5 mg/kg	86.1	70	130
		EP068: Chlorpyrifos-methyl	5598-13-0	0.5 mg/kg	97.5	70	130
		EP068: Diazinon	333-41-5	0.5 mg/kg	78.0	70	130
		EP068: Pirimphos-ethyl	23505-41-1	0.5 mg/kg	87.2	70	130
		EP068: Prothiofos	34643-46-4	0.5 mg/kg	74.8	70	130
EP075(SIM)A: Phenolic Compounds (QCLot: 215408)							
ES1531108-001	BD4/100915	EP075(SIM): 2-Chlorophenol	95-57-8	10 mg/kg	106	70	130
		EP075(SIM): 2-Nitrophenol	88-75-5	10 mg/kg	77.5	60	130
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	10 mg/kg	84.5	70	130
		EP075(SIM): Pentachlorophenol	87-86-5	10 mg/kg	88.4	20	130
		EP075(SIM): Phenol	108-95-2	10 mg/kg	106	70	130
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 215408)							
ES1531108-001	BD4/100915	EP075(SIM): Acenaphthene	83-32-9	10 mg/kg	97.9	70	130
		EP075(SIM): Pyrene	129-00-0	10 mg/kg	115	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 214548)							
ES1530944-021	Anonymous	EP080: C6 - C9 Fraction	----	32.5 mg/kg	104	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 215407)							

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EP080/071: Total Petroleum Hydrocarbons (QCLot: 215407) - continued							
ES1531108-001	BD4/100915	EP071: C10 - C14 Fraction	----	523 mg/kg	104	73	137
		EP071: C15 - C28 Fraction	----	2319 mg/kg	104	53	131
		EP071: C29 - C36 Fraction	----	1714 mg/kg	124	52	132
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 214548)							
ES1530944-021	Anonymous	EP080: C6 - C10 Fraction	C6_C10	37.5 mg/kg	105	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 215407)							
ES1531108-001	BD4/100915	EP071: >C10 - C16 Fraction	>C10_C16	860 mg/kg	93.5	73	137
		EP071: >C16 - C34 Fraction	----	3223 mg/kg	117	53	131
		EP071: >C34 - C40 Fraction	----	1058 mg/kg	112	52	132
EP080: BTEXN (QCLot: 214548)							
ES1530944-021	Anonymous	EP080: Benzene	71-43-2	2.5 mg/kg	91.1	70	130
		EP080: Ethylbenzene	100-41-4	2.5 mg/kg	108	70	130
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2.5 mg/kg	111	70	130
		EP080: Naphthalene	91-20-3	2.5 mg/kg	88.4	70	130
		EP080: ortho-Xylene	95-47-6	2.5 mg/kg	112	70	130
		EP080: Toluene	108-88-3	2.5 mg/kg	103	70	130

ALS Environmental

QA/QC Compliance Assessment for DQO Reporting

Work Order	: **ES1531108**	Page	: 1 of 4
Client	: **DOUGLAS PARTNERS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR JOHN RUSSELL	Telephone	: 07 3552 8657
Project	: 71459.03 MOOREBANK	Date Samples Received	: 14-Sep-2015
Site	: ----	Issue Date	: 17-Sep-2015
Sampler	: ----	No. of samples received	: 3
Order number	: ----	No. of samples analysed	: 3

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content							
Soil Glass Jar - Unpreserved (EA055-103) BD4/100915, BD6/100915	**10-Sep-2015**	**----**	----	----	**14-Sep-2015**	24-Sep-2015	✓
Soil Glass Jar - Unpreserved (EA055-103) BD7/100915	**10-Sep-2015**	**----**	----	----	**15-Sep-2015**	24-Sep-2015	✓
EG005T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T) BD4/100915, BD6/100915, BD7/100915	**10-Sep-2015**	**14-Sep-2015**	08-Mar-2016	✓	**15-Sep-2015**	08-Mar-2016	✓
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T) BD4/100915, BD6/100915, BD7/100915	**10-Sep-2015**	**14-Sep-2015**	08-Oct-2015	✓	**15-Sep-2015**	08-Oct-2015	✓
EP066: Polychlorinated Biphenyls (PCB)							
Soil Glass Jar - Unpreserved (EP066) BD4/100915	**10-Sep-2015**	**16-Sep-2015**	24-Sep-2015	✓	**16-Sep-2015**	26-Oct-2015	✓
EP068A: Organochlorine Pesticides (OC)							
Soil Glass Jar - Unpreserved (EP068) BD4/100915	**10-Sep-2015**	**16-Sep-2015**	24-Sep-2015	✓	**16-Sep-2015**	26-Oct-2015	✓
EP080/071: Total Petroleum Hydrocarbons							
Soil Glass Jar - Unpreserved (EP071) BD4/100915	**10-Sep-2015**	**16-Sep-2015**	24-Sep-2015	✓	**17-Sep-2015**	26-Oct-2015	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Soil Glass Jar - Unpreserved (EP075(SIM)) BD4/100915, BD6/100915, BD7/100915	**10-Sep-2015**	**16-Sep-2015**	24-Sep-2015	✓	**17-Sep-2015**	26-Oct-2015	✓
EP080/071: Total Petroleum Hydrocarbons							
Soil Glass Jar - Unpreserved (EP080) BD4/100915	**10-Sep-2015**	**16-Sep-2015**	24-Sep-2015	✓	**16-Sep-2015**	24-Sep-2015	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Moisture Content	EA055-103	2	20	**10.00**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (SIM)	EP075(SIM)	1	8	**12.50**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Pesticides by GCMS	EP068	1	9	**11.11**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Polychlorinated Biphenyls (PCB)	EP066	1	9	**11.11**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS	EG035T	1	9	**11.11**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	2	12	**16.67**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	1	8	**12.50**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	2	18	**11.11**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
PAH/Phenols (SIM)	EP075(SIM)	1	8	**12.50**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Pesticides by GCMS	EP068	1	9	**11.11**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Polychlorinated Biphenyls (PCB)	EP066	1	9	**11.11**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS	EG035T	1	9	**11.11**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	1	12	**8.33**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	1	8	**12.50**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	1	18	**5.56**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
PAH/Phenols (SIM)	EP075(SIM)	1	8	**12.50**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Pesticides by GCMS	EP068	1	9	**11.11**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Polychlorinated Biphenyls (PCB)	EP066	1	9	**11.11**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS	EG035T	1	9	**11.11**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	1	12	**8.33**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	1	8	**12.50**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	1	18	**5.56**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
PAH/Phenols (SIM)	EP075(SIM)	1	8	**12.50**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Pesticides by GCMS	EP068	1	9	**11.11**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Polychlorinated Biphenyls (PCB)	EP066	1	9	**11.11**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS	EG035T	1	9	**11.11**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	1	12	**8.33**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	1	8	**12.50**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	1	18	**5.56**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Moisture Content	EA055-103	SOIL	In-house. A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Polychlorinated Biphenyls (PCB)	EP066	SOIL	(USEPA SW 846 - 8270B) Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3) (Method 504)
Pesticides by GCMS	EP068	SOIL	(USEPA SW 846 - 8270B) Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM (2013) Schedule B(3) (Method 504,505)
TRH - Semivolatile Fraction	EP071	SOIL	(USEPA SW 846 - 8015A) Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C40.
PAH/Phenols (SIM)	EP075(SIM)	SOIL	(USEPA SW 846 - 8270B) Extracts are analysed by Capillary GC/MS in Selective Ion Mode (SIM) and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3) (Method 502 and 507)
TRH Volatiles/BTEX	EP080	SOIL	(USEPA SW 846 - 8260B) Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve.

Preparation Methods	Method	Matrix	Method Descriptions
Methanolic Extraction of Soils for Purge and Trap	* ORG16	SOIL	(USEPA SW 846 - 5030A) 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids	ORG17	SOIL	In-house, Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.

CHAIN OF CUSTODY

Douglas Partners
Geotechnics / Environment / Groundwater

Client: Douglas Partners	**Project Number** 71459.03	**To:**	Envirolab Services
Contact Person: Chris Bagia	**Project Name:** Moorebank	**Contact Person:**	Aileen Hie
Project Mgr: John Russell	**PO No.:**	**Address:**	12 Ashley Street
	lab Quote No. :		Chatswood NSW 2068
Address: 96 Hermitage Road	**Date results required:** 17/09/15 (for 14 day holding time)	**Phone:**	02 9910 6200
West Ryde NSW 2114	**Or choose:** standard	**Fax:**	02 9910 6201
	Note: Inform lab in advance if urgent turnaround is required - surcharges apply	**Email:**	ahie@envirolab.com.au
Phone: 9809 0666 **Mob:** 0422 000 434	**Report format:** esdat / PDF / Excel	**Laboratory Report No:**	
Email: john.russell@douglaspartners.com.au	**Comments:**	**Lab Comments:**	

Sample information						Tests Required											Comments
Lab Sample ID	Field Sample ID	Depth	Date sampled	Container Type	Type of sample	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn, Mn	TRH	BTEX	PAH	OCP	OPP	PCB	Phenols	pH / CEC		Combo	Provide as much information about the sample as you can
	BH203	0.1-0.2	10/09/2015	g	s	X	X	X	X	X	X	X	X	X		8 (+Mn)	
	BH203	0.9-1.35	10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
	BH203	2.9-3.35	10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
	BH201	0.1-0.2	10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
	BH201	0.9-1.35	10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
	BH207	0.1-0.2	10/09/2015	g	s	X	X	X	X	X	X	X	X	X		8 (+Mn)	
	BH207	0.9-1.35	10/09/2015	g	s	X			X								
	BH206	0.1-0.2	10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
	BH206	0.9-1.35	10/09/2015	g	s	X			X								
	BH206	2.9-2.35	10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
	BH206	4.9-4.35	10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
	BH208	0.9-1.35	10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
	BH208	3.9-4.35	10/09/2015	g	s	X			X								
	BD1/070815		7/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
	BD2/080915		8/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
	BD3/090915		9/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	
1 –	BD4/100915		10/09/2015	g	s	X	X	X	X	X	X	X	X			8 (+Mn)	Please send to ALS
	BD5/100915		10/09/2015	g	s	X			X								
2 –	BD6/100915		10/09/2015	g	s	X			X								Please send to ALS
3 –	BD7/100915		10/09/2015	g	s	X			X								Please send to ALS
	TS1	prepared on	1/09/2015				X	X									
	TB1	prepared on	1/09/2015				X	X									
	TS2	prepared on	1/09/2015				X	X									
	TB2	prepared on	1/09/2015				X	X									
	TS3	prepared on	1/09/2015				X	X									
	TB3	prepared on	1/09/2015				X	X									

Relinquished by: Douglas Partners	**Sample Receipt**	***Lab use only:***
Courier (by whom) HUNTER EXPRESS	**Received by (Company):** ALS	**Samples Received: Cool or Ambient (circle one)**
Condition of Sample at dispatch Cool or Ambient (circle)	**Print Name:** Ron	**Temperature Received at:** (if applicable)
Temperature (if Applicable):	**Date & Time:** 14-9-15 15:20	**Transported by: Hand delivered / courier**
Print Name: John Russell	**Signature:**	
Date & Time 11/09/15; 3pm		13.4 222.
Signature:		

Relinquished by: PT(ELS) 14/9/15 12:00

FAIL

Environmental Division
Sydney
Work Order Reference
ES1531108

Telephone : +61-2-8784 8555

12 Ashley Street, Chatswood, NSW 2067
tel: +61 2 9910 6200

email: sydney@envirolab.com.au
envirolab.com.au

Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 136637

Client:
Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: John Russell

Sample log in details:

Your Reference:	**Moorebank**
No. of samples:	4 suma canisters
Date samples received / completed instructions received	29/10/15 / 29/10/15

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	5/11/15 / 5/11/15
Date of Preliminary Report:	Not Issued

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Jacinta Hurst
Laboratory Manager

TO15 in Canisters + ug/m3 calc Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	136637-1 JK101 27/10/2015 AIR	136637-2 JK107B 27/10/2015 AIR	136637-3 BH/MW216 27/10/2015 AIR	136637-4 BD1 27/10/2015 AIR
Vacuum before Shipment	Hg"	-30	-30	-30	-30
Vacuum before Analysis	Hg"	-4	-5	-4	-4
Date prepared	-	04/11/2015	04/11/2015	04/11/2015	04/11/2015
Date analysed	-	04/11/2015	04/11/2015	04/11/2015	04/11/2015
Propylene	ppbv	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane	ppbv	4	25	43	46
Chloromethane	ppbv	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorotetrafluoroethane	ppbv	<0.5	<0.5	<0.5	<0.5
Vinyl chloride	ppbv	<0.5	<0.5	<0.5	<0.5
1,3-Butadiene	ppbv	<0.5	<0.5	<0.5	<0.5
Bromomethane	ppbv	<0.5	<0.5	<0.5	<0.5
Chloroethane	ppbv	<0.5	1	1	2
Ethanol	ppbv	12	9.0	9.7	10
Acrolein	ppbv	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane (Freon 11)	ppbv	<0.5	<0.5	<0.5	<0.5
Isopropyl Alcohol	ppbv	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene	ppbv	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichlorotrifluoroethane	ppbv	<0.5	<0.5	<0.5	<0.5
Carbon Disulfide	ppbv	2	0.7	<0.5	<0.5
trans-1,2-dichloroethene	ppbv	<0.5	<0.5	<0.5	<0.5
MTBE	ppbv	<0.5	<0.5	<0.5	<0.5
1,1- Dichloroethane	ppbv	<0.5	<0.5	<0.5	<0.5
Vinyl Acetate	ppbv	<0.5	<0.5	<0.5	<0.5
MEK	ppbv	<0.5	<0.5	<0.5	<0.5
Hexane	ppbv	28	11	13	15
cis-1,2-Dichloroethene	ppbv	<0.5	<0.5	2	2
Ethyl Acetate	ppbv	<0.5	<0.5	<0.5	<0.5
Chloroform	ppbv	<0.5	<0.5	<0.5	<0.5
Tetrahydrofuran	ppbv	<0.5	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	ppbv	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethane	ppbv	<0.5	<0.5	<0.5	<0.5
Benzene	ppbv	1	2	1	2
Carbon tetrachloride	ppbv	<0.5	<0.5	<0.5	<0.5
Cyclohexane	ppbv	33	40	26	29
Heptane	ppbv	7.5	3	1	1
Trichloroethene	ppbv	<0.5	<0.5	0.9	<0.5
1,2-Dichloropropane	ppbv	<0.5	<0.5	<0.5	<0.5
1,4-Dioxane	ppbv	<0.5	<0.5	<0.5	<0.5
Bromodichloromethane	ppbv	<0.5	<0.5	<0.5	<0.5
Methyl Methacrylate	ppbv	<0.5	<0.5	<0.5	<0.5
MIBK	ppbv	<0.5	<0.5	<0.5	<0.5
cis-1,3-Dichloropropene	ppbv	<0.5	<0.5	<0.5	<0.5

TO15 in Canisters + ug/m3 calc Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	136637-1 JK101 27/10/2015 AIR	136637-2 JK107B 27/10/2015 AIR	136637-3 BH/MW216 27/10/2015 AIR	136637-4 BD1 27/10/2015 AIR
trans-1,3-Dichloropropene	ppbv	<0.5	<0.5	<0.5	<0.5
Toluene	ppbv	2	2	2	2
1,1,2-Trichloroethane	ppbv	<0.5	<0.5	<0.5	<0.5
Methyl Butyl Ketone	ppbv	<0.5	<0.5	<0.5	<0.5
Dibromochloromethane	ppbv	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	ppbv	<0.5	<0.5	<0.5	<0.5
1,2-Dibromoethane	ppbv	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	ppbv	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	ppbv	1	1	2	2
m-& *p*-Xylene	ppbv	2	2	2	2
Styrene	ppbv	<0.5	10	3	4
o-Xylene	ppbv	0.8	0.9	0.8	0.7
Bromoform	ppbv	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	ppbv	<0.5	<0.5	<0.5	<0.5
4-ethyl toluene	ppbv	<0.5	<0.5	<0.5	<0.5
1,3,5-Trimethylbenzene	ppbv	<0.5	<0.5	<0.5	<0.5
1,2,4-Trimethylbenzene	ppbv	1	0.9	1	0.9
1,3-Dichlorobenzene	ppbv	<0.5	<0.5	<0.5	<0.5
Benzyl chloride	ppbv	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	ppbv	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	ppbv	<0.5	<0.5	<0.5	<0.5
1,2,4-Trichlorobenzene	ppbv	<0.5	<0.5	<0.5	<0.5
Naphthalene	ppbv	3	2	1	0.8
Hexachloro- 1,3-butadiene	ppbv	<0.5	<0.5	<0.5	<0.5
Surrogate-Bromochloromethane	% rec	100	103	98	99
Surrogate-1,4-Difluorobenzene	% rec	104	105	96	99
Surrogate-Chlorobenzene-D5	% rec	105	103	99	98
Propylene	µg/m^3	<0.9	<0.9	<0.9	<0.9
Dichlorodifluoromethane	µg/m^3	20	120	210	230
Chloromethane	µg/m^3	<1	<1	<1	<1
1,2-Dichlorotetrafluoroethane	µg/m^3	<2	<2	<2	<2
Vinyl chloride	µg/m^3	<1	<1	<1	<1
1,3-Butadiene	µg/m^3	<1	<1	<1	<1
Bromomethane	µg/m^3	<2	<2	<2	<2
Chloroethane	µg/m^3	<1	4	3	4
Ethanol	µg/m^3	22	17	18	19
Acrolein	µg/m^3	<1	<1	<1	<1
Trichlorofluoromethane	µg/m^3	<3	<3	<3	<3
Isopropyl Alcohol	µg/m^3	<1	<1	<1	<1
1,1-Dichloroethene	µg/m^3	<2	<2	<2	<2
1,1,2-Trichlorotrifluoroethane	µg/m^3	<4	<4	<4	<4
Carbon Disulfide	µg/m^3	6	2	<2	<2
trans-1,2-dichloroethene	µg/m^3	<2	<2	<2	<2

TO15 in Canisters + ug/m3 calc Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	136637-1 JK101 27/10/2015 AIR	136637-2 JK107B 27/10/2015 AIR	136637-3 BH/MW216 27/10/2015 AIR	136637-4 BD1 27/10/2015 AIR
MTBE	µg/m^3	<2	<2	<2	<2
1,1-Dichloroethane	µg/m^3	<2	<2	<2	<2
Vinyl Acetate	µg/m^3	<2	<2	<2	<2
MEK	µg/m^3	<1	<1	<1	<1
Hexane	µg/m^3	100	38	47	53
cis-1,2-Dichloroethene	µg/m^3	<2	<2	6	7
Ethyl Acetate	µg/m^3	<2	<2	<2	<2
Chloroform	µg/m^3	<2	<2	<2	<2
Tetrahydrofuran	µg/m^3	<1	<1	<1	<1
1,1,1-Trichloroethane	µg/m^3	<3	<3	<3	<3
1,2-Dichloroethane	µg/m^3	<2	<2	<2	<2
Benzene	µg/m^3	4	8	5	6
Carbon tetrachloride	µg/m^3	<3	<3	<3	<3
Cyclohexane	µg/m^3	110	130	88	98
Heptane	µg/m^3	30	10	4	5
Trichloroethene	µg/m^3	<3	<3	5	<3
1,2-Dichloropropane	µg/m^3	<2	<2	<2	<2
1,4-Dioxane	µg/m^3	<2	<2	<2	<2
Bromodichloromethane	µg/m^3	<3	<3	<3	<3
Methyl Methacrylate	µg/m^3	<2	<2	<2	<2
MIBK	µg/m^3	<2	<2	<2	<2
cis-1,3-Dichloropropene	µg/m^3	<2	<2	<2	<2
trans-1,3-Dichloropropene	µg/m^3	<2	<2	<2	<2
Toluene	µg/m^3	9	8	9	8
1,1,2-Trichloroethane	µg/m^3	<3	<3	<3	<3
Methyl Butyl Ketone	µg/m^3	<2	<2	<2	<2
Dibromochloromethane	µg/m^3	<2	<2	<2	<2
Tetrachloroethene	µg/m^3	<3	<3	<3	<3
1,2-Dibromoethane	µg/m^3	<4	<4	<4	<4
Chlorobenzene	µg/m^3	<2	<2	<2	<2
Ethylbenzene	µg/m^3	5	6	7	7
m-& *p*-Xylene	µg/m^3	10	10	10	9
Styrene	µg/m^3	<2	43	10	10
o-Xylene	µg/m^3	4	4	4	3
Bromoform	µg/m^3	<5	<5	<5	<5
1,1,2,2-Tetrachloroethane	µg/m^3	<3	<3	<3	<3
4-ethyl toluene	µg/m^3	<2	<2	<2	<2
1,3,5-Trimethylbenzene	µg/m^3	<2	<2	<2	<2
1,2,4-Trimethylbenzene	µg/m^3	6	5	5	5
1,3-Dichlorobenzene	µg/m^3	<3	<3	<3	<3
Benzyl chloride	µg/m^3	<3	<3	<3	<3
1,4-Dichlorobenzene	µg/m^3	<3	<3	<3	<3
1,2-Dichlorobenzene	µg/m^3	<3	<3	<3	<3

TO15 in Canisters + ug/m3 calc Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ---------- 	136637-1 JK101 27/10/2015 AIR	136637-2 JK107B 27/10/2015 AIR	136637-3 BH/MW216 27/10/2015 AIR	136637-4 BD1 27/10/2015 AIR
1,2,4-Trichlorobenzene	µg/m^3	<4	<4	<4	<4
Naphthalene	µg/m^3	10	10	7	4
Hexachloro-1,3-butadiene	µg/m^3	<5	<5	<5	<5

Method ID	Methodology Summary
TO15	USEPA TO15 - Analysis of VOC's in air following USEPA TO15 protocols

QUALITY CONTROL TO15 in Canisters + ug/m3 calc	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Vacuum before Shipment	Hg"			[NT]	136637-3	-30 || -30 || RPD: 0	[NR]	[NR]
Vacuum before Analysis	Hg"			[NT]	136637-3	-4 || -4 || RPD: 0	[NR]	[NR]
Date prepared	-			04/11/2015	136637-3	04/11/2015 || 04/11/2015	LCS-1	04/11/2015
Date analysed	-			04/11/2015	136637-3	04/11/2015 || 04/11/2015	LCS-1	04/11/2015
Propylene	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	LCS-1	99%
Dichlorodifluoromethane	ppbv	0.5	TO15	<0.5	136637-3	43 || 42 || RPD: 2	[NR]	[NR]
Chloromethane	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
1,2-Dichlorotetrafluoroethane	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Vinyl chloride	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
1,3-Butadiene	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Bromomethane	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Chloroethane	ppbv	0.5	TO15	<0.5	136637-3	1 || 2 || RPD: 67	[NR]	[NR]
Ethanol	ppbv	0.5	TO15	<0.5	136637-3	9.7 || 9.9 || RPD: 2	[NR]	[NR]
Acrolein	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Trichlorofluoromethane (Freon 11)	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Isopropyl Alcohol	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
1,1-Dichloroethene	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
1,1,2-Trichlorotrifluoroethane	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Carbon Disulfide	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
trans-1,2-dichloroethene	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
MTBE	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
1,1-Dichloroethane	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Vinyl Acetate	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
MEK	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Hexane	ppbv	0.5	TO15	<0.5	136637-3	13 || 13 || RPD: 0	LCS-1	88%
cis-1,2-Dichloroethene	ppbv	0.5	TO15	<0.5	136637-3	2 || 2 || RPD: 0	[NR]	[NR]
Ethyl Acetate	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Chloroform	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Tetrahydrofuran	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
1,1,1-Trichloroethane	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
1,2-Dichloroethane	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Benzene	ppbv	0.5	TO15	<0.5	136637-3	1 || 2 || RPD: 67	LCS-1	95%
Carbon tetrachloride	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Cyclohexane	ppbv	0.5	TO15	<0.5	136637-3	26 || 26 || RPD: 0	LCS-1	99%
Heptane	ppbv	0.5	TO15	<0.5	136637-3	1 || 1 || RPD: 0	LCS-1	98%
Trichloroethene	ppbv	0.5	TO15	<0.5	136637-3	0.9 || 0.8 || RPD: 12	[NR]	[NR]
1,2-Dichloropropane	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
1,4-Dioxane	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Bromodichloromethane	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Methyl Methacrylate	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]

Client Reference: Moorebank

QUALITY CONTROL TO15 in Canisters + ug/m3 calc	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
MIBK	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
cis-1,3-Dichloropropene	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
trans-1,3-Dichloropropene	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Toluene	ppbv	0.5	TO15	<0.5	136637-3	2 || 2 || RPD: 0	LCS-1	101%
1,1,2-Trichloroethane	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Methyl Butyl Ketone	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Dibromochloromethane	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Tetrachloroethene	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
1,2-Dibromoethane	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Chlorobenzene	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Ethylbenzene	ppbv	0.5	TO15	<0.5	136637-3	2 || 2 || RPD: 0	LCS-1	104%
m-& *p*-Xylene	ppbv	1	TO15	<1	136637-3	2 || 2 || RPD: 0	LCS-1	102%
Styrene	ppbv	0.5	TO15	<0.5	136637-3	3 || 3 || RPD: 0	LCS-1	104%
o-Xylene	ppbv	0.5	TO15	<0.5	136637-3	0.8 || 0.8 || RPD: 0	LCS-1	106%
Bromoform	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
1,1,2,2-Tetrachloroethane	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
4-ethyl toluene	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	LCS-1	109%
1,3,5-Trimethylbenzene	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	LCS-1	99%
1,2,4-Trimethylbenzene	ppbv	0.5	TO15	<0.5	136637-3	1 || 0.9 || RPD: 11	LCS-1	107%
1,3-Dichlorobenzene	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Benzyl chloride	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
1,4-Dichlorobenzene	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
1,2-Dichlorobenzene	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
1,2,4-Trichlorobenzene	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Naphthalene	ppbv	0.5	TO15	<0.5	136637-3	1 || 1 || RPD: 0	[NR]	[NR]
Hexachloro- 1,3-butadiene	ppbv	0.5	TO15	<0.5	136637-3	<0.5 || <0.5	[NR]	[NR]
Surrogate-Bromochloromethane	% rec		TO15	102	136637-3	98 || 103 || RPD: 5	LCS-1	106%
Surrogate-1,4-Difluorobenzene	% rec		TO15	101	136637-3	96 || 106 || RPD: 10	LCS-1	112%
Surrogate-Chlorobenzene-D5	% rec		TO15	104	136637-3	99 || 103 || RPD: 4	LCS-1	108%

Report Comments:

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NR: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

CANISTER CHAIN OF CUSTODY RECORD

Page 1 of 1

Client Name	Douglas Partners	Project Contact	John Russell	Quote No	
Client Address	Moorebank	Contact Phone No / Contact Mobile No	0422 000 434	Date Results Required	1 day / 2 days / 3 days / Standard
Project Name		Results Required by	standard	E-mail Report To	John Russell
Site Location	Moorebank	Sampled by	RL	PO No	123602

	Client sample ID (Field location)	Canister #	Soil gas train / Mass flow controller #	Leak Test Passed	PID Reading (ppmv)	Date of Collection	Collection Time		Canister vacuum (Hg")		Analysis requested							
							Time on	Time off	Initial	Final	TO-15	TPH	5-Sulfides	Ozone precursors	RGA gases			
1)	JK101	2276	635			27/10/15	11:22	11:24	-28	-5	✓							
2)	JK107b	2275	1538			27/10/15	10:02	10:04	-28	-5	✓							
3)	BH/MW 216	1879	1541			27/10/15	10:28	10:30	-28	-5	✓							
4)	BD1	2240	1549			27/10/15	—	—	-28	-5	✓							

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 136637

Date Received: 29/10/15
Time Received: 17:00
Received by: PT
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Relinquished by	JRR	Date & Time	29/10/15	Received by	Lab	Date & Time	29/10/15	Notes:
Print Name		Signature		Print Name		Signature	17:00	
				PT	ELS			

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

Canister Sampling Field Test Data Sheet and Custody Record

General Information (where applicable)

Company: Douglas Partners Project Contact: John Russell

Project Name: Canister Serial No: 2276

Site Location: Moore Park Restrictor Serial No.: 635

Site Address: Sampling Date: 27/10/15

Canister Leak check Date: 23/10/2015 Cleaned/certified Date: 25/9/15

Canister Sampling Details

SK101

Sample ID SK 101	Before shipment (determined in lab with certified gauge)	Before sampling in Field (from canister gauge)	After sampling in Field (from canister gauge)	After receipt (determined in lab with certified gauge)
Vacuum (-"Hg)	-29.75 Hg "	-28	-5	
Passive Flow Leak Check		n/a	n/a	n/a
Date/Time/Initial/	23/10/2015	27/10/15	27/10/15	
	Temperature (°C)	Humidity (%)	Weather Conditions	
Start	16.5	68	Overcast	
Stop				
Date/Time	27/10/15			
Initial				

	Sampling Times		Flow Rates (mL/min)	
	Time	Elapsed Time	Restrictor Flow Rate before shipping	Restrictor Flow Rate on sample receipt
Start	11:22	2 min		-----
Stop	11:24		----	
Date/Time	27/10/15		----	
Initial				

Canister Pressurised to PSI with Helium / Nitrogen PLEASE CIRCLE **on receipt**

Canister and Sample Gauge Details

	Relinquished Date/Initial (lab)	Received by Date/Time (sampler)	Relinquished Date/Initial (sampler)	Received by Date/Initial (lab)
Canister	23/10/2015	23/10/15	29/10	
Sample Restrictor	-----			

(customers please complete shaded areas for each canister)

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

Canister Sampling Field Test Data Sheet and Custody Record

General Information(where applicable)

Company: Douglas Partners Project Contact: John Russell
Project Name: Canister Serial No: 2275
Site Location: Moorebank Restrictor Serial No.: 1538
Site Address: Sampling Date: 27/10/15
Canister Leak check Date: 23/10/2015 Cleaned/certified Date: 20/10/15

Canister Sampling Details

JK107B

Sample ID JK107b	Before shipment (determined in lab with certified gauge)	Before sampling in Field (from canister gauge)	After sampling in Field (from canister gauge)	After receipt (determined in lab with certified gauge)
Vacuum (-"Hg)	-29.74Hg"	~~-24~~ -28	-05	
Passive Flow Leak Check		n/a	n/a	n/a
Date/Time/Initial/	23/10/2015 #	27/10/15	27/10/15	
	Temperature (°C)	Humidity (%)	Weather Conditions	
Start	16.6	64	Overcast	
Stop	16.6	64		
Date/Time	27/10/15	10.04		
Initial				

	Sampling Times		Flow Rates (mL/min)	
	Time	Elapsed Time	Restrictor Flow Rate before shipping	Restrictor Flow Rate on sample receipt
Start	10.02	2min	344	-----
Stop	10.04		----	
Date/Time	27/10/15		----	
Initial				

Canister Pressurised to _____ PSI with Helium / Nitrogen PLEASE CIRCLE **on receipt**

Canister and Sample Gauge Details

	Relinquished Date/Initial(lab)	Received by Date/Time(sampler)	Relinquished Date/Initial(sampler)	Received by Date/Initial(lab)
Canister	23/10/2015 #	23/10/15	29/10	
Sample Restrictor	-----			

(customers please complete shaded areas for each canister)

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

Canister Sampling Field Test Data Sheet and Custody Record

General Information (where applicable)

Company: Douglas Partners Project Contact: John Russell

Project Name: Canister Serial No: 1879

Site Location: Moorebank Restrictor Serial No.: 1541

Site Address: Sampling Date: 27/10/15

Canister Leak check Date: 23/10/2015 Cleaned/certified Date: 25/9/15

Canister Sampling Details

BH216

Sample ID BH/MW216	Before shipment (determined in lab with certified gauge)	Before sampling in Field (from canister gauge)	After sampling in Field (from canister gauge)	After receipt (determined in lab with certified gauge)
Vacuum (-"Hg)	-29.73 Hg"	~~-25~~ -28	-5	
Passive Flow Leak Check		n/a	n/a	n/a
Date/Time/Initial/	23/10/2015			

	Temperature (°C)	Humidity (%)	Weather Conditions
Start	16.9	65	Overcast
Stop	16.9	65	
Date/Time	27/10/15		
Initial			

	Sampling Times		Flow Rates (mL/min)	
	Time	Elapsed Time	Restrictor Flow Rate before shipping	Restrictor Flow Rate on sample receipt
Start	10.28			-----
Stop	10.30	2 min	----	
Date/Time	27/10/15		----	
Initial				

Canister Pressurised to _____ PSI with Helium / Nitrogen PLEASE CIRCLE **on receipt**

Canister and Sample Gauge Details

	Relinquished Date/Initial (lab)	Received by Date/Time (sampler)	Relinquished Date/Initial (sampler)	Received by Date/Initial (lab)
Canister	23/10/2015	23/10/15	29/10	
Sample Restrictor	-----			

(customers please complete shaded areas for each canister)

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

Canister Sampling Field Test Data Sheet and Custody Record

General Information (where applicable)

Company: Douglas Partners Project Contact: John Russell
Project Name: Canister Serial No: 2240
Site Location: Moorebank Restrictor Serial No.: 1549
Site Address: Sampling Date: 27/10/15
Canister Leak check Date: 23/10/2015 Cleaned/certified Date: 25/9/15

Canister Sampling Details

BDI - 1879

Sample ID BDI	Before shipment (determined in lab with certified gauge)	Before sampling in Field (from canister gauge)	After sampling in Field (from canister gauge)	After receipt (determined in lab with certified gauge)
Vacuum (-"Hg)	-29.74Hg"	-28	-5	
Passive Flow Leak Check		n/a	n/a	n/a
Date/Time/Initial/	23/10/2015 ✓			
	Temperature (°C)	Humidity (%)	Weather Conditions	
Start	16.4	65	Overcast	
Stop	16.9	65		
Date/Time	27/10/15			
Initial	✓			

	Sampling Times		Flow Rates (mL/min)	
	Time	Elapsed Time	Restrictor Flow Rate before shipping	Restrictor Flow Rate on sample receipt
Start	10.28	2min		-----
Stop	10.30		----	
Date/Time	27/10/15		----	
Initial	✓			

Canister Pressurised to _____ PSI with Helium / Nitrogen PLEASE CIRCLE **on receipt**

Canister and Sample Gauge Details

	Relinquished Date/Initial (lab)	Received by Date/Time (sampler)	Relinquished Date/Initial (sampler)	Received by Date/Initial (lab)
Canister	23/10/2015 ✓	23/10/15	29/10 ✓	
Sample Restrictor	-----			

(customers please complete shaded areas for each canister)

Dilution Factor for Pressurization of Subatmospheric Samples in Canister

136637 DP

DF=(Pf+14.7)/(Pi+14.7)

psig																
	Pressure (psig) prior to pressurization (Pi):	**-14.5**	**-14.5**	**-14.5**	**-14.5**	**-14.5**	**-14.5**	**-14.5**	**-14.5**	**-14.5**	**-14.5**	**-14.5**	**-14.5**	**-14.5**	**-14.5**	**-14.5**
	Pressure (psig) after pressurization (Pf):	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**
	Dilution Factor (DF):	**223.500**	**223.500**	**223.500**	**223.500**	**223.500**	**223.500**	**223.500**	**223.500**	**223.500**	**223.500**	**223.500**	**223.500**	**223.500**	**223.500**	**223.500**

1 "Hg=0.491 psig

DF=(Pf+14.7)/(Pi*0.491+14.7)

133619-5

	canister ID:	2276	2275	1879	2240											
	Job ID:	136637-1	136637-2	136637-3	136637-4											
"Hg	**Pressure ("Hg) prior to pressurization (Pi):**	**-3.660**	**-4.750**	**-4.190**	**-4.170**											
	Pressure (psig) after pressurization (Pf):	**20.29**	**17.47**	**21.2**	**21.07**											
	Dilution Factor (DF): (250ml sample)	**2.71**	**2.60**	**2.84**	**2.83**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
	Dilution Factor (DF): (125ml sample)	5.42	5.20	5.68	5.65	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	Dilution Factor (DF): (65ml sample)	10.85	10.40	11.36	11.31	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
	Dilution Factor (DF): (30ml sample)	22.60	21.68	23.66	23.56	8.33	8.33	8.33	8.33	8.33	8.33	8.33	8.33	8.33	8.33	8.33
	Dilution Factor (DF): (9ml sample)	75.33	72.25	78.88	78.53	27.78	27.78	27.78	27.78	27.78	27.78	27.78	27.78	27.78	27.78	27.78
	Dilution Factor (DF): (1ml sample)	**677.95**	**650.28**	**709.90**	**706.78**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**
	Dilution Factor (DF): (100ul sample)	6779.46	6502.80	7098.95	7067.76	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00
	Dilution Factor (DF): (10ul sample)	67794.63	65028.00	70989.53	70677.56	25000.00	25000.00	25000.00	25000.00	25000.00	25000.00	25000.00	25000.00	25000.00	25000.00	25000.00

	canister ID:															
	Job ID:															
"Hg	**Pressure ("Hg) prior to pressurization (Pi):**															
	Pressure (psig) after pressurization (Pf):															
	Dilution Factor (DF): (250ml sample)	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
	Dilution Factor (DF): (125ml sample)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	Dilution Factor (DF): (65ml sample)	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
	Dilution Factor (DF): (30ml sample)	8.33	8.33	8.33	8.33	8.33	8.33	8.33	8.33	8.33	8.33	8.33	8.33	8.33	8.33	8.33
	Dilution Factor (DF): (9ml sample)	27.78	27.78	27.78	27.78	27.78	27.78	27.78	27.78	27.78	27.78	27.78	27.78	27.78	27.78	27.78
	Dilution Factor (DF): (1ml sample)	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**	**250.00**
	Dilution Factor (DF): (100ul sample)	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00
	Dilution Factor (DF): (10ul sample)	25000.00	25000.00	25000.00	25000.00	25000.00	25000.00	25000.00	25000.00	25000.00	25000.00	25000.00	25000.00	25000.00	25000.00	25000.00

14.7 psi is 1 Atmosphere

COPY 30/10/15

CUSTOMER RECEIPT OF AIR SAMPLING EQUIPMENT

CUSTOMER DETAILS

ELS Job No: 136637-1

Name	John Russell	**Delivery date**	23/10/2015
Company	Douglas Partners Pty Ltd		
Contact Email	John.Russell@douglaspartners.com.au		
Telephone Number	02-98090666, 0422 000 434		
Deliver address	96 Hermitage Road, West Ryde, NSW 2114		

Received the following Air Sampling Equipment from Envirolab:

Quantity	Descriptions
	6L Canisters
	3.2L Canisters
4 ✓	1L canisters
	Flow restrictors at mL/min for sampling.
	Flow restrictors at mL/min for sampling.
	Flow restrictors at mL/min for sampling.
1 ✓	Dual canister manifolds
	SS-400-NFSET nut and ferrule set (1/4")
8 ✓	SS-400-6 Union each with 2 nut and ferrule set (1/4")
	SS-400-3 Union tee each with 3 nut and ferrule set (1/4")
1 ?	2 meter (length) ¼" Teflon tubing
	SS-43GS4 40G ball valve (1/4")
	TD Tubes
	Carbon tubes (SKC 226-09)
	50 mL of isopropyl alcohol (IPA)
	3L Tedlar bags
	1L Tedlar bags
1 ✓	Pressure gauge with ¼"female connection

Customer Signature		**Relinquished by**	TT (ELS)
Date		**Date**	23/10/2015

(the signature accepts the terms and conditions below)

Please note: All samples will be disposed after 1 week of issuing the "Certificate of Analysis" (CoA): this means that 1 week after the issuing the CoA, all canisters will be cleaned, all TD Tubes will be conditioned, all carbon tubes and Tedlar bags will be disposed, unless there is a pre-arrangement (please inform Envirolab if you need to hold the samples – fees apply as below).
For on hold samples, the sample holding fee will apply: $50 per week per canister sample; $25 per week per TD tube sample.

*Please fax (**02-99106299**) /email signed receipt of sampling equipment*
*(**enquires@envirolab.com.au**)*

Canisters

Canister size	Quantity	With ¼" connection	With male quick-fit connection	Cost (each/per week)	Total $
1 L	4	yes		$50	200
3.2 L				$50	
6 L				$50	
Dual canister manifold	1	¼"	----	$20	20








6L canister 3.2L canister 1L canister 1L canister ¼"connection Dual canister manifold

Flow Restrictors (flow restrictors will be modified if Quick-fit connections are required)

Quantity	Flow rate	Cost (each/per week)	Total $
		$50	
		$50	
		$50	
*Please DO NOT LOSS the Frit and Spring Washer if you need to disconnect the sampling tube of the flow restrictor. Otherwise, there will be $30 charge to cover the cost for each pair of them.			



Thermal Desorption and charcoal Tubes, Tedlar bags

	Quantity	Cost	Total $
TD tube		$25each/week	
SKC Anasorb 226-09 (Charcoal tube)		$10 each	
Tedlar bags (1L)		$50 each	
Tedlar bags (3L)		$50 each	



Fittings and Miscellaneous

Item	Quantity	Size	Cost ($) (no charge if returned)	Total $	Images
Union Tee with two female Quick-fit connections		¼"	$300		
SS-400-3 Union Tee		¼"	$45		
SS-400-6 Union		¼"	$25		
SS-400-NFSET (nut and ferrule set)		¼"	$8		
SS-400-SET (ferrule set)		¼"	$5		
SS-43GS4 Ball valve		¼"	$180		
NAL8050-0250 Teflon tubing	2m	¼"	$20/meter		
Isopropyl alcohol (40mL)		40 mL	$50		
Pressure gauge with ¼"female connection	1	¼"	no charge if returned	---	

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

136637-1

Canister Sampling Field Test Data Sheet and Custody Record

General Information (where applicable)

Company: Douglas Partners Project Contact: John Russell
Project Name: Canister Serial No: 2276
Site Location: Moore Park Restrictor Serial No.: 635
Site Address: Sampling Date: 27/10/15
Canister Leak check Date: 23/10/2015 Cleaned/certified Date: 25/9/15

Canister Sampling Details

JK101

Sample ID JK101	Before shipment (determined in lab with certified gauge)	Before sampling in Field (from canister gauge)	After sampling in Field (from canister gauge)	After receipt (determined in lab with certified gauge)
Vacuum (-"Hg)	-29.75 Hg"	-28	-5	-3.66 Hg"
Passive Flow Leak Check		n/a	n/a	n/a
Date/Time/Initial/	23/10/2015 TT	27/10/15	27/10/15	30/10/15 TT
	Temperature (°C)	Humidity (%)	Weather Conditions	
Start	16.5	68	Overcast	
Stop				
Date/Time	27/10/15			
Initial				

	Sampling Times		Flow Rates (mL/min)	
	Time	Elapsed Time	Restrictor Flow Rate before shipping	Restrictor Flow Rate on sample receipt
Start	11:22	2 min		-----
Stop	11:24		----	
Date/Time	27/10/15		----	
Initial	TT			

Canister Pressurised to 20.29 PSI with Helium / Nitrogen PLEASE CIRCLE on receipt

Canister and Sample Gauge Details

	Relinquished Date/Initial (lab)	Received by Date/Time (sampler)	Relinquished Date/Initial (sampler)	Received by Date/Initial (lab)
Canister	23/10/2015 TT	23/10/15	29/10	
Sample Restrictor	-----			

(customers please complete shaded areas for each canister)

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

136637-2

Canister Sampling Field Test Data Sheet and Custody Record

General Information (where applicable)

Company: Douglas Partners Project Contact: John Russell
Project Name: Canister Serial No: 2275
Site Location: Moorebank Restrictor Serial No.: 1538
Site Address: Sampling Date: 27/10/15
Canister Leak check Date: 23/10/2015 Cleaned/certified Date: 20/10/15

Canister Sampling Details

JK107B

Sample ID JK107b	Before shipment (determined in lab with certified gauge)	Before sampling in Field (from canister gauge)	After sampling in Field (from canister gauge)	After receipt (determined in lab with certified gauge)
Vacuum (-"Hg)	-29.74 Hg"	~~-24~~ -28	-05	-4.75 Hg"
Passive Flow Leak Check		n/a	n/a	n/a
Date/Time/Initial/	23/10/2015	27/10/15	27/10/15	30/10/15

	Temperature (°C)	Humidity (%)	Weather Conditions
Start	16.6	64	Overcast
Stop	16.6	64	
Date/Time	27/10/15	10:04	
Initial			

	Sampling Times		Flow Rates (mL/min)	
	Time	Elapsed Time	Restrictor Flow Rate before shipping	Restrictor Flow Rate on sample receipt
Start	10:02	2 min	3.4	-----
Stop	10:04		----	
Date/Time	27/10/15		----	
Initial				

Canister Pressurised to 17.47 PSI with Helium / Nitrogen PLEASE CIRCLE on receipt

Canister and Sample Gauge Details

	Relinquished Date/Initial (lab)	Received by Date/Time (sampler)	Relinquished Date/Initial (sampler)	Received by Date/Initial (lab)
Canister	23/10/2015	23/10/15	29/10	
Sample Restrictor	-----			

(customers please complete shaded areas for each canister)

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

136637-3

Canister Sampling Field Test Data Sheet and Custody Record

General Information (where applicable)

Company: Douglas Partners Project Contact: John Russell

Project Name: Canister Serial No: 1879 (133619-5)

Site Location: Moorebank Restrictor Serial No.: 1541 (136292-20)

Site Address: Sampling Date: 27/10/15

Canister Leak check Date: 23/10/2015 Cleaned/certified Date: 25/9/15

Canister Sampling Details

BH216

Sample ID BH/MW216	Before shipment (determined in lab with certified gauge)	Before sampling in Field (from canister gauge)	After sampling in Field (from canister gauge)	After receipt (determined in lab with certified gauge)
Vacuum (-"Hg)	-29.73 Hg"	~~-25~~ -28	-5	-4.19 Hg"
Passive Flow Leak Check		n/a	n/a	n/a
Date/Time/Initial/	23/10/2015 TT			30/10/15 TT
	Temperature (°C)	Humidity (%)	Weather Conditions	
Start	16.4	65	Overcast	
Stop	16.4	65		
Date/Time	27/10/15			
Initial				

	Sampling Times		Flow Rates (mL/min)	
	Time	Elapsed Time	Restrictor Flow Rate before shipping	Restrictor Flow Rate on sample receipt
Start	10.28			-----
Stop	10.30	2 min	----	
Date/Time	27/10/15		----	
Initial				

Canister Pressurised to 21.20 PSI with Helium / (Nitrogen) PLEASE CIRCLE on receipt

Canister and Sample Gauge Details

	Relinquished Date/Initial (lab)	Received by Date/Time (sampler)	Relinquished Date/Initial (sampler)	Received by Date/Initial (lab)
Canister	23/10/2015 TT	23/10/15	29/10	
Sample Restrictor	-----			

(customers please complete shaded areas for each canister)

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

136637 -4

Canister Sampling Field Test Data Sheet and Custody Record

General Information (where applicable)

Company: Douglas Partners Project Contact: John Russell

Project Name Canister Serial No: 2240

Site Location: Mascot Restrictor Serial No.: 1549

Site Address: Sampling Date: 27/10/15

Canister Leak check Date: 23/10/2015 Cleaned/certified Date: 25/9/15

133619-8
136292-5

Canister Sampling Details

BD1 - 1879

Sample ID BD1	Before shipment (determined in lab with certified gauge)	Before sampling in Field (from canister gauge)	After sampling in Field (from canister gauge)	After receipt (determined in lab with certified gauge)
Vacuum (-"Hg)	-29.74Hg"	-28	-5	-4.17Hg"
Passive Flow Leak Check		n/a	n/a	n/a
Date/Time/Initial/	23/10/2015 T			30/10/15 T
	Temperature (°C)	Humidity (%)	Weather Conditions	
Start	16.9	65	Overcast	
Stop	16.9	65		
Date/Time	27/10/15			
Initial				

	Sampling Times		Flow Rates (mL/min)	
	Time	Elapsed Time	Restrictor Flow Rate before shipping	Restrictor Flow Rate on sample receipt
Start	10.25	2min		-----
Stop	10.30		----	
Date/Time	27/10/15		----	
Initial				

Canister Pressurised to 2.07 PSI with Helium / Nitrogen PLEASE CIRCLE on receipt

Canister and Sample Gauge Details

	Relinquished Date/Initial (lab)	Received by Date/Time (sampler)	Relinquished Date/Initial (sampler)	Received by Date/Initial (lab)
Canister	23/10/2015 T	23/10/15	29/10	
Sample Restrictor	-----			

(customers please complete shaded areas for each canister)

COPY

CUSTOMER RECEIPT OF AIR SAMPLING EQUIPMENT

CUSTOMER DETAILS

ELS Job No:

Name	John Russell	**Delivery date**	26/10/2015
Company	Douglas Partners Pty Ltd		
Contact Email	John.Russell@douglaspartners.com.au		
Telephone Number	02-98090666, 0422 000 434		
Deliver address	96 Hermitage Road, West Ryde, NSW 2114		

Received the following Air Sampling Equipment from Envirolab:

Quantity	Descriptions
	6L Canisters
	3.2L Canisters
	1L canisters
4 ✓	Flow restrictors at 350 mL/min for 2 minute sampling.
	Flow restrictors at mL/min for sampling.
	Flow restrictors at mL/min for sampling.
	Dual canister manifolds
	SS-400-NFSET nut and ferrule set (1/4")
	SS-400-6 Union each with 2 nut and ferrule set (1/4")
	SS-400-3 Union tee each with 3 nut and ferrule set (1/4")
	2 meter (length) ¼" Teflon tubing
	SS-43GS4 40G ball valve (1/4")
	TD Tubes
	Carbon tubes (SKC 226-09)
	50 mL of isopropyl alcohol (IPA)
	3L Tedlar bags
	1L Tedlar bags
	Pressure gauge with ¼"female connection

Customer Signature		**Relinquished by**	TT (ELS)
Date		**Date**	26/10/2015

(the signature accepts the terms and conditions below)

Please note: **All samples will be disposed after 1 week of issuing the "Certificate of Analysis" (CoA): this means that 1 week after the issuing the CoA, all canisters will be cleaned, all TD Tubes will be conditioned, all carbon tubes and Tedlar bags will be disposed, unless there is a pre-arrangement (please inform Envirolab if you need to hold the samples – fees apply as below).**
For on hold samples, the sample holding fee will apply: $50 per week per canister sample; $25 per week per TD tube sample.

Please fax (02-99106299) /email signed receipt of sampling equipment
(enquires@envirolab.com.au)

Canisters

Canister size	Quantity	With ¼" connection	With male quick-fit connection	Cost (each/per week)	Total $
1 L		yes		$50	
3.2 L				$50	
6 L				$50	
Dual canister manifold		¼"	----	$20	








6L canister 3.2L canister 1L canister 1L canister ¼"connection Dual canister manifold

Flow Restrictors (flow restrictors will be modified if Quick-fit connections are required)

Quantity	Flow rate	Cost (each/per week)	Total $
4	350 ml/min	$50	200
		$50	
		$50	

*Please DO NOT LOSS the Frit and Spring Washer if you need to disconnect the sampling tube of the flow restrictor. Otherwise, there will be $30 charge to cover the cost for each pair of them.



Thermal Desorption and charcoal Tubes, Tedlar bags

	Quantity	Cost	Total $
TD tube		$25each/week	
SKC Anasorb 226-09 (Charcoal tube)		$10 each	
Tedlar bags (1L)		$50 each	
Tedlar bags (3L)		$50 each	



Fittings and Miscellaneous

Item	Quantity	Size	Cost ($) (no charge if returned)	Total $	Images
Union Tee with two female Quick-fit connections		¼"	$300		
SS-400-3 Union Tee		¼"	$45		
SS-400-6 Union		¼"	$25		
SS-400-NFSET (nut and ferrule set)		¼"	$8		
SS-400-SET (ferrule set)		¼"	$5		
SS-43GS4 Ball valve		¼"	$180		
NAL8050-0250 Teflon tubing		¼"	$20/meter		
Isopropyl alcohol (40mL)		40 mL	$50		
Pressure gauge with ¼"female connection		¼"	no charge if returned	---	

Envirolab Services flow restrictors log book

Client name: __DP__ Date: 26/10/2015

Entry	Flow restrictor ID	Flow rate before delivery (mL/min)	Flow rate after sampling (mL/min)	Orifice size	Entry	Flow restrictor ID	Flow rate before delivery (mL/min)	Flow rate after sampling (mL/min	Orifice size
1	1541	351	354	90	26				
2	1549	351	352	90	27				
3	635	350	352	90	28				
4	1538	349	356	90	29				
5					30				
6					31				
7					32				
8					33				
9					34				
10					35				
11					36				
12					37				
13					38				
14					39				
15					40				
16					41				
17					42				
18					43				
19					44				
20					45				
21					46				
22					47				
23					48				
24					49				
25					50				

Tania Tan

From: Jacinta Hurst
Sent: Thursday, 22 October 2015 6:07 PM
To: AirTox Sydney
Subject: Fwd: Cannisters

Regards,

Jacinta Hurst | Sydney Laboratory Manager | Envirolab Services Pty Ltd

Great Chemistry, Great Service.

12 Ashley Street Chatswood NSW 2067
T 612 9910 6200 F 612 9910 6201 M 0407 003 037
jhurst@envirolab.com.au | www.envirolab.com.au



Our new 2016 Price List commences 1st November 2015 – please contact your local Envirolab office for a copy.

Follow this link to provide feedback on our service.

Latest Links Below:

Please note that all samples submitted to the Envirolab Group laboratories will be analysed under the Envirolab Group Terms and Conditions. The Terms and Conditions are accessible by clicking this link

Sent from my iPhone

Begin forwarded message:

> **From:** John Russell <John.Russell@douglaspartners.com.au>
> **Date:** 22 October 2015 17:57:12 AEDT
> **To:** Jacinta Hurst <JHurst@envirolab.com.au>
> **Subject: Cannisters**
>
> Jacinta
>
> I need four canisters for TO-15 method. They don't need to be time weighted. Please include a dual sampling manifold and all the necessary fittings to connect to some Teflon tubing. Can you please also include 2m of Teflon tubing?
>
> Are we able to get this delivery tomorrow or Monday to West Ryde office (proposed sampling is Tuesday)? Do you need a PO now or is it OK to send one with the samples?
>
> Thanks

ENVIROLAB

CANISTER CHAIN OF CUSTODY RECORD

Client Name	Douglas Partners	Project Contact	John Russell	Quote No	
Client Address	Moorebank	Contact Phone No		Date Results Required	1 day / 2 days / 3 days / Standard
Project Name		Contact Mobile No	0422 000 434	E-mail Report To	John Russell
Site Location	Moorebank	Results Required by	standard	PO No	123602
		Sampled by	RL		

	Client sample ID (Field location)	Canister #	Soil gas train / Mass flow controller #	Leak Test Passed	PID Reading (ppmv)	Date of Collection	Collection Time		Canister vacuum (Hg")		Analysis requested							
							Time on	Time off	Initial	Final	TO-15	TPH	5-Sulfides	Ozone precursors	RGA gases			
1)	JK101	2276	635			27/10/15	11:22	11:24	-28	-5	✓							
2)	JK107b	2275	1538			27/10/15	10:02	10:04	-28	-5	✓							
3)	BH/MW216	1879	1541			27/10/15	10:28	10:30	-28	-5	✓							
4)	BD1	2240	1549			27/10/15	—	—	-28	-5	✓							

ENVIROLAB Envirolab Services 12 Ashley St Chatswood NSW 2067 Ph: (02) 9910 6200

Job No: 136637

Date Received: 29/10/15

Time Received: 17:00

Received by: PT

Temp: Cool/Ambient

Cooling: Ice/Icepack

Security: Intact/Broken/None

Relinquished by	JRR	Date & Time	29/10/15	Received by		Lab		Date & Time	29/10/15	Notes:
Print Name		Signature		Print Name	PT		ELS	Signature	17:00	

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

SAMPLE RECEIPT ADVICE

Client Details	
Client	Douglas Partners Pty Ltd
Attention	John Russell

Sample Login Details	
Your Reference	Moorebank
Envirolab Reference	**136637**
Date Sample Received	29/10/2015
Date Instructions Received	29/10/2015
Date Results Expected to be Reported	**05/11/2015**

Sample Condition	
Samples received in appropriate condition for analysis	YES
No. of Samples Provided	4 suma canisters
Turnaround Time Requested	Standard
Temperature on receipt (°C)	na
Cooling Method	None
Sampling Date Provided	YES

Comments
Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	Phone: 02 9910 6200
Fax: 02 9910 6201	Fax: 02 9910 6201
Email: ahie@envirolabservices.com.au	Email: jhurst@envirolabservices.com.au

Sample and Testing Details on following page

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

Sample Id	*TO15 in Canisters + ug/m3 calc*
JK101	✓
JK107B	✓
BH/MW216	✓
BD1	✓

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1532954**	Page	: 1 of 8
Client	: **DOUGLAS PARTNERS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR JOHN RUSSELL	Contact	: Jenny Bevan
Address	: PO BOX 472 96 HERMITAGE ROAD WEST RYDE NSW, AUSTRALIA 1685	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: john.russell@douglaspartners.com.au	E-mail	: jenny.bevan@alsglobal.com
Telephone	: +61 02 49609600	Telephone	: 07 3552 8657
Facsimile	: +61 02 49609601	Facsimile	: +61-2-8784 8500
Project	: 71459.03 MOOREBANK	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: 123475	Date Samples Received	: 06-Oct-2015 16:30
C-O-C number	: ----	Date Analysis Commenced	: 07-Oct-2015
Sampler	: ----	Issue Date	: 13-Oct-2015 18:00
Site	: ----		
		No. of samples received	: 1
Quote number	: ----	No. of samples analysed	: 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Phalak Inthakesone	Laboratory Manager - Organics	Sydney Organics
Shobhna Chandra	Metals Coordinator	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- Poor spike recovery for (EP234) due to matrix interferences(confirmed by re-analysis).
- Total PAH reported as the sum of Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benz(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene and Benzo(g,h,i)perylene.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BD1/021015	----	----	----	----
				Client sampling date / time	[02-Oct-2015]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1532954-001	--------	--------	--------	--------
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		**0.003**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L		<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		**0.046**	----	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.245**	----	----	----	----
Manganese	7439-96-5	0.001	mg/L		**0.985**	----	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**2.56**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
^ **Nitrate as N**	14797-55-8	0.01	mg/L		**0.03**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.03**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**3.58**	----	----	----	----
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1	µg/L		<1.0	----	----	----	----
2-Chlorophenol	95-57-8	1	µg/L		<1.0	----	----	----	----
2-Methylphenol	95-48-7	1	µg/L		<1.0	----	----	----	----
3- & 4-Methylphenol	1319-77-3	2	µg/L		<2.0	----	----	----	----
2-Nitrophenol	88-75-5	1	µg/L		<1.0	----	----	----	----
2.4-Dimethylphenol	105-67-9	1	µg/L		<1.0	----	----	----	----
2.4-Dichlorophenol	120-83-2	1	µg/L		<1.0	----	----	----	----
2.6-Dichlorophenol	87-65-0	1	µg/L		<1.0	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	1	µg/L		<1.0	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	1	µg/L		<1.0	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	1	µg/L		<1.0	----	----	----	----
Pentachlorophenol	87-86-5	2	µg/L		<2.0	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons									

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BD1/021015	----	----	----	----
				Client sampling date / time	[02-Oct-2015]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1532954-001	--------	--------	--------	--------
					Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons - Continued									
C6 - C9 Fraction	----	20	µg/L		<20	----	----	----	----
C10 - C14 Fraction	----	50	µg/L		<50	----	----	----	----
C15 - C28 Fraction	----	100	µg/L		<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L		<50	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	----	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	----	----	----	----
>C10 - C16 Fraction	>C10_C16	100	µg/L		<100	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L		<100	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	----	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	----	----	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	----	----	----	----
Toluene	108-88-3	2	µg/L		<2	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	----	----	----	----
^ Total Xylenes	1330-20-7	2	µg/L		<2	----	----	----	----
^ Sum of BTEX	----	1	µg/L		<1	----	----	----	----
Naphthalene	91-20-3	5	µg/L		<5	----	----	----	----
EP131A: Organochlorine Pesticides									
Aldrin	309-00-2	0.01	µg/L		<0.010	----	----	----	----
alpha-BHC	319-84-6	0.01	µg/L		<0.010	----	----	----	----
beta-BHC	319-85-7	0.01	µg/L		<0.010	----	----	----	----
delta-BHC	319-86-8	0.01	µg/L		<0.010	----	----	----	----
4.4`-DDD	72-54-8	0.01	µg/L		<0.010	----	----	----	----
4.4`-DDE	72-55-9	0.01	µg/L		<0.010	----	----	----	----
4.4`-DDT	50-29-3	0.01	µg/L		<0.010	----	----	----	----
^ Sum of DDD + DDE + DDT	----	0.01	µg/L		<0.010	----	----	----	----
Dieldrin	60-57-1	0.01	µg/L		<0.010	----	----	----	----
alpha-Endosulfan	959-98-8	0.01	µg/L		<0.010	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BD1/021015	----	----	----	----
				Client sampling date / time	[02-Oct-2015]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1532954-001	--------	--------	--------	--------
					Result	Result	Result	Result	Result
EP131A: Organochlorine Pesticides - Continued									
beta-Endosulfan	33213-65-9	0.01	µg/L		<0.010	----	----	----	----
Endosulfan sulfate	1031-07-8	0.01	µg/L		<0.010	----	----	----	----
Endosulfan (sum)	115-29-7	0.01	µg/L		<0.010	----	----	----	----
Endrin	72-20-8	0.01	µg/L		<0.010	----	----	----	----
Endrin aldehyde	7421-93-4	0.01	µg/L		<0.010	----	----	----	----
Endrin ketone	53494-70-5	0.01	µg/L		<0.010	----	----	----	----
Heptachlor	76-44-8	0.005	µg/L		<0.005	----	----	----	----
Heptachlor epoxide	1024-57-3	0.01	µg/L		<0.010	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.01	µg/L		<0.010	----	----	----	----
gamma-BHC	58-89-9	0.01	µg/L		<0.010	----	----	----	----
Methoxychlor	72-43-5	0.01	µg/L		<0.010	----	----	----	----
cis-Chlordane	5103-71-9	0.01	µg/L		<0.010	----	----	----	----
trans-Chlordane	5103-74-2	0.01	µg/L		<0.010	----	----	----	----
^ Total Chlordane (sum)	----	0.01	µg/L		<0.010	----	----	----	----
Oxychlordane	27304-13-8	0.01	µg/L		<0.010	----	----	----	----
EP131B: Polychlorinated Biphenyls (as Aroclors)									
Total Polychlorinated biphenyls	----	0.1	µg/L		<0.10	----	----	----	----
Aroclor 1016	12674-11-2	0.1	µg/L		<0.10	----	----	----	----
Aroclor 1221	11104-28-2	0.1	µg/L		<0.10	----	----	----	----
Aroclor 1232	11141-16-5	0.1	µg/L		<0.10	----	----	----	----
Aroclor 1242	53469-21-9	0.1	µg/L		<0.10	----	----	----	----
Aroclor 1248	12672-29-6	0.1	µg/L		<0.10	----	----	----	----
Aroclor 1254	11097-69-1	0.1	µg/L		<0.10	----	----	----	----
Aroclor 1260	11096-82-5	0.1	µg/L		<0.10	----	----	----	----
EP132B: Polynuclear Aromatic Hydrocarbons									
3-Methylcholanthrene	56-49-5	0.1	µg/L		<0.1	----	----	----	----
2-Methylnaphthalene	91-57-6	0.1	µg/L		<0.1	----	----	----	----
7.12-Dimethylbenz(a)anthracene	57-97-6	0.1	µg/L		<0.1	----	----	----	----
Acenaphthene	83-32-9	0.1	µg/L		<0.1	----	----	----	----
Acenaphthylene	208-96-8	0.1	µg/L		<0.1	----	----	----	----
Anthracene	120-12-7	0.1	µg/L		<0.1	----	----	----	----
Benz(a)anthracene	56-55-3	0.1	µg/L		<0.1	----	----	----	----
Benzo(a)pyrene	50-32-8	0.05	µg/L		<0.05	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.1	µg/L		<0.1	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BD1/021015	----	----	----	----
				Client sampling date / time	[02-Oct-2015]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1532954-001	--------	--------	--------	--------
					Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Benzo(e)pyrene	192-97-2	0.1	µg/L		<0.1	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	0.1	µg/L		<0.1	----	----	----	----
Benzo(k)fluoranthene	207-08-9	0.1	µg/L		<0.1	----	----	----	----
Chrysene	218-01-9	0.1	µg/L		<0.1	----	----	----	----
Coronene	191-07-1	0.1	µg/L		<0.1	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	0.1	µg/L		<0.1	----	----	----	----
Fluoranthene	206-44-0	0.1	µg/L		<0.1	----	----	----	----
Fluorene	86-73-7	0.1	µg/L		<0.1	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.1	µg/L		<0.1	----	----	----	----
Naphthalene	91-20-3	0.1	µg/L		<0.1	----	----	----	----
Perylene	198-55-0	0.1	µg/L		<0.1	----	----	----	----
Phenanthrene	85-01-8	0.1	µg/L		<0.1	----	----	----	----
Pyrene	129-00-0	0.1	µg/L		<0.1	----	----	----	----
Sum of PAHs	----	0.05	µg/L		<0.05	----	----	----	----
Benzo(a)pyrene TEQ (zero)	----	0.05	µg/L		<0.05	----	----	----	----
EP234A: OP Pesticides									
Acephate	30560-19-1	0.5	µg/L		<0.5	----	----	----	----
Azinphos-methyl	86-50-0	0.02	µg/L		<0.02	----	----	----	----
Azinphos-ethyl	2642-71-9	0.02	µg/L		<0.02	----	----	----	----
Bensulide	741-58-2	0.1	µg/L		<0.1	----	----	----	----
Bromophos-ethyl	4824-78-6	0.1	µg/L		<0.10	----	----	----	----
Carbofenothion	786-19-6	0.02	µg/L		<0.02	----	----	----	----
^ Chlorfenvinphos	470-90-6	0.02	µg/L		<0.02	----	----	----	----
Chlorpyrifos	2921-88-2	0.02	µg/L		<0.02	----	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.2	µg/L		<0.2	----	----	----	----
Coumaphos	56-72-4	0.01	µg/L		<0.01	----	----	----	----
Demeton-O	298-03-0	0.02	µg/L		<0.02	----	----	----	----
^ Demeton-O & Demeton-S	298-03-3/126-75-0	0.02	µg/L		<0.02	----	----	----	----
Demeton-S	126-75-0	0.02	µg/L		<0.02	----	----	----	----
Demeton-S-methyl	919-86-8	0.02	µg/L		<0.02	----	----	----	----
Diazinon	333-41-5	0.01	µg/L		<0.01	----	----	----	----
Dichlorvos	62-73-7	0.2	µg/L		<0.20	----	----	----	----
Dimethoate	60-51-5	0.02	µg/L		<0.02	----	----	----	----
Disulfoton	298-04-4	0.05	µg/L		<0.05	----	----	----	----
EPN	2104-64-5	0.05	µg/L		<0.05	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BD1/021015	----	----	----	----
				Client sampling date / time	[02-Oct-2015]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1532954-001	--------	--------	--------	--------
					Result	Result	Result	Result	Result
EP234A: OP Pesticides - Continued									
Ethion	563-12-2	0.02	µg/L		<0.02	----	----	----	----
Ethoprophos	13194-48-4	0.01	µg/L		<0.01	----	----	----	----
Fenamiphos	22224-92-6	0.01	µg/L		<0.01	----	----	----	----
Fenchlorphos (Ronnel)	299-84-3	10	µg/L		<10	----	----	----	----
Fenitrothion	122-14-5	2	µg/L		<2	----	----	----	----
Fensulfothion	115-90-2	0.01	µg/L		<0.01	----	----	----	----
Fenthion	55-38-9	0.05	µg/L		<0.05	----	----	----	----
Formothion	2540-82-1	20	µg/L		<20	----	----	----	----
Fosetyl Aluminium	39148-24-8	10	µg/L		<10	----	----	----	----
Malathion	121-75-5	0.02	µg/L		<0.02	----	----	----	----
Methidathion	950-37-8	0.1	µg/L		<0.1	----	----	----	----
^ **Mevinphos**	7786-34-7	0.02	µg/L		<0.02	----	----	----	----
Monocrotophos	6923-22-4	0.02	µg/L		<0.02	----	----	----	----
Naftalofos	1491-41-4	1	µg/L		<1.0	----	----	----	----
Omethoate	1113-02-6	0.01	µg/L		<0.01	----	----	----	----
Parathion	56-38-2	0.2	µg/L		<0.2	----	----	----	----
Parathion-methyl	298-00-0	0.5	µg/L		<0.5	----	----	----	----
Phorate	298-02-2	0.1	µg/L		<0.1	----	----	----	----
Pirimiphos-ethyl	23505-41-1	0.01	µg/L		<0.01	----	----	----	----
Pirimiphos-methyl	29232-93-7	0.01	µg/L		<0.01	----	----	----	----
Profenofos	41198-08-7	0.01	µg/L		<0.01	----	----	----	----
Prothiofos	34643-46-4	0.1	µg/L		<0.1	----	----	----	----
Pyrazophos	13457-18-6	0.1	µg/L		<0.1	----	----	----	----
Sulfotep	3689-24-5	0.005	µg/L		<0.005	----	----	----	----
Sulprofos	35400-43-2	0.05	µg/L		<0.05	----	----	----	----
Temephos	3383-96-8	0.02	µg/L		<0.02	----	----	----	----
Terbufos	13071-79-9	0.01	µg/L		<0.01	----	----	----	----
Tetrachlorvinphos	22248-79-9	0.01	µg/L		<0.01	----	----	----	----
Thiometon	640-15-3	0.5	µg/L		<0.5	----	----	----	----
Triazophos	24017-47-8	0.005	µg/L		<0.005	----	----	----	----
Trichlorfon	52-68-6	0.02	µg/L		<0.02	----	----	----	----
Trichloronate	327-98-0	0.5	µg/L		<0.5	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	1	%		**25.6**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	1	%		**52.9**	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BD1/021015	----	----	----	----
				Client sampling date / time	[02-Oct-2015]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1532954-001	--------	--------	--------	--------
					Result	Result	Result	Result	Result
EP075(SIM)S: Phenolic Compound Surrogates - Continued									
2.4.6-Tribromophenol	118-79-6	1	%		42.3	----	----	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	1	%		75.3	----	----	----	----
Anthracene-d10	1719-06-8	1	%		51.1	----	----	----	----
4-Terphenyl-d14	1718-51-0	1	%		73.0	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		105	----	----	----	----
Toluene-D8	2037-26-5	2	%		116	----	----	----	----
4-Bromofluorobenzene	460-00-4	2	%		115	----	----	----	----
EP131S: OC Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.01	%		130	----	----	----	----
EP131T: PCB Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%		115	----	----	----	----
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		90.5	----	----	----	----
Anthracene-d10	1719-06-8	0.1	%		106	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.1	%		109	----	----	----	----

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **ES1532954**	Page	: 1 of 12
Client	: **DOUGLAS PARTNERS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR JOHN RUSSELL	Contact	: Jenny Bevan
Address	: PO BOX 472 96 HERMITAGE ROAD WEST RYDE NSW, AUSTRALIA 1685	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: john.russell@douglaspartners.com.au	E-mail	: jenny.bevan@alsglobal.com
Telephone	: +61 02 49609600	Telephone	: 07 3552 8657
Facsimile	: +61 02 49609601	Facsimile	: +61-2-8784 8500
Project	: 71459.03 MOOREBANK	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: 123475	Date Samples Received	: 06-Oct-2015
C-O-C number	: ----	Date Analysis Commenced	: 07-Oct-2015
Sampler	: ----	Issue Date	: 13-Oct-2015
Site	: ----	No. of samples received	: 1
Quote number	: ----	No. of samples analysed	: 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out ir compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Phalak Inthakesone	Laboratory Manager - Organics	Sydney Organics
Shobhna Chandra	Metals Coordinator	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 237483)									
EN1513381-010	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.006	0.007	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.006	18.4	No Limit
ES1532927-002	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.007	0.008	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.032	0.032	0.00	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.003	0.003	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.021	0.023	8.75	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 237484)									
ES1532846-050	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
ES1533106-005	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 237814)									
ES1532954-001	BD1/021015	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	2.56	2.54	0.566	0% - 20%
ES1533043-007	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	193	195	1.01	0% - 20%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 235442)									
ES1532898-010	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
ES1532887-010	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 237813)									
ES1532954-001	BD1/021015	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.03	0.03	0.00	No Limit
ES1533043-007	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	2.23	1.83	19.7	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 237771)									
ES1533106-007	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.03	0.02	0.00	No Limit
ES1533014-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.06	0.05	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 237294)									
ES1532924-003	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 237294)									

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 237294) - continued									
ES1532924-003	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EP080: BTEXN (QC Lot: 237294)									
ES1532924-003	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	4	3	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
EP234A: OP Pesticides (QC Lot: 237579)									
ES1532954-001	BD1/021015	EP234-1x: Bensulide	741-58-2	0.1	µg/L	<0.1	<0.1	0.00	No Limit
		EP234-1x: Methidathion	950-37-8	0.1	µg/L	<0.1	<0.1	0.00	No Limit
		EP234-1x: Pyrazophos	13457-18-6	0.1	µg/L	<0.1	<0.1	0.00	No Limit
		EP234-1x: Acephate	30560-19-1	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP234-1x: Thiometon	640-15-3	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP234-1x: Naftalofos	1491-41-4	1	µg/L	<1.0	<1.0	0.00	No Limit
		EP234-1x: Fosetyl Aluminium	39148-24-8	10	µg/L	<10	<10	0.00	No Limit
		EP234-1x: Formothion	2540-82-1	20	µg/L	<20	<20	0.00	No Limit
EP234A: OP Pesticides (QC Lot: 237580)									
ES1532954-001	BD1/021015	EP234-1: Sulfotep	3689-24-5	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		EP234-1: Triazophos	24017-47-8	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		EP234-1: Coumaphos	56-72-4	0.01	µg/L	<0.01	<0.01	0.00	No Limit
		EP234-1: Diazinon	333-41-5	0.01	µg/L	<0.01	<0.01	0.00	No Limit
		EP234-1: Ethoprophos	13194-48-4	0.01	µg/L	<0.01	<0.01	0.00	No Limit
		EP234-1: Fenamiphos	22224-92-6	0.01	µg/L	<0.01	<0.01	0.00	No Limit
		EP234-1: Fensulfothion	115-90-2	0.01	µg/L	<0.01	<0.01	0.00	No Limit
		EP234-1: Omethoate	1113-02-6	0.01	µg/L	<0.01	<0.01	0.00	No Limit
		EP234-1: Pirimiphos-ethyl	23505-41-1	0.01	µg/L	<0.01	<0.01	0.00	No Limit
		EP234-1: Pirimiphos-methyl	29232-93-7	0.01	µg/L	<0.01	<0.01	0.00	No Limit
		EP234-1: Profenofos	41198-08-7	0.01	µg/L	<0.01	<0.01	0.00	No Limit
		EP234-1: Terbufos	13071-79-9	0.01	µg/L	<0.01	<0.01	0.00	No Limit
		EP234-1: Tetrachlorvinphos	22248-79-9	0.01	µg/L	<0.01	<0.01	0.00	No Limit
		EP234-1: Azinphos-ethyl	2642-71-9	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP234-1: Azinphos-methyl	86-50-0	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP234-1: Carbofenothion	786-19-6	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP234-1: Chlorfenvinphos	470-90-6	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP234-1: Chlorpyrifos	2921-88-2	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP234-1: Demeton-O	298-03-0	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP234-1: Demeton-O & Demeton-S	298-03-3/126-75-0	0.02	µg/L	<0.02	<0.02	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP234A: OP Pesticides (QC Lot: 237580) - continued									
ES1532954-001	BD1/021015	EP234-1: Demeton-S	126-75-0	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP234-1: Demeton-S-methyl	919-86-8	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP234-1: Dimethoate	60-51-5	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP234-1: Ethion	563-12-2	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP234-1: Malathion	121-75-5	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP234-1: Mevinphos	7786-34-7	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP234-1: Monocrotophos	6923-22-4	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP234-1: Temephos	3383-96-8	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP234-1: Trichlorfon	52-68-6	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP234-1: Disulfoton	298-04-4	0.05	µg/L	<0.05	<0.05	0.00	No Limit
		EP234-1: EPN	2104-64-5	0.05	µg/L	<0.05	<0.05	0.00	No Limit
		EP234-1: Fenthion	55-38-9	0.05	µg/L	<0.05	<0.05	0.00	No Limit
		EP234-1: Sulprofos	35400-43-2	0.05	µg/L	<0.05	<0.05	0.00	No Limit
		EP234-1: Bromophos-ethyl	4824-78-6	0.1	µg/L	<0.10	<0.10	0.00	No Limit
		EP234-1: Phorate	298-02-2	0.1	µg/L	<0.1	<0.1	0.00	No Limit
		EP234-1: Prothiofos	34643-46-4	0.1	µg/L	<0.1	<0.1	0.00	No Limit
		EP234-1: Chlorpyrifos-methyl	5598-13-0	0.2	µg/L	<0.2	<0.2	0.00	No Limit
		EP234-1: Dichlorvos	62-73-7	0.2	µg/L	<0.20	<0.20	0.00	No Limit
		EP234-1: Parathion	56-38-2	0.2	µg/L	<0.2	<0.2	0.00	No Limit
		EP234-1: Parathion-methyl	298-00-0	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP234-1: Trichloronate	327-98-0	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP234-1: Fenchlorphos (Ronnel)	299-84-3	10	µg/L	<10	<10	0.00	No Limit
		EP234-1: Fenitrothion	122-14-5	2	µg/L	<2	<2	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 237483)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	93.2	85	115
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	94.4	85	115
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	90.6	85	115
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	90.6	85	115
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	90.5	85	115
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	92.3	85	115
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	97.1	85	115
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	94.0	85	115
EG035F: Dissolved Mercury by FIMS (QCLot: 237484)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	99.9	78	114
EK055G: Ammonia as N by Discrete Analyser (QCLot: 237814)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	1 mg/L	99.5	90	114
EK057G: Nitrite as N by Discrete Analyser (QCLot: 235442)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	93.1	82	114
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 237813)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	110	91	113
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 237771)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	98.7	71	101
				<0.01	0.442 mg/L	102	72	108
				<0.01	1 mg/L	116	78	118
EP075(SIM)A: Phenolic Compounds (QCLot: 236429)								
EP075(SIM): 2.4.5-Trichlorophenol	95-95-4	1	µg/L	<1.0	5 µg/L	71.4	50	108
EP075(SIM): 2.4.6-Trichlorophenol	88-06-2	1	µg/L	<1.0	5 µg/L	70.7	59	118
EP075(SIM): 2.4-Dichlorophenol	120-83-2	1	µg/L	<1.0	5 µg/L	72.1	59	122
EP075(SIM): 2.4-Dimethylphenol	105-67-9	1	µg/L	<1.0	5 µg/L	67.8	60	112
EP075(SIM): 2.6-Dichlorophenol	87-65-0	1	µg/L	<1.0	5 µg/L	73.9	64	118
EP075(SIM): 2-Chlorophenol	95-57-8	1	µg/L	<1.0	5 µg/L	69.2	64	110
EP075(SIM): 2-Methylphenol	95-48-7	1	µg/L	<1.0	5 µg/L	71.6	56	112
EP075(SIM): 2-Nitrophenol	88-75-5	1	µg/L	<1.0	5 µg/L	88.7	63	117
EP075(SIM): 3- & 4-Methylphenol	1319-77-3	2	µg/L	<2.0	10 µg/L	69.4	43	114
EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	1	µg/L	<1.0	5 µg/L	66.3	63	119
EP075(SIM): Pentachlorophenol	87-86-5	2	µg/L	<2.0	10 µg/L	51.1	10	95
EP075(SIM): Phenol	108-95-2	1	µg/L	<1.0	5 µg/L	52.2	25	62

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 236428)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	2000 µg/L	99.5	59	129
EP071: C15 - C28 Fraction	----	100	µg/L	<100	3000 µg/L	95.7	71	131
EP071: C29 - C36 Fraction	----	50	µg/L	<50	2000 µg/L	96.4	62	120
EP080/071: Total Petroleum Hydrocarbons (QCLot: 237294)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	125	75	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 236428)								
EP071: >C10 - C16 Fraction	>C10_C16	100	µg/L	<100	2500 µg/L	96.4	59	131
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	3500 µg/L	98.6	74	138
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	1500 µg/L	100	67	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 237294)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	310 µg/L	124	75	127
EP080: BTEXN (QCLot: 237294)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	102	70	124
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	111	70	120
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	10 µg/L	113	69	121
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	100	70	124
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	102	72	122
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	114	65	129
EP131A: Organochlorine Pesticides (QCLot: 236992)								
EP131A: 4.4`-DDD	72-54-8	0.01	µg/L	<0.010	0.1 µg/L	96.4	36	156
EP131A: 4.4`-DDE	72-55-9	0.01	µg/L	<0.010	0.1 µg/L	104	30	124
EP131A: 4.4`-DDT	50-29-3	0.01	µg/L	<0.010	0.1 µg/L	138	30	165
EP131A: Aldrin	309-00-2	0.01	µg/L	<0.010	0.1 µg/L	107	34	150
EP131A: alpha-BHC	319-84-6	0.01	µg/L	<0.010	0.1 µg/L	119	27	161
EP131A: alpha-Endosulfan	959-98-8	0.01	µg/L	<0.010	0.1 µg/L	102	34	144
EP131A: beta-BHC	319-85-7	0.01	µg/L	<0.010	0.1 µg/L	97.4	29	149
EP131A: beta-Endosulfan	33213-65-9	0.01	µg/L	<0.010	0.1 µg/L	104	32	140
EP131A: cis-Chlordane	5103-71-9	0.01	µg/L	<0.010	0.1 µg/L	110	27	139
EP131A: delta-BHC	319-86-8	0.01	µg/L	<0.010	0.1 µg/L	118	36	150
EP131A: Dieldrin	60-57-1	0.01	µg/L	<0.010	0.1 µg/L	111	28	142
EP131A: Endosulfan (sum)	115-29-7	0.01	µg/L	<0.010	----	----	----	----
EP131A: Endosulfan sulfate	1031-07-8	0.01	µg/L	<0.010	0.1 µg/L	112	35	163
EP131A: Endrin	72-20-8	0.01	µg/L	<0.010	0.1 µg/L	94.4	22	165
EP131A: Endrin aldehyde	7421-93-4	0.01	µg/L	<0.010	0.1 µg/L	104	23	123
EP131A: Endrin ketone	53494-70-5	0.01	µg/L	<0.010	0.1 µg/L	118	16	146
EP131A: gamma-BHC	58-89-9	0.01	µg/L	<0.010	0.1 µg/L	103	29	153
EP131A: Heptachlor	76-44-8	0.005	µg/L	<0.005	0.1 µg/L	123	33	165

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP131A: Organochlorine Pesticides (QCLot: 236992) - continued								
EP131A: Heptachlor epoxide	1024-57-3	0.01	µg/L	<0.010	0.1 µg/L	122	33	149
EP131A: Hexachlorobenzene (HCB)	118-74-1	0.01	µg/L	<0.010	0.1 µg/L	111	24	150
EP131A: Methoxychlor	72-43-5	0.01	µg/L	<0.010	0.1 µg/L	108	30	166
EP131A: Sum of DDD + DDE + DDT	----	0.01	µg/L	<0.010	----	----	----	----
EP131A: Total Chlordane (sum)	----	0.01	µg/L	<0.010	----	----	----	----
EP131A: trans-Chlordane	5103-74-2	0.01	µg/L	<0.010	0.1 µg/L	87.3	31	135
EP131B: Polychlorinated Biphenyls (as Aroclors) (QCLot: 236993)								
EP131B: Aroclor 1254	11097-69-1	----	µg/L	----	1 µg/L	133	51	133
EP131B: Total Polychlorinated biphenyls	----	0.1	µg/L	<0.10	----	----	----	----
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 235752)								
EP132: 2-Methylnaphthalene	91-57-6	0.1	µg/L	<0.1	2 µg/L	94.8	59	123
EP132: 3-Methylcholanthrene	56-49-5	0.1	µg/L	<0.1	2 µg/L	75.2	60	120
EP132: 7.12-Dimethylbenz(a)anthracene	57-97-6	0.1	µg/L	<0.1	2 µg/L	81.2	12	156
EP132: Acenaphthene	83-32-9	0.1	µg/L	<0.1	2 µg/L	72.4	64	122
EP132: Acenaphthylene	208-96-8	0.1	µg/L	<0.1	2 µg/L	75.3	62	124
EP132: Anthracene	120-12-7	0.1	µg/L	<0.1	2 µg/L	76.6	66	124
EP132: Benz(a)anthracene	56-55-3	0.1	µg/L	<0.1	2 µg/L	81.3	64	130
EP132: Benzo(a)pyrene	50-32-8	0.05	µg/L	<0.05	2 µg/L	81.1	64	126
EP132: Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.1	µg/L	<0.1	2 µg/L	81.4	62	126
EP132: Benzo(e)pyrene	192-97-2	0.1	µg/L	<0.1	2 µg/L	83.9	62	126
EP132: Benzo(g.h.i)perylene	191-24-2	0.1	µg/L	<0.1	2 µg/L	78.7	56	126
EP132: Benzo(k)fluoranthene	207-08-9	0.1	µg/L	<0.1	2 µg/L	81.8	63	127
EP132: Chrysene	218-01-9	0.1	µg/L	<0.1	2 µg/L	81.8	64	128
EP132: Coronene	191-07-1	0.1	µg/L	<0.1	2 µg/L	76.2	35	133
EP132: Dibenz(a.h)anthracene	53-70-3	0.1	µg/L	<0.1	2 µg/L	80.0	58	128
EP132: Fluoranthene	206-44-0	0.1	µg/L	<0.1	2 µg/L	79.6	65	127
EP132: Fluorene	86-73-7	0.1	µg/L	<0.1	2 µg/L	76.0	64	124
EP132: Indeno(1.2.3.cd)pyrene	193-39-5	0.1	µg/L	<0.1	2 µg/L	79.8	57	127
EP132: Naphthalene	91-20-3	0.1	µg/L	<0.1	2 µg/L	71.3	60	124
EP132: Perylene	198-55-0	0.1	µg/L	<0.1	2 µg/L	78.1	64	124
EP132: Phenanthrene	85-01-8	0.1	µg/L	<0.1	2 µg/L	77.5	65	125
EP132: Pyrene	129-00-0	0.1	µg/L	<0.1	2 µg/L	80.1	66	128
EP234A: OP Pesticides (QCLot: 237579)								
EP234-1x: Acephate	30560-19-1	0.5	µg/L	<0.5	5 µg/L	128	70	130
EP234-1x: Bensulide	741-58-2	0.1	µg/L	<0.1	5 µg/L	121	70	130
EP234-1x: Formothion	2540-82-1	20	µg/L	<20	5 µg/L	109	70	130
EP234-1x: Fosetyl Aluminium	39148-24-8	10	µg/L	<10	5 µg/L	128	70	130

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP234A: OP Pesticides (QCLot: 237579) - continued								
EP234-1x: Methidathion	950-37-8	0.1	µg/L	<0.1	5 µg/L	117	70	130
EP234-1x: Naftalofos	1491-41-4	1	µg/L	<1.0	5 µg/L	109	70	130
EP234-1x: Pyrazophos	13457-18-6	0.1	µg/L	<0.1	5 µg/L	104	70	130
EP234-1x: Thiometon	640-15-3	0.5	µg/L	<0.5	5 µg/L	120	70	130
EP234A: OP Pesticides (QCLot: 237580)								
EP234-1: Azinphos-ethyl	2642-71-9	0.02	µg/L	<0.02	0.2 µg/L	99.0	75	135
EP234-1: Azinphos-methyl	86-50-0	0.02	µg/L	<0.02	0.2 µg/L	96.0	77	129
EP234-1: Bromophos-ethyl	4824-78-6	0.1	µg/L	<0.10	1 µg/L	88.8	70	130
EP234-1: Carbofenothion	786-19-6	0.02	µg/L	<0.02	0.2 µg/L	99.5	70	130
EP234-1: Chlorfenvinphos	470-90-6	0.02	µg/L	<0.02	0.4 µg/L	87.5	73	139
EP234-1: Chlorpyrifos	2921-88-2	0.02	µg/L	<0.02	0.2 µg/L	91.0	70	130
EP234-1: Chlorpyrifos-methyl	5598-13-0	0.2	µg/L	<0.2	2 µg/L	94.3	70	130
EP234-1: Coumaphos	56-72-4	0.01	µg/L	<0.01	0.1 µg/L	92.0	70	130
EP234-1: Demeton-O	298-03-0	0.02	µg/L	<0.02	0.1 µg/L	95.0	64	134
EP234-1: Demeton-O & Demeton-S	298-03-3/126-75-0	0.02	µg/L	<0.02	0.2 µg/L	92.0	79	127
EP234-1: Demeton-S	126-75-0	0.02	µg/L	<0.02	0.1 µg/L	89.0	63	135
EP234-1: Demeton-S-methyl	919-86-8	0.02	µg/L	<0.02	0.2 µg/L	95.0	76	126
EP234-1: Diazinon	333-41-5	0.01	µg/L	<0.01	0.1 µg/L	87.0	68	138
EP234-1: Dichlorvos	62-73-7	0.2	µg/L	<0.20	2 µg/L	90.0	76	128
EP234-1: Dimethoate	60-51-5	0.02	µg/L	<0.02	0.2 µg/L	102	79	127
EP234-1: Disulfoton	298-04-4	0.05	µg/L	<0.05	0.5 µg/L	93.4	72	134
EP234-1: EPN	2104-64-5	0.05	µg/L	<0.05	0.5 µg/L	91.2	70	130
EP234-1: Ethion	563-12-2	0.02	µg/L	<0.02	0.2 µg/L	95.0	70	130
EP234-1: Ethoprophos	13194-48-4	0.01	µg/L	<0.01	0.1 µg/L	97.0	78	128
EP234-1: Fenamiphos	22224-92-6	0.01	µg/L	<0.01	0.1 µg/L	97.0	71	135
EP234-1: Fenchlorphos (Ronnel)	299-84-3	10	µg/L	<10	100 µg/L	89.5	70	130
EP234-1: Fenitrothion	122-14-5	2	µg/L	<2	20 µg/L	100	64	136
EP234-1: Fensulfothion	115-90-2	0.01	µg/L	<0.01	0.1 µg/L	100	79	125
EP234-1: Fenthion	55-38-9	0.05	µg/L	<0.05	0.5 µg/L	86.2	70	130
EP234-1: Malathion	121-75-5	0.02	µg/L	<0.02	0.2 µg/L	93.0	70	130
EP234-1: Mevinphos	7786-34-7	0.02	µg/L	<0.02	0.4 µg/L	100	78	126
EP234-1: Monocrotophos	6923-22-4	0.02	µg/L	<0.02	0.2 µg/L	102	82	124
EP234-1: Omethoate	1113-02-6	0.01	µg/L	<0.01	0.1 µg/L	101	74	130
EP234-1: Parathion	56-38-2	0.2	µg/L	<0.2	2 µg/L	100	69	139
EP234-1: Parathion-methyl	298-00-0	0.5	µg/L	<0.5	20 µg/L	118	66	140
EP234-1: Phorate	298-02-2	0.1	µg/L	<0.1	1 µg/L	90.0	68	136
EP234-1: Pirimiphos-ethyl	23505-41-1	0.01	µg/L	<0.01	0.1 µg/L	91.0	70	130
EP234-1: Pirimiphos-methyl	29232-93-7	0.01	µg/L	<0.01	0.1 µg/L	94.0	71	137

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EP234A: OP Pesticides (QCLot: 237580) - continued								
EP234-1: Profenofos	41198-08-7	0.01	µg/L	<0.01	0.1 µg/L	95.0	70	130
EP234-1: Prothiofos	34643-46-4	0.1	µg/L	<0.1	1 µg/L	86.9	70	130
EP234-1: Sulfotep	3689-24-5	0.005	µg/L	<0.005	0.05 µg/L	92.0	71	137
EP234-1: Sulprofos	35400-43-2	0.05	µg/L	<0.05	0.5 µg/L	88.8	70	130
EP234-1: Temephos	3383-96-8	0.02	µg/L	<0.02	0.2 µg/L	104	70	130
EP234-1: Terbufos	13071-79-9	0.01	µg/L	<0.01	0.1 µg/L	93.0	70	130
EP234-1: Tetrachlorvinphos	22248-79-9	0.01	µg/L	<0.01	0.1 µg/L	87.0	74	128
EP234-1: Triazophos	24017-47-8	0.005	µg/L	<0.005	0.05 µg/L	96.0	77	131
EP234-1: Trichlorfon	52-68-6	0.02	µg/L	<0.02	0.2 µg/L	120	70	130
EP234-1: Trichloronate	327-98-0	0.5	µg/L	<0.5	5 µg/L	83.9	63	139

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Recovery Limits (%): Low	Recovery Limits (%): High
EG020F: Dissolved Metals by ICP-MS (QCLot: 237483)							
EN1513381-011	Anonymous	EG020A-F: Arsenic	7440-38-2	0.2 mg/L	118	70	130
		EG020A-F: Cadmium	7440-43-9	0.05 mg/L	125	70	130
		EG020A-F: Chromium	7440-47-3	0.2 mg/L	107	70	130
		EG020A-F: Copper	7440-50-8	0.2 mg/L	113	70	130
		EG020A-F: Lead	7439-92-1	0.2 mg/L	109	70	130
		EG020A-F: Manganese	7439-96-5	0.2 mg/L	120	70	130
		EG020A-F: Nickel	7440-02-0	0.2 mg/L	119	70	130
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	121	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 237484)							
ES1532846-046	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	79.4	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 237814)							
ES1532954-001	BD1/021015	EK055G: Ammonia as N	7664-41-7	1 mg/L	72.2	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 235442)							
ES1532887-010	Anonymous	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	103	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 237813)							
ES1532954-001	BD1/021015	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	105	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 237771)							
ES1533079-002	Anonymous						

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 237771) - continued							
ES1533079-002	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	# Not Determined	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 237294)							
ES1532924-003	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	111	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 237294)							
ES1532924-003	Anonymous	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	110	70	130
EP080: BTEXN (QCLot: 237294)							
ES1532924-003	Anonymous	EP080: Benzene	71-43-2	25 µg/L	103	70	130
		EP080: Ethylbenzene	100-41-4	25 µg/L	104	70	130
		EP080: meta- & para-Xylene	108-38-3 106-42-3	25 µg/L	103	70	130
		EP080: Naphthalene	91-20-3	25 µg/L	84.4	70	130
		EP080: ortho-Xylene	95-47-6	25 µg/L	102	70	130
		EP080: Toluene	108-88-3	25 µg/L	103	70	130
EP234A: OP Pesticides (QCLot: 237579)							
ES1532954-001	BD1/021015	EP234-1x: Acephate	30560-19-1	5 µg/L	88.4	70	130
		EP234-1x: Bensulide	741-58-2	5 µg/L	99.5	70	130
		EP234-1x: Formothion	2540-82-1	5 µg/L	87.7	70	130
		EP234-1x: Fosetyl Aluminium	39148-24-8	5 µg/L	91.3	70	130
		EP234-1x: Methidathion	950-37-8	5 µg/L	99.7	70	130
		EP234-1x: Naftalofos	1491-41-4	5 µg/L	102	70	130
		EP234-1x: Pyrazophos	13457-18-6	5 µg/L	117	70	130
		EP234-1x: Thiometon	640-15-3	5 µg/L	94.0	70	130
EP234A: OP Pesticides (QCLot: 237580)							
ES1532954-001	BD1/021015	EP234-1: Azinphos-ethyl	2642-71-9	0.2 µg/L	90.5	70	130
		EP234-1: Azinphos-methyl	86-50-0	0.2 µg/L	84.0	70	130
		EP234-1: Bromophos-ethyl	4824-78-6	1 µg/L	88.1	70	130
		EP234-1: Carbofenothion	786-19-6	0.2 µg/L	90.5	70	130
		EP234-1: Chlorfenvinphos	470-90-6	0.4 µg/L	90.0	70	130
		EP234-1: Chlorpyrifos	2921-88-2	0.2 µg/L	102	70	130
		EP234-1: Chlorpyrifos-methyl	5598-13-0	2 µg/L	95.6	58	136
		EP234-1: Coumaphos	56-72-4	0.1 µg/L	82.0	70	130
		EP234-1: Demeton-O	298-03-0	0.1 µg/L	83.0	70	130
		EP234-1: Demeton-O & Demeton-S	298-03-3/126 -75-0	0.2 µg/L	80.0	69	129
		EP234-1: Demeton-S	126-75-0	0.1 µg/L	77.0	70	130
		EP234-1: Demeton-S-methyl	919-86-8	0.2 µg/L	# 64.0	70	130
		EP234-1: Diazinon	333-41-5	0.1 µg/L	86.0	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP234A: OP Pesticides (QCLot: 237580) - continued							
ES1532954-001	BD1/021015	EP234-1: Dichlorvos	62-73-7	2 µg/L	# 58.2	70	130
		EP234-1: Dimethoate	60-51-5	0.2 µg/L	102	69	131
		EP234-1: Disulfoton	298-04-4	0.5 µg/L	81.8	70	130
		EP234-1: EPN	2104-64-5	0.5 µg/L	97.2	70	130
		EP234-1: Ethion	563-12-2	0.2 µg/L	100	70	130
		EP234-1: Ethoprophos	13194-48-4	0.1 µg/L	86.0	70	132
		EP234-1: Fenamiphos	22224-92-6	0.1 µg/L	79.0	70	130
		EP234-1: Fenchlorphos (Ronnel)	299-84-3	100 µg/L	104	71	133
		EP234-1: Fenitrothion	122-14-5	20 µg/L	91.8	64	136
		EP234-1: Fensulfothion	115-90-2	0.1 µg/L	86.0	83	123
		EP234-1: Fenthion	55-38-9	0.5 µg/L	85.6	70	130
		EP234-1: Malathion	121-75-5	0.2 µg/L	84.5	70	130
		EP234-1: Mevinphos	7786-34-7	0.4 µg/L	93.5	69	125
		EP234-1: Monocrotophos	6923-22-4	0.2 µg/L	101	70	128
		EP234-1: Omethoate	1113-02-6	0.1 µg/L	93.0	70	130
		EP234-1: Parathion	56-38-2	2 µg/L	84.6	70	130
		EP234-1: Parathion-methyl	298-00-0	20 µg/L	104	70	140
		EP234-1: Phorate	298-02-2	1 µg/L	100	70	130
		EP234-1: Pirimiphos-ethyl	23505-41-1	0.1 µg/L	98.0	70	130
		EP234-1: Pirimiphos-methyl	29232-93-7	0.1 µg/L	85.0	70	130
		EP234-1: Profenofos	41198-08-7	0.1 µg/L	96.0	70	130
		EP234-1: Prothiofos	34643-46-4	1 µg/L	88.2	70	130
		EP234-1: Sulfotep	3689-24-5	0.05 µg/L	92.0	63	135
		EP234-1: Sulprofos	35400-43-2	0.5 µg/L	103	70	130
		EP234-1: Temephos	3383-96-8	0.2 µg/L	114	70	130
		EP234-1: Terbufos	13071-79-9	0.1 µg/L	84.0	70	130
		EP234-1: Tetrachlorvinphos	22248-79-9	0.1 µg/L	89.0	77	125
		EP234-1: Triazophos	24017-47-8	0.05 µg/L	96.0	74	132
		EP234-1: Trichlorfon	52-68-6	0.2 µg/L	116	70	130
		EP234-1: Trichloronate	327-98-0	5 µg/L	84.8	63	139

ALS Environmental

QA/QC Compliance Assessment for DQO Reporting

Work Order	: **ES1532954**	Page	: 1 of 8
Client	: **DOUGLAS PARTNERS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR JOHN RUSSELL	Telephone	: 07 3552 8657
Project	: 71459.03 MOOREBANK	Date Samples Received	: 06-Oct-2015
Site	: ----	Issue Date	: 13-Oct-2015
Sampler	: ----	No. of samples received	: 1
Order number	: 123475	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EK067G: Total Phosphorus as P by Discrete Analyser	ES1533079--002	Anonymous	**Total Phosphorus as P**	----	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
EP234A: OP Pesticides	ES1532954--001	BD1/021015	**Demeton-S-methyl**	919-86-8	64.0 %	70-130%	**Recovery less than lower data quality objective**
EP234A: OP Pesticides	ES1532954--001	BD1/021015	**Dichlorvos**	62-73-7	58.2 %	70-130%	**Recovery less than lower data quality objective**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EK057G: Nitrite as N by Discrete Analyser						
Clear Plastic Bottle - Natural						
BD1/021015	----	----	----	07-Oct-2015	04-Oct-2015	**3**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type / Method	Count		Rate (%)		Quality Control Specification
	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
Organochlorine Pesticides (Ultra-trace)	0	2	0.00	10.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	0	8	0.00	10.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PCB's (Ultra-trace)	0	1	0.00	10.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Semivolatile Compounds by GCMS(SIM - Ultra-trace)	0	9	0.00	10.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	0	16	0.00	10.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)					
Organochlorine Pesticides (Ultra-trace)	0	2	0.00	5.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	0	8	0.00	5.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PCB's (Ultra-trace)	0	1	0.00	5.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Semivolatile Compounds by GCMS(SIM - Ultra-trace)	0	9	0.00	5.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	0	16	0.00	5.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
BD1/021015	**02-Oct-2015**	**----**	----	----	**09-Oct-2015**	30-Mar-2016	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)							
BD1/021015	**02-Oct-2015**	**----**	----	----	**12-Oct-2015**	30-Oct-2015	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
BD1/021015	**02-Oct-2015**	**----**	----	----	**09-Oct-2015**	30-Oct-2015	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G)							
BD1/021015	**02-Oct-2015**	**----**	----	----	**07-Oct-2015**	04-Oct-2015	×
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
BD1/021015	**02-Oct-2015**	**----**	----	----	**09-Oct-2015**	30-Oct-2015	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G)							
BD1/021015	**02-Oct-2015**	**09-Oct-2015**	30-Oct-2015	✓	**09-Oct-2015**	30-Oct-2015	✓
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071)							
BD1/021015	**02-Oct-2015**	**07-Oct-2015**	09-Oct-2015	✓	**08-Oct-2015**	16-Nov-2015	✓
EP075(SIM)T: PAH Surrogates							
Amber Glass Bottle - Unpreserved (EP075(SIM))							
BD1/021015	**02-Oct-2015**	**07-Oct-2015**	09-Oct-2015	✓	**09-Oct-2015**	16-Nov-2015	✓
EP080S: TPH(V)/BTEX Surrogates							
Amber VOC Vial - HCl (EP080)							
BD1/021015	**02-Oct-2015**	**12-Oct-2015**	16-Oct-2015	✓	**12-Oct-2015**	16-Oct-2015	✓
EP131A: Organochlorine Pesticides							
Amber Glass Bottle - Unpreserved (EP131A)							
BD1/021015	**02-Oct-2015**	**08-Oct-2015**	09-Oct-2015	✓	**08-Oct-2015**	17-Nov-2015	✓
EP131B: Polychlorinated Biphenyls (as Aroclors)							
Amber Glass Bottle - Unpreserved (EP131B)							
BD1/021015	**02-Oct-2015**	**08-Oct-2015**	09-Oct-2015	✓	**08-Oct-2015**	17-Nov-2015	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP132B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP132)							
BD1/021015	**02-Oct-2015**	**07-Oct-2015**	09-Oct-2015	✓	**09-Oct-2015**	16-Nov-2015	✓
EP234A: OP Pesticides							
Amber Glass Bottle - Unpreserved (EP234-1)							
BD1/021015	**02-Oct-2015**	**----**	----	----	**09-Oct-2015**	09-Oct-2015	✓
EP234A: OP Pesticides							
Amber Glass Bottle - Unpreserved (EP234-1x)							
BD1/021015	**02-Oct-2015**	**----**	----	----	**09-Oct-2015**	09-Oct-2015	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	2	20	**10.00**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	2	18	**11.11**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	**10.00**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	20	**10.00**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	2	20	**10.00**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Organochlorine Pesticides (Ultra-trace)	EP131A	0	2	**0.00**	**10.00**	×	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	8	**0.00**	**10.00**	×	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PCB's (Ultra-trace)	EP131B	0	1	**0.00**	**10.00**	×	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Pesticides by LCMSMS (Positive Ion Mode)	EP234-1	1	1	**100.00**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Pesticides by LCMSMS (Positive Ion Mode) - extended	EP234-1x	1	1	**100.00**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Semivolatile Compounds by GCMS(SIM - Ultra-trace)	EP132	0	9	**0.00**	**10.00**	×	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	2	14	**14.29**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	0	16	**0.00**	**10.00**	×	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	1	7	**14.29**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	18	**5.56**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	**5.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Organochlorine Pesticides (Ultra-trace)	EP131A	1	2	**50.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	8	**12.50**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PCB's (Ultra-trace)	EP131B	1	1	**100.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Pesticides by LCMSMS (Positive Ion Mode)	EP234-1	1	1	**100.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Pesticides by LCMSMS (Positive Ion Mode) - extended	EP234-1x	1	1	**100.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Semivolatile Compounds by GCMS(SIM - Ultra-trace)	EP132	1	9	**11.11**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	3	14	**21.43**	**15.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	1	16	**6.25**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	1	7	**14.29**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	18	**5.56**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	**5.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Organochlorine Pesticides (Ultra-trace)	EP131A	1	2	**50.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	8	**12.50**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PCB's (Ultra-trace)	EP131B	1	1	**100.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Pesticides by LCMSMS (Positive Ion Mode)	EP234-1	1	1	**100.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Pesticides by LCMSMS (Positive Ion Mode) - extended	EP234-1x	1	1	**100.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Semivolatile Compounds by GCMS(SIM - Ultra-trace)	EP132	1	9	**11.11**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	1	14	**7.14**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	1	16	**6.25**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	1	7	**14.29**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	18	**5.56**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	**5.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Organochlorine Pesticides (Ultra-trace)	EP131A	0	2	**0.00**	**5.00**	×	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	8	**0.00**	**5.00**	×	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PCB's (Ultra-trace)	EP131B	0	1	**0.00**	**5.00**	×	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Pesticides by LCMSMS (Positive Ion Mode)	EP234-1	1	1	**100.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Pesticides by LCMSMS (Positive Ion Mode) - extended	EP234-1x	1	1	**100.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Semivolatile Compounds by GCMS(SIM - Ultra-trace)	EP132	0	9	**0.00**	**5.00**	×	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	1	14	**7.14**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	0	16	**0.00**	**5.00**	×	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	1	7	**14.29**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45 um filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
Organochlorine Pesticides (Ultra-trace)	EP131A	WATER	USEPA Method 3640 (GPC cleanup),3620 (Florisil), 8081/8082 (GC/uECD/uECD). This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
PCB's (Ultra-trace)	EP131B	WATER	USEPA Method 3640 (GPC cleanup),3620 (Florisil), 8081/8082 (GC/uECD/uECD). This method is compliant with NEPM (2013) Schedule B(3)
Semivolatile Compounds by GCMS(SIM - Ultra-trace)	EP132	WATER	USEPA 3640 (GPC Cleanup), 8270 GCMS Capiliary column, SIM mode. This method is compliant with NEPM (2013) Schedule B(3)
Pesticides by LCMSMS (Positive Ion Mode)	EP234-1	WATER	In-House, LC-MSMS, direct injection. A sample is filtered and injected directly onto the LC-MSMS. Analysis is by LC/MSMS, ESI Positive Mode.
Pesticides by LCMSMS (Positive Ion Mode) - extended	EP234-1x	WATER	In-House, LC-MSMS, direct injection. A sample is filtered and injected directly onto the LC-MSMS. Analysis is by LC/MSMS, ESI Positive Mode.

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **ES1532954**

Client	: **DOUGLAS PARTNERS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR JOHN RUSSELL	Contact	: Jenny Bevan
Address	: PO BOX 472 96 HERMITAGE ROAD WEST RYDE NSW, AUSTRALIA 1685	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: john.russell@douglaspartners.com.au	E-mail	: jenny.bevan@alsglobal.com
Telephone	: +61 02 49609600	Telephone	: 07 3552 8657
Facsimile	: +61 02 49609601	Facsimile	: +61-2-8784 8500
Project	: 71459.03 MOOREBANK	Page	: 1 of 3
Order number	: 123475	Quote number	: EB2014DOUPAR0262 (EN/020/14)
C-O-C number	: ----	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
Sampler	:		

Dates

Date Samples Received	: 06-Oct-2015 4:30 PM	Issue Date	: 07-Oct-2015
Client Requested Due Date	: 13-Oct-2015	Scheduled Reporting Date	: **13-Oct-2015**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: 16.7 - Ice Bricks present
Receipt Detail	:	No. of samples received / analysed	: 1 / 1

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- **Sample(s) requiring volatile organic compound analysis received in airtight containers (ZHE).**
- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exist.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

Matrix: **WATER**

Laboratory sample ID	Client sampling date / time	Client sample ID	WATER - EG020F Dissolved Metals by ICPMS	WATER - EK055G Ammonia as N By Discrete Analyser	WATER - EP075 SIM Phenols only SIM - Phenols only	WATER - EP132(PAH) Ultra Trace Polynuclear Aromatic Compounds	WATER - NT-04 Nitrite and Nitrate	WATER - UTO-3W Ultratrace OP / OC / PCB Pesticides	WATER - W-05 TRH/BTEXN/8 Metals
ES1532954-001	[02-Oct-2015]	BD1/021015	✓	✓	✓	✓	✓	✓	✓

Matrix: **WATER**

Laboratory sample ID	Client sampling date / time	Client sample ID	WATER - EK067G Total Phosphorus as P By Discrete Analyser
ES1532954-001	[02-Oct-2015]	BD1/021015	✓

Proactive Holding Time Report

The following table summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory.

Matrix: **WATER** Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Client Sample ID(s)	Container	Due for extraction	Due for analysis	Samples Received Date	Samples Received Evaluation	Instructions Received Date	Instructions Received Evaluation
EK057G: Nitrite as N by Discrete Analyser							
BD1/021015	Clear Plastic Bottle - Natural	----	04-Oct-2015	06-Oct-2015	×	----	----

Requested Deliverables

JOHN RUSSELL

- *AU Certificate of Analysis - NATA (COA)	Email	john.russell@douglaspartners.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	john.russell@douglaspartners.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	john.russell@douglaspartners.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	john.russell@douglaspartners.com.au
- A4 - AU Tax Invoice (INV)	Email	john.russell@douglaspartners.com.au
- Chain of Custody (CoC) (COC)	Email	john.russell@douglaspartners.com.au
- EDI Format - ENMRG (ENMRG)	Email	john.russell@douglaspartners.com.au
- EDI Format - ESDAT (ESDAT)	Email	john.russell@douglaspartners.com.au
- EDI Format - XTab (XTAB)	Email	john.russell@douglaspartners.com.au

CHAIN OF CUSTODY

Douglas Partners
Geotechnics / Environment / Groundwater

Client: Douglas Partners	**Project Number** 71459.03	**To:**	Envirolab Services
Contact Person: John Russell	**Project Name:** Moorebank	**Contact Person:**	Aileen Hie
Project Mgr: John Russell	**PO No.:** 123475	**Address:**	12 Ashley Street
	lab Quote No. :		Chatswood NSW 2068
Address: 96 Hermitage Road	**Date results required:** standard	**Phone:**	02 9910 6200
West Ryde NSW 2114	**Or choose:** standard	**Fax:**	02 9910 6201
	Note: Inform lab in advance if urgent turnaround is required - surcharges apply	**Email:**	ahie@envirolab.com.au
Phone: 9809 0666 **Mob:** 0422 000 434	**Report format:** esdat / PDF / Excel	**Laboratory Report No:**	
Email: john.russell@douglaspartners.com.au	**Comments:**	**Lab Comments:**	

Lab Sample ID	Field Sample ID	Depth	Date sampled	Container Type	Type of sample	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn, Mn	TRH/BTEX	PAH (low)	OCP/OPP/ PCB (trace)	Phenols	nitrate/nitrite/ ammonia	Phosphorous	sulphate/ chloride	VOC		Combo	Comments: Provide as much information about the sample as you can
						Tests Required											
1	BH/MW216		1/10/2015	p/g	w	X	X	X	X	X	X	X	X	X		3L	Hydrocarbon odour
2	BH/MW218		1/10/2015	p/g	w	X	X	X	X	X	X	X	X	X		3L	
3	JKBH/MW1	(JK lost Date)	2/10/2015	p/g	w	X	X	X	X	X	X	X	X	X		3L	
4	JKBH/MW16		1/10/2015	p/g	w	X	X	X	X	X	X	X	X	X		3L	
5	JKBH/MW107A		1/10/2015	p/g	w	X	X	X	X	X	X	X	X	X		3L	
6	SW1		1/10/2015	p/g	w	X	X	X	X	X	X	X	X	X		3L	
7	SW2		1/10/2015	p/g	w	X	X	X	X	X	X	X	X	X		3L	Possibly quite saline
8	SW3		2/10/2015	p/g	w	X	X	X	X	X	X	X	X	X		3L	Possibly quite saline
9	BD2/011015		1/10/2015	p/g	w	X	X	X	X	X	X	X	X	X		3L	Possibly quite saline
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
11	R1/021015		2/10/2015	p/g	w	X	X	X	X	X						3L	
12	Spike						X										
13	Blank						X										
14	Spike						X										
15	Blank						X										
extra → 16	BD/011015																

(1)

ENVIROLAB GROUP
Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 135368

Date Received: 2-10-15
Time Received: 1545
Received by: CB
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Environmental Division
Sydney
Work Order Reference
ES1532954

Telephone : +61-2-8784 8555

Relinquished by: Douglas Partners	EL	**Sample Receipt**	Ravi ALS
Courier (by whom) HUNTER EXPRESS		**Received by (Company):** ELS.	
Condition of Sample at dispatch Cool or Ambient (circle)		**Print Name:** CALUM BONSER.	6/10/15 1230
Temperature (if Applicable):		**Date & Time:** 2.10.15 1545	
Print Name: John Russell	PT	**Signature:** CB	
Date & Time 2/10/15; 2pm	6/10/15		
Signature:	12:00		

Lab use only:
Samples Received: Cool or Ambient (circle one)
Temperature Received at: 17.8 **(if applicable)**
Transported by: Hand delivered / courier

12 Ashley Street, Chatswood, NSW 2067
tel: +61 2 9910 6200

email: sydney@envirolab.com.au
envirolab.com.au

Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 135368

Client:
Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: John Russell

Sample log in details:

Your Reference:	**71459.03, Moorebank**
No. of samples:	16 Waters
Date samples received / completed instructions received	02/10/2015 / 02/10/2015

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	12/10/15 / 15/10/15
Date of Preliminary Report:	Not Issued

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Jacinta Hurst
Laboratory Manager

VOCs in water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	135368-1 BH/MW216 1/10/2015 Water	135368-2 BH/MW218 1/10/2015 Water	135368-3 JKBH/MW1 2/10/2015 Water	135368-4 JKBH/MW16 1/10/2015 Water	135368-5 JKBH/MW107 A 1/10/2015 Water
Date extracted	-	08/10/2015	08/10/2015	08/10/2015	08/10/2015	08/10/2015
Date analysed	-	08/10/2015	08/10/2015	08/10/2015	08/10/2015	08/10/2015
Dichlorodifluoromethane	µg/L	<10	<100	<10	<10	<10
Chloromethane	µg/L	<10	<100	<10	<10	<10
Vinyl Chloride	µg/L	<10	<100	<10	<10	<10
Bromomethane	µg/L	<10	<100	<10	<10	<10
Chloroethane	µg/L	<10	<100	<10	<10	<10
Trichlorofluoromethane	µg/L	<10	<100	<10	<10	<10
1,1-Dichloroethene	µg/L	<1	<10	<1	<1	<1
Trans-1,2-dichloroethene	µg/L	<1	<10	<1	<1	<1
1,1-dichloroethane	µg/L	<1	<10	<1	<1	<1
Cis-1,2-dichloroethene	µg/L	<1	<10	<1	<1	<1
Bromochloromethane	µg/L	<1	<10	<1	<1	<1
Chloroform	µg/L	<1	<10	<1	<1	<1
2,2-dichloropropane	µg/L	<1	<10	<1	<1	<1
1,2-dichloroethane	µg/L	<1	<10	<1	<1	<1
1,1,1-trichloroethane	µg/L	<1	<10	<1	<1	<1
1,1-dichloropropene	µg/L	<1	<10	<1	<1	<1
Cyclohexane	µg/L	<1	<10	<1	<1	<1
Carbon tetrachloride	µg/L	<1	<10	<1	<1	<1
Benzene	µg/L	<1	<10	<1	<1	<1
Dibromomethane	µg/L	<1	<10	<1	<1	<1
1,2-dichloropropane	µg/L	<1	<10	<1	<1	<1
Trichloroethene	µg/L	<1	<10	<1	<1	<1
Bromodichloromethane	µg/L	<1	<10	<1	<1	<1
trans-1,3-dichloropropene	µg/L	<1	<10	<1	<1	<1
cis-1,3-dichloropropene	µg/L	<1	<10	<1	<1	<1
1,1,2-trichloroethane	µg/L	<1	<10	<1	<1	<1
Toluene	µg/L	<1	<10	<1	<1	<1
1,3-dichloropropane	µg/L	<1	<10	<1	<1	<1
Dibromochloromethane	µg/L	<1	<10	<1	<1	<1
1,2-dibromoethane	µg/L	<1	<10	<1	<1	<1
Tetrachloroethene	µg/L	<1	<10	<1	<1	<1
1,1,1,2-tetrachloroethane	µg/L	<1	<10	<1	<1	<1
Chlorobenzene	µg/L	<1	<10	<1	<1	<1
Ethylbenzene	µg/L	<1	<10	<1	<1	<1
Bromoform	µg/L	<1	<10	<1	<1	<1
m+p-xylene	µg/L	<2	<20	<2	<2	<2
Styrene	µg/L	<1	<10	<1	<1	<1
1,1,2,2-tetrachloroethane	µg/L	<1	<10	<1	<1	<1
o-xylene	µg/L	<1	<10	<1	<1	<1

VOCs in water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	135368-1 BH/MW216 1/10/2015 Water	135368-2 BH/MW218 1/10/2015 Water	135368-3 JKBH/MW1 2/10/2015 Water	135368-4 JKBH/MW16 1/10/2015 Water	135368-5 JKBH/MW107 A 1/10/2015 Water
1,2,3-trichloropropane	µg/L	<1	<10	<1	<1	<1
Isopropylbenzene	µg/L	<1	<10	<1	<1	<1
Bromobenzene	µg/L	<1	<10	<1	<1	<1
n-propyl benzene	µg/L	<1	<10	<1	<1	<1
2-chlorotoluene	µg/L	<1	<10	<1	<1	<1
4-chlorotoluene	µg/L	<1	<10	<1	<1	<1
1,3,5-trimethyl benzene	µg/L	<1	<10	<1	<1	<1
Tert-butyl benzene	µg/L	<1	<10	<1	<1	<1
1,2,4-trimethyl benzene	µg/L	<1	<10	<1	<1	<1
1,3-dichlorobenzene	µg/L	<1	<10	<1	<1	<1
Sec-butyl benzene	µg/L	<1	<10	<1	<1	<1
1,4-dichlorobenzene	µg/L	<1	<10	<1	<1	<1
4-isopropyl toluene	µg/L	<1	<10	<1	<1	<1
1,2-dichlorobenzene	µg/L	<1	<10	<1	<1	<1
n-butyl benzene	µg/L	<1	<10	<1	<1	<1
1,2-dibromo-3-chloropropane	µg/L	<1	<10	<1	<1	<1
1,2,4-trichlorobenzene	µg/L	<1	<10	<1	<1	<1
Hexachlorobutadiene	µg/L	<1	<10	<1	<1	<1
1,2,3-trichlorobenzene	µg/L	<1	<10	<1	<1	<1
Surrogate Dibromofluoromethane	%	84	73	78	82	78
Surrogate toluene-d8	%	76	76	75	76	75
Surrogate 4-BFB	%	84	73	78	82	78

VOCs in water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	135368-6 SW1 1/10/2015 Water	135368-7 SW2 1/10/2015 Water	135368-8 SW3 2/10/2015 Water	135368-9 BD2/011015 1/10/2015 Water
Date extracted	-	06/10/2015	08/10/2015	06/10/2015	08/10/2015
Date analysed	-	08/10/2015	08/10/2015	08/10/2015	08/10/2015
Dichlorodifluoromethane	µg/L	<10	<10	<10	<10
Chloromethane	µg/L	<10	<10	<10	<10
Vinyl Chloride	µg/L	<10	<10	<10	<10
Bromomethane	µg/L	<10	<10	<10	<10
Chloroethane	µg/L	<10	<10	<10	<10
Trichlorofluoromethane	µg/L	<10	<10	<10	<10
1,1-Dichloroethene	µg/L	<1	<1	<1	<1
Trans-1,2-dichloroethene	µg/L	<1	<1	<1	<1
1,1-dichloroethane	µg/L	<1	<1	<1	<1
Cis-1,2-dichloroethene	µg/L	<1	<1	<1	<1
Bromochloromethane	µg/L	<1	<1	<1	<1
Chloroform	µg/L	<1	<1	<1	<1
2,2-dichloropropane	µg/L	<1	<1	<1	<1
1,2-dichloroethane	µg/L	<1	<1	<1	<1
1,1,1-trichloroethane	µg/L	<1	<1	<1	<1
1,1-dichloropropene	µg/L	<1	<1	<1	<1
Cyclohexane	µg/L	<1	<1	<1	<1
Carbon tetrachloride	µg/L	<1	<1	<1	<1
Benzene	µg/L	<1	<1	<1	<1
Dibromomethane	µg/L	<1	<1	<1	<1
1,2-dichloropropane	µg/L	<1	<1	<1	<1
Trichloroethene	µg/L	<1	<1	<1	<1
Bromodichloromethane	µg/L	<1	<1	<1	<1
trans-1,3-dichloropropene	µg/L	<1	<1	<1	<1
cis-1,3-dichloropropene	µg/L	<1	<1	<1	<1
1,1,2-trichloroethane	µg/L	<1	<1	<1	<1
Toluene	µg/L	<1	<1	<1	<1
1,3-dichloropropane	µg/L	<1	<1	<1	<1
Dibromochloromethane	µg/L	<1	<1	<1	<1
1,2-dibromoethane	µg/L	<1	<1	<1	<1
Tetrachloroethene	µg/L	<1	<1	<1	<1
1,1,1,2-tetrachloroethane	µg/L	<1	<1	<1	<1
Chlorobenzene	µg/L	<1	<1	<1	<1
Ethylbenzene	µg/L	<1	<1	<1	<1
Bromoform	µg/L	<1	<1	<1	<1
m+p-xylene	µg/L	<2	<2	<2	<2
Styrene	µg/L	<1	<1	<1	<1
1,1,2,2-tetrachloroethane	µg/L	<1	<1	<1	<1
o-xylene	µg/L	<1	<1	<1	<1
1,2,3-trichloropropane	µg/L	<1	<1	<1	<1
Isopropylbenzene	µg/L	<1	<1	<1	<1

VOCs in water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	135368-6 SW1 1/10/2015 Water	135368-7 SW2 1/10/2015 Water	135368-8 SW3 2/10/2015 Water	135368-9 BD2/011015 1/10/2015 Water
Bromobenzene	µg/L	<1	<1	<1	<1
n-propyl benzene	µg/L	<1	<1	<1	<1
2-chlorotoluene	µg/L	<1	<1	<1	<1
4-chlorotoluene	µg/L	<1	<1	<1	<1
1,3,5-trimethyl benzene	µg/L	<1	<1	<1	<1
Tert-butyl benzene	µg/L	<1	<1	<1	<1
1,2,4-trimethyl benzene	µg/L	<1	<1	<1	<1
1,3-dichlorobenzene	µg/L	<1	<1	<1	<1
Sec-butyl benzene	µg/L	<1	<1	<1	<1
1,4-dichlorobenzene	µg/L	<1	<1	<1	<1
4-isopropyl toluene	µg/L	<1	<1	<1	<1
1,2-dichlorobenzene	µg/L	<1	<1	<1	<1
n-butyl benzene	µg/L	<1	<1	<1	<1
1,2-dibromo-3-chloropropane	µg/L	<1	<1	<1	<1
1,2,4-trichlorobenzene	µg/L	<1	<1	<1	<1
Hexachlorobutadiene	µg/L	<1	<1	<1	<1
1,2,3-trichlorobenzene	µg/L	<1	<1	<1	<1
Surrogate Dibromofluoromethane	%	87	86	88	84
Surrogate toluene-d8	%	89	77	90	77
Surrogate 4-BFB	%	87	86	88	84

vTRH(C6-C10)/BTEXN in Water						
Our Reference:	UNITS	135368-1	135368-2	135368-3	135368-4	135368-5
Your Reference	----------	BH/MW216	BH/MW218	JKBH/MW1	JKBH/MW16	JKBH/MW107 A
Date Sampled	----------	1/10/2015	1/10/2015	2/10/2015	1/10/2015	1/10/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	08/10/2015	08/10/2015	08/10/2015	08/10/2015	08/10/2015
Date analysed	-	08/10/2015	08/10/2015	08/10/2015	08/10/2015	08/10/2015
$TRHC_6$ - C_9	µg/L	<10	<100	<10	<10	<10
$TRHC_6$ - C_{10}	µg/L	<10	<100	<10	<10	<10
$TRHC_6$ - C_{10} less BTEX (F1)	µg/L	<10	<10	<10	<10	<10
Benzene	µg/L	<1	<10	<1	<1	<1
Toluene	µg/L	<1	<10	<1	<1	<1
Ethylbenzene	µg/L	<1	<10	<1	<1	<1
m+p-xylene	µg/L	<2	<20	<2	<2	<2
o-xylene	µg/L	<1	<10	<1	<1	<1
Naphthalene	µg/L	<1	<10	<1	<1	<1
Surrogate Dibromofluoromethane	%	104	106	105	104	103
Surrogate toluene-d8	%	76	76	75	76	75
Surrogate 4-BFB	%	84	73	78	82	78

vTRH(C6-C10)/BTEXN in Water						
Our Reference:	UNITS	135368-6	135368-7	135368-8	135368-9	135368-11
Your Reference	----------	SW1	SW2	SW3	BD2/011015	R1/021015
Date Sampled	----------	1/10/2015	1/10/2015	2/10/2015	1/10/2015	2/10/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	06/10/2015	08/10/2015	06/10/2015	08/10/2015	06/10/2015
Date analysed	-	08/10/2015	08/10/2015	08/10/2015	08/10/2015	07/10/2015
$TRHC_6$ - C_9	µg/L	<10	<10	<10	<10	<10
$TRHC_6$ - C_{10}	µg/L	<10	<10	<10	<10	<10
$TRHC_6$ - C_{10} less BTEX (F1)	µg/L	<10	<10	<10	<10	<10
Benzene	µg/L	<1	<1	<1	<1	<1
Toluene	µg/L	<1	<1	<1	<1	<1
Ethylbenzene	µg/L	<1	<1	<1	<1	<1
m+p-xylene	µg/L	<2	<2	<2	<2	<2
o-xylene	µg/L	<1	<1	<1	<1	<1
Naphthalene	µg/L	<1	<1	<1	<1	<1
Surrogate Dibromofluoromethane	%	102	102	102	104	104
Surrogate toluene-d8	%	89	77	90	77	93
Surrogate 4-BFB	%	87	86	88	84	96

vTRH(C6-C10)/BTEXN in Water					
Our Reference:	UNITS	135368-12	135368-13	135368-14	135368-15
Your Reference	----------	Spike	Blank	Spike	Blank
Date Sampled	----------	1/10/2015	1/10/2015	1/10/2015	1/10/2015
Type of sample		Water	Water	Water	Water
Date extracted	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Date analysed	-	07/10/2015	07/10/2015	07/10/2015	07/10/2015
TRHC$_6$ - C$_9$	µg/L	[NA]	<10	[NA]	<10
TRHC$_6$ - C$_{10}$	µg/L	[NA]	<10	[NA]	<10
Benzene	µg/L	105%	<1	104%	<1
Toluene	µg/L	95%	<1	94%	<1
Ethylbenzene	µg/L	100%	<1	100%	<1
m+p-xylene	µg/L	100%	<2	101%	<2
o-xylene	µg/L	101%	<1	102%	<1
Surrogate Dibromofluoromethane	%	103	103	102	101
Surrogate toluene-d8	%	96	93	97	94
Surrogate 4-BFB	%	100	96	101	97

svTRH (C10-C40) in Water						
Our Reference:	UNITS	135368-1	135368-2	135368-3	135368-4	135368-5
Your Reference	----------	BH/MW216	BH/MW218	JKBH/MW1	JKBH/MW16	JKBH/MW107 A
Date Sampled	----------	1/10/2015	1/10/2015	2/10/2015	1/10/2015	1/10/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Date analysed	-	09/10/2015	08/10/2015	09/10/2015	07/10/2015	07/10/2015
TRHC$_{10}$ - C$_{14}$	µg/L	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	µg/L	<100	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	µg/L	<100	<100	<100	<100	<100
TRH>C$_{10}$ - C$_{16}$	µg/L	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	<50	<50	<50	<50	<50
TRH>C$_{16}$ - C$_{34}$	µg/L	<100	<100	<100	<100	<100
TRH>C$_{34}$ - C$_{40}$	µg/L	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	97	104	103	97	130

svTRH (C10-C40) in Water						
Our Reference:	UNITS	135368-6	135368-7	135368-8	135368-9	135368-11
Your Reference	----------	SW1	SW2	SW3	BD2/011015	R1/021015
Date Sampled	----------	1/10/2015	1/10/2015	2/10/2015	1/10/2015	2/10/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Date analysed	-	07/10/2015	07/10/2015	07/10/2015	07/10/2015	07/10/2015
TRHC$_{10}$ - C$_{14}$	µg/L	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	µg/L	<100	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	µg/L	<100	<100	<100	<100	<100
TRH>C$_{10}$ - C$_{16}$	µg/L	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	<50	<50	<50	<50	<50
TRH>C$_{16}$ - C$_{34}$	µg/L	<100	<100	<100	<100	<100
TRH>C$_{34}$ - C$_{40}$	µg/L	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	122	106	98	107	105

PAHs in Water - Low Level Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	135368-1 BH/MW216 1/10/2015 Water	135368-2 BH/MW218 1/10/2015 Water	135368-3 JKBH/MW1 2/10/2015 Water	135368-4 JKBH/MW16 1/10/2015 Water	135368-5 JKBH/MW107 A 1/10/2015 Water
Date extracted	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Date analysed	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Naphthalene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Acenaphthylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	µg/L	<0.1	<0.1	<0.1	<0.1	0.1
Anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	µg/L	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE	0.15
Surrogate p-Terphenyl-d14	%	70	99	80	78	76

PAHs in Water - Low Level Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	135368-6 SW1 1/10/2015 Water	135368-7 SW2 1/10/2015 Water	135368-8 SW3 2/10/2015 Water	135368-9 BD2/011015 1/10/2015 Water	135368-11 R1/021015 2/10/2015 Water
Date extracted	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Date analysed	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Naphthalene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Acenaphthylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	µg/L	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE
Surrogate p-Terphenyl-d14	%	74	74	77	77	76

OCP in water - trace level						
Our Reference:	UNITS	135368-1	135368-2	135368-3	135368-4	135368-5
Your Reference	----------	BH/MW216	BH/MW218	JKBH/MW1	JKBH/MW16	JKBH/MW107 A
Date Sampled	----------	1/10/2015	1/10/2015	2/10/2015	1/10/2015	1/10/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015	12/10/2015
Date analysed	-	14/10/2015	14/10/2015	14/10/2015	14/10/2015	14/10/2015
HCB	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Heptachlor	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Heptachlor Epoxide	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Aldrin	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
gamma-BHC (Lindane)	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
alpha-BHC	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
beta-BHC	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
delta-BHC	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
trans-Chlordane	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
cis-Chlordane	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Oxychlordane	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Dieldrin	µg/L	0.008	0.076	0.001	0.003	0.003
p,p-DDE	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
p,p-DDD	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
p,p-DDT	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Endrin	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Endrin Aldehyde	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Endrin Ketone	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
alpha-Endosulfan	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
beta-Endosulfan	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Endosulfan Sulfate	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Methoxychlor	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Surrogate OC Recovery	%	82	53	87	92	73

OCP in water - trace level Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	135368-6 SW1 1/10/2015 Water	135368-7 SW2 1/10/2015 Water	135368-8 SW3 2/10/2015 Water	135368-9 BD2/011015 1/10/2015 Water	135368-11 R1/021015 2/10/2015 Water
Date extracted	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015	12/10/2015
Date analysed	-	14/10/2015	14/10/2015	14/10/2015	14/10/2015	14/10/2015
HCB	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Heptachlor	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Heptachlor Epoxide	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Aldrin	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
gamma-BHC (Lindane)	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
alpha-BHC	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
beta-BHC	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
delta-BHC	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
trans-Chlordane	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
cis-Chlordane	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Oxychlordane	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Dieldrin	µg/L	0.001	0.004	<0.001	0.004	<0.001
p,p-DDE	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
p,p-DDD	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
p,p-DDT	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Endrin	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Endrin Aldehyde	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Endrin Ketone	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
alpha-Endosulfan	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
beta-Endosulfan	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Endosulfan Sulfate	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Methoxychlor	µg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Surrogate OC Recovery	%	94	79	83	72	97

OP Pesticides -Trace Level Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	135368-1 BH/MW216 1/10/2015 Water	135368-2 BH/MW218 1/10/2015 Water	135368-3 JKBH/MW1 2/10/2015 Water	135368-4 JKBH/MW16 1/10/2015 Water	135368-5 JKBH/MW107 A 1/10/2015 Water
Date prepared	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015	12/10/2015
Date analysed	-	14/10/2015	14/10/2015	14/10/2015	14/10/2015	14/10/2015
Demeton-S-methyl	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Dichlorvos	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Diazinon	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Dimethoate	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorpyrifos	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorpyrifos methyl	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Malathion	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Fenthion	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Azinphos Ethyl	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Azinphos Methyl	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorfenvinphos (E)	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorfenvinphos (Z)	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Ethion	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Fenitrothion	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Parathion (Ethyl)	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Parathion (Methyl)	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Primiphos Ethyl	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Primiphos Methyl	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Surrogate OP Recovery - TPP	%	94	48	85	91	85

OP Pesticides -Trace Level Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	135368-6 SW1 1/10/2015 Water	135368-7 SW2 1/10/2015 Water	135368-8 SW3 2/10/2015 Water	135368-9 BD2/011015 1/10/2015 Water	135368-11 R1/021015 2/10/2015 Water
Date prepared	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015	12/10/2015
Date analysed	-	14/10/2015	14/10/2015	14/10/2015	14/10/2015	14/10/2015
Demeton-S-methyl	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Dichlorvos	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Diazinon	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Dimethoate	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorpyrifos	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorpyrifos methyl	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Malathion	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Fenthion	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Azinphos Ethyl	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Azinphos Methyl	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorfenvinphos (E)	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorfenvinphos (Z)	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Ethion	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Fenitrothion	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Parathion (Ethyl)	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Parathion (Methyl)	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Primiphos Ethyl	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Primiphos Methyl	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Surrogate OP Recovery - TPP	%	86	91	87	83	92

PCB in water - trace level						
Our Reference:	UNITS	135368-1	135368-2	135368-3	135368-4	135368-5
Your Reference	----------	BH/MW216	BH/MW218	JKBH/MW1	JKBH/MW16	JKBH/MW107 A
Date Sampled	----------	1/10/2015	1/10/2015	2/10/2015	1/10/2015	1/10/2015
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015	12/10/2015
Date analysed	-	14/10/2015	14/10/2015	14/10/2015	14/10/2015	14/10/2015
Aroclor 1016	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor 1221	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor 1232	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor 1242	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor 1248	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor 1254	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor 1260	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Total PCB's (as above)	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01

PCB in water - trace level						
Our Reference:	UNITS	135368-6	135368-7	135368-8	135368-9	135368-11
Your Reference	----------	SW1	SW2	SW3	BD2/011015	R1/021015
Date Sampled	----------	1/10/2015	1/10/2015	2/10/2015	1/10/2015	2/10/2015
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015	12/10/2015
Date analysed	-	14/10/2015	14/10/2015	14/10/2015	14/10/2015	14/10/2015
Aroclor 1016	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor 1221	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor 1232	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor 1242	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor 1248	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor 1254	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor 1260	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Total PCB's (as above)	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Total Phenolics in Water						
Our Reference:	UNITS	135368-1	135368-2	135368-3	135368-4	135368-5
Your Reference	----------	BH/MW216	BH/MW218	JKBH/MW1	JKBH/MW16	JKBH/MW107 A
Date Sampled	----------	1/10/2015	1/10/2015	2/10/2015	1/10/2015	1/10/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Date analysed	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Total Phenolics (as Phenol)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05

Total Phenolics in Water						
Our Reference:	UNITS	135368-6	135368-7	135368-8	135368-9	135368-11
Your Reference	----------	SW1	SW2	SW3	BD2/011015	R1/021015
Date Sampled	----------	1/10/2015	1/10/2015	2/10/2015	1/10/2015	2/10/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Date analysed	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Total Phenolics (as Phenol)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05

HM in water - dissolved						
Our Reference:	UNITS	135368-1	135368-2	135368-3	135368-4	135368-5
Your Reference	----------	BH/MW216	BH/MW218	JKBH/MW1	JKBH/MW16	JKBH/MW107 A
Date Sampled	----------	1/10/2015	1/10/2015	2/10/2015	1/10/2015	1/10/2015
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Date analysed	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Arsenic-Dissolved	µg/L	2	11	1	<1	3
Cadmium-Dissolved	µg/L	<0.1	<0.1	0.1	0.1	<0.1
Chromium-Dissolved	µg/L	1	190	<1	<1	<1
Copper-Dissolved	µg/L	1	17	5	4	7
Lead-Dissolved	µg/L	1	7	<1	<1	<1
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel-Dissolved	µg/L	9	160	30	20	12
Zinc-Dissolved	µg/L	60	84	97	820	79
Manganese-Dissolved	µg/L	1,400	650	950	4,400	420

HM in water - dissolved						
Our Reference:	UNITS	135368-6	135368-7	135368-8	135368-9	135368-11
Your Reference	----------	SW1	SW2	SW3	BD2/011015	R1/021015
Date Sampled	----------	1/10/2015	1/10/2015	2/10/2015	1/10/2015	2/10/2015
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Date analysed	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Arsenic-Dissolved	µg/L	<1	2	<1	2	<1
Cadmium-Dissolved	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium-Dissolved	µg/L	<1	<1	<1	<1	<1
Copper-Dissolved	µg/L	2	<1	<1	<1	<1
Lead-Dissolved	µg/L	<1	<1	<1	<1	<1
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel-Dissolved	µg/L	1	5	2	5	<1
Zinc-Dissolved	µg/L	6	5	18	5	<1
Manganese-Dissolved	µg/L	12	420	100	400	<5

Metals in Waters - Acid extractable						
Our Reference:	UNITS	135368-1	135368-2	135368-3	135368-4	135368-5
Your Reference	----------	BH/MW216	BH/MW218	JKBH/MW1	JKBH/MW16	JKBH/MW107 A
Date Sampled	----------	1/10/2015	1/10/2015	2/10/2015	1/10/2015	1/10/2015
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Date analysed	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Phosphorus - Total	mg/L	0.7	0.3	<0.05	<0.05	<0.05

Metals in Waters - Acid extractable					
Our Reference:	UNITS	135368-6	135368-7	135368-8	135368-9
Your Reference	----------	SW1	SW2	SW3	BD2/011015
Date Sampled	----------	1/10/2015	1/10/2015	2/10/2015	1/10/2015
Type of sample		Water	Water	Water	Water
Date prepared	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Date analysed	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Phosphorus - Total	mg/L	<0.05	<0.05	<0.05	<0.05

Miscellaneous Inorganics						
Our Reference:	UNITS	135368-1	135368-2	135368-3	135368-4	135368-5
Your Reference	----------	BH/MW216	BH/MW218	JKBH/MW1	JKBH/MW16	JKBH/MW107 A
Date Sampled	----------	1/10/2015	1/10/2015	2/10/2015	1/10/2015	1/10/2015
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Date analysed	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Nitrate as N in water	mg/L	<0.005	<0.25	0.01	0.02	0.006
Nitrite as N in water	mg/L	<0.005	<0.25	<0.005	<0.005	<0.005
Ammonia as N in water	mg/L	20	30	3.2	4.9	10
Chloride, Cl	mg/L	2,200	2,300	750	3,400	700
Sulphate, SO4	mg/L	91	410	1,100	1,700	75

Miscellaneous Inorganics					
Our Reference:	UNITS	135368-6	135368-7	135368-8	135368-9
Your Reference	----------	SW1	SW2	SW3	BD2/011015
Date Sampled	----------	1/10/2015	1/10/2015	2/10/2015	1/10/2015
Type of sample		Water	Water	Water	Water
Date prepared	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Date analysed	-	06/10/2015	06/10/2015	06/10/2015	06/10/2015
Nitrate as N in water	mg/L	0.29	0.11	0.02	0.16
Nitrite as N in water	mg/L	0.006	0.080	<0.005	0.083
Ammonia as N in water	mg/L	0.025	8.4	0.017	8.2
Chloride, Cl	mg/L	6,900	2,700	91	[NA]
Sulphate, SO4	mg/L	890	590	12	[NA]

Method ID	Methodology Summary
Org-013	Water samples are analysed directly by purge and trap GC-MS.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.
Ext-020	Analysis subcontracted to Australian Government - National Measurement Institute. NATA Accreditation No: 198
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Metals-022 ICP-MS	Determination of various metals by ICP-MS.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Inorg-055	Nitrate - determined colourimetrically. Soils are analysed following a water extraction.
Inorg-055	Nitrite - determined colourimetrically based on APHA latest edition NO2- B. Soils are analysed following a water extraction.
Inorg-057	Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Soils are analysed following a KCl extraction.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B.

QUALITY CONTROL VOCs in water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			08/10/2015	[NT]	[NT]	LCS-W3	08/10/2015
Date analysed	-			08/10/2015	[NT]	[NT]	LCS-W3	08/10/2015
Dichlorodifluoromethane	µg/L	10	Org-013	<10	[NT]	[NT]	[NR]	[NR]
Chloromethane	µg/L	10	Org-013	<10	[NT]	[NT]	[NR]	[NR]
Vinyl Chloride	µg/L	10	Org-013	<10	[NT]	[NT]	[NR]	[NR]
Bromomethane	µg/L	10	Org-013	<10	[NT]	[NT]	[NR]	[NR]
Chloroethane	µg/L	10	Org-013	<10	[NT]	[NT]	[NR]	[NR]
Trichlorofluoromethane	µg/L	10	Org-013	<10	[NT]	[NT]	[NR]	[NR]
1,1-Dichloroethene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Trans-1,2-dichloroethene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
1,1-dichloroethane	µg/L	1	Org-013	<1	[NT]	[NT]	LCS-W3	114%
Cis-1,2-dichloroethene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Bromochloromethane	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Chloroform	µg/L	1	Org-013	<1	[NT]	[NT]	LCS-W3	112%
2,2-dichloropropane	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
1,2-dichloroethane	µg/L	1	Org-013	<1	[NT]	[NT]	LCS-W3	104%
1,1,1-trichloroethane	µg/L	1	Org-013	<1	[NT]	[NT]	LCS-W3	109%
1,1-dichloropropene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Cyclohexane	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Carbon tetrachloride	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Benzene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Dibromomethane	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
1,2-dichloropropane	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Trichloroethene	µg/L	1	Org-013	<1	[NT]	[NT]	LCS-W3	119%
Bromodichloromethane	µg/L	1	Org-013	<1	[NT]	[NT]	LCS-W3	105%
trans-1,3-dichloropropene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
cis-1,3-dichloropropene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
1,1,2-trichloroethane	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Toluene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
1,3-dichloropropane	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Dibromochloromethane	µg/L	1	Org-013	<1	[NT]	[NT]	LCS-W3	103%
1,2-dibromoethane	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Tetrachloroethene	µg/L	1	Org-013	<1	[NT]	[NT]	LCS-W3	96%
1,1,1,2-tetrachloroethane	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Chlorobenzene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Ethylbenzene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Bromoform	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
m+p-xylene	µg/L	2	Org-013	<2	[NT]	[NT]	[NR]	[NR]
Styrene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
1,1,2,2-tetrachloroethane	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
o-xylene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]

QUALITY CONTROL VOCs in water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
1,2,3-trichloropropane	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Isopropylbenzene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Bromobenzene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
n-propyl benzene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
2-chlorotoluene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
4-chlorotoluene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
1,3,5-trimethyl benzene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Tert-butyl benzene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
1,2,4-trimethyl benzene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
1,3-dichlorobenzene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Sec-butyl benzene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
1,4-dichlorobenzene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
4-isopropyl toluene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
1,2-dichlorobenzene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
n-butyl benzene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
1,2-dibromo-3-chloropropane	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
1,2,4-trichlorobenzene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Hexachlorobutadiene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
1,2,3-trichlorobenzene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Surrogate Dibromofluoromethane	%		Org-013	82	[NT]	[NT]	LCS-W3	107%
Surrogate toluene-d8	%		Org-013	80	[NT]	[NT]	LCS-W3	96%
Surrogate 4-BFB	%		Org-013	82	[NT]	[NT]	LCS-W3	107%

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			08/10/2015	[NT]	[NT]	LCS-W3	08/10/2015
Date analysed	-			08/10/2015	[NT]	[NT]	LCS-W3	08/10/2015
TRHC$_6$ - C$_9$	µg/L	10	Org-016	<10	[NT]	[NT]	LCS-W3	111%
TRHC$_6$ - C$_{10}$	µg/L	10	Org-016	<10	[NT]	[NT]	LCS-W3	111%
Benzene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W3	108%
Toluene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W3	103%
Ethylbenzene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W3	112%
m+p-xylene	µg/L	2	Org-016	<2	[NT]	[NT]	LCS-W3	116%
o-xylene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W3	120%
Naphthalene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Surrogate Dibromofluoromethane	%		Org-016	105	[NT]	[NT]	LCS-W3	106%
Surrogate toluene-d8	%		Org-016	80	[NT]	[NT]	LCS-W3	96%
Surrogate 4-BFB	%		Org-016	82	[NT]	[NT]	LCS-W3	107%

QUALITY CONTROL svTRH (C10-C40) in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			06/10/2015	[NT]	[NT]	LCS-W1	06/10/2015
Date analysed	-			07/10/2015	[NT]	[NT]	LCS-W1	07/10/2015
TRHC$_{10}$ - C$_{14}$	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W1	123%
TRHC$_{15}$ - C$_{28}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	109%
TRHC$_{29}$ - C$_{36}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	84%
TRH>C$_{10}$ - C$_{16}$	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W1	123%
TRH>C$_{16}$ - C$_{34}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	109%
TRH>C$_{34}$ - C$_{40}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	84%
Surrogate o-Terphenyl	%		Org-003	78	[NT]	[NT]	LCS-W1	79%

QUALITY CONTROL PAHs in Water - Low Level	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			06/10/2015	[NT]	[NT]	LCS-W2	06/10/2015
Date analysed	-			06/10/2015	[NT]	[NT]	LCS-W2	06/10/2015
Naphthalene	µg/L	0.2	Org-012	<0.2	[NT]	[NT]	LCS-W2	74%
Acenaphthylene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Acenaphthene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Fluorene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	LCS-W2	76%
Phenanthrene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	LCS-W2	76%
Anthracene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Fluoranthene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	LCS-W2	75%
Pyrene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	LCS-W2	77%

QUALITY CONTROL PAHs in Water - Low Level	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Benzo(a)anthracene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Chrysene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	LCS-W2	70%
Benzo(b,j+k) fluoranthene	µg/L	0.2	Org-012	<0.2	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	LCS-W2	88%
Indeno(1,2,3-c,d)pyrene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	µg/L	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012	76	[NT]	[NT]	LCS-W2	72%
QUALITY CONTROL OCP in water - trace level	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			12/10/2015	[NT]	[NT]	LCS-W1	12/10/2015
Date analysed	-			14/10/2015	[NT]	[NT]	LCS-W1	14/10/2015
HCB	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	[NR]	[NR]
Heptachlor	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	LCS-W1	67%
Heptachlor Epoxide	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	[NR]	[NR]
Aldrin	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	LCS-W1	69%
gamma-BHC (Lindane)	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	LCS-W1	65%
alpha-BHC	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	[NR]	[NR]
beta-BHC	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	[NR]	[NR]
delta-BHC	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	[NR]	[NR]
trans-Chlordane	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	[NR]	[NR]
cis-Chlordane	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	[NR]	[NR]
Oxychlordane	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	[NR]	[NR]
Dieldrin	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	LCS-W1	89%
p,p-DDE	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	[NR]	[NR]
p,p-DDD	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	[NR]	[NR]
p,p-DDT	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	LCS-W1	89%
Endrin	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	LCS-W1	86%
Endrin Aldehyde	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	[NR]	[NR]
Endrin Ketone	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	[NR]	[NR]
alpha-Endosulfan	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	[NR]	[NR]
beta-Endosulfan	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	[NR]	[NR]
Endosulfan Sulfate	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	[NR]	[NR]
Methoxychlor	µg/L	0.001	Ext-020	<0.001	[NT]	[NT]	[NR]	[NR]
Surrogate OC Recovery	%		Ext-020	[NT]	[NT]	[NT]	LCS-W1	66%

QUALITY CONTROL OP Pesticides - Trace Level	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			12/10/2015	[NT]	[NT]	LCS-W1	12/10/2015
Date analysed	-			14/10/2015	[NT]	[NT]	LCS-W1	14/10/2015
Demeton-S-methyl	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Dichlorvos	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Diazinon	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	LCS-W1	82%
Dimethoate	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Chlorpyrifos	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	LCS-W1	91%
Chlorpyrifos methyl	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Malathion	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Fenthion	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Azinphos Ethyl	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Azinphos Methyl	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Chlorfenvinphos (E)	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Chlorfenvinphos (Z)	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Ethion	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	LCS-W1	100%
Fenitrothion	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Parathion (Ethyl)	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	LCS-W1	111%
Parathion (Methyl)	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Primiphos Ethyl	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Primiphos Methyl	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Surrogate OP Recovery - TPP	%		Ext-020	[NT]	[NT]	[NT]	LCS-W1	87%

QUALITY CONTROL PCB in water - trace level	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			12/10/2015	[NT]	[NT]	LCS-W1	12/10/2015
Date analysed	-			14/10/2015	[NT]	[NT]	LCS-W1	14/10/2015
Aroclor 1016	µg/L	0.01	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Aroclor 1221	µg/L	0.01	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Aroclor 1232	µg/L	0.01	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Aroclor 1242	µg/L	0.01	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Aroclor 1248	µg/L	0.01	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Aroclor 1254	µg/L	0.01	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Aroclor 1260	µg/L	0.01	Ext-020	<0.01	[NT]	[NT]	[NR]	[NR]
Total PCB's (as above)	µg/L	0.010	Ext-020	<0.01	[NT]	[NT]	LCS-W1	96%
QUALITY CONTROL Total Phenolics in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			06/10/2015	135368-1	06/10/2015 || 06/10/2015	LCS-W1	06/10/2015
Date analysed	-			06/10/2015	135368-1	06/10/2015 || 06/10/2015	LCS-W1	06/10/2015
Total Phenolics (as Phenol)	mg/L	0.05	Inorg-031	<0.05	135368-1	<0.05 || <0.05	LCS-W1	92%
QUALITY CONTROL HM in water - dissolved	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			06/10/2015	135368-1	06/10/2015 || 06/10/2015	LCS-W2	06/10/2015
Date analysed	-			06/10/2015	135368-1	06/10/2015 || 06/10/2015	LCS-W2	06/10/2015
Arsenic-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	135368-1	2 || 2 || RPD: 0	LCS-W2	94%
Cadmium-Dissolved	µg/L	0.1	Metals-022 ICP-MS	<0.1	135368-1	<0.1 || <0.1	LCS-W2	97%
Chromium-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	135368-1	1 || <1	LCS-W2	91%
Copper-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	135368-1	1 || 1 || RPD: 0	LCS-W2	90%
Lead-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	135368-1	1 || <1	LCS-W2	96%
Mercury-Dissolved	µg/L	0.05	Metals-021 CV-AAS	<0.05	135368-1	<0.05 || <0.05	LCS-W2	103%
Nickel-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	135368-1	9 || 9 || RPD: 0	LCS-W2	92%
Zinc-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	135368-1	60 || 59 || RPD: 2	LCS-W2	93%
Manganese-Dissolved	µg/L	5	Metals-022 ICP-MS	<5	135368-1	1400 || 1400 || RPD: 0	LCS-W2	94%

QUALITY CONTROL Metals in Waters - Acid extractable	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			06/10/2015	135368-1	06/10/2015 || 06/10/2015	LCS-2	06/10/2015
Date analysed	-			06/10/2015	135368-1	06/10/2015 || 06/10/2015	LCS-2	06/10/2015
Phosphorus - Total	mg/L	0.05	Metals-020 ICP-AES	<0.05	135368-1	0.7 || 0.7 || RPD: 0	LCS-2	108%

QUALITY CONTROL Miscellaneous Inorganics	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			06/10/2015	135368-1	06/10/2015 || 06/10/2015	LCS-W1	06/10/2015
Date analysed	-			06/10/2015	135368-1	06/10/2015 || 06/10/2015	LCS-W1	06/10/2015
Nitrate as N in water	mg/L	0.005	Inorg-055	<0.005	135368-1	<0.005 || <0.005	LCS-W1	109%
Nitrite as N in water	mg/L	0.005	Inorg-055	<0.005	135368-1	<0.005 || <0.005	LCS-W1	115%
Ammonia as N in water	mg/L	0.005	Inorg-057	<0.005	135368-1	20 || 21 || RPD: 5	LCS-W1	107%
Chloride, Cl	mg/L	1	Inorg-081	<1	135368-1	2200 || 2200 || RPD: 0	LCS-W1	100%
Sulphate, SO4	mg/L	1	Inorg-081	<1	135368-1	91 || 110 || RPD: 19	LCS-W1	103%

QUALITY CONTROL Total Phenolics in Water	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	135368-2	06/10/2015
Date analysed	-	[NT]	[NT]	135368-2	06/10/2015
Total Phenolics (as Phenol)	mg/L	[NT]	[NT]	135368-2	103%

QUALITY CONTROL HM in water - dissolved	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	135368-2	06/10/2015
Date analysed	-	[NT]	[NT]	135368-2	06/10/2015
Arsenic-Dissolved	µg/L	[NT]	[NT]	135368-2	98%
Cadmium-Dissolved	µg/L	[NT]	[NT]	135368-2	96%
Chromium-Dissolved	µg/L	[NT]	[NT]	135368-2	90%
Copper-Dissolved	µg/L	[NT]	[NT]	135368-2	83%
Lead-Dissolved	µg/L	[NT]	[NT]	135368-2	114%
Mercury-Dissolved	µg/L	[NT]	[NT]	[NR]	[NR]
Nickel-Dissolved	µg/L	[NT]	[NT]	135368-2	85%
Zinc-Dissolved	µg/L	[NT]	[NT]	135368-2	91%
Manganese-Dissolved	µg/L	[NT]	[NT]	135368-2	91%

QUALITY CONTROL Metals in Waters - Acid extractable	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	135368-2	06/10/2015
Date analysed	-	[NT]	[NT]	135368-2	06/10/2015
Phosphorus - Total	mg/L	[NT]	[NT]	135368-2	111%
QUALITY CONTROL Miscellaneous Inorganics	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	135368-2	06/10/2015
Date analysed	-	[NT]	[NT]	135368-2	06/10/2015
Nitrate as N in water	mg/L	[NT]	[NT]	[NR]	[NR]
Nitrite as N in water	mg/L	[NT]	[NT]	[NR]	[NR]
Ammonia as N in water	mg/L	[NT]	[NT]	[NR]	[NR]
Chloride, Cl	mg/L	[NT]	[NT]	135368-2	#
Sulphate, SO4	mg/L	[NT]	[NT]	135368-2	#

Report Comments:

MISC_INORG: PQL for Nitrate and Nitrite has been raised due to possible colorimetric interference. Due to strong background colour.
MISC_INORG:# Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

VOC_W: PQL has been raised as the sample/s were foamy and required dilution.

TRH_BTEX_W_V: PQL has been raised as the sample/s were foamy and required dilution.

OC/OP/PCB's in water analysed by NMI. Report No.RN1086753.

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NA: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

CHAIN OF CUSTODY

Douglas Partners
Geotechnics / Environment / Groundwater

Client: Douglas Partners	**Project Number** 71459.03	**To:**	Envirolab Services
Contact Person: John Russell	**Project Name:** Moorebank	**Contact Person:**	Aileen Hie
Project Mgr: John Russell	**PO No.:** 133475	**Address:**	12 Ashley Street
	lab Quote No. :		Chatswood NSW 2068
Address: 96 Hermitage Road West Ryde NSW 2114	**Date results required:** standard **Or choose:** standard *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*	**Phone:**	02 9910 6200
		Fax:	02 9910 6201
		Email:	ahie@envirolab.com.au
Phone: 9809 0666 **Mob:** 0422 000 434	**Report format:** esdat / PDF / Excel	**Laboratory Report No:**	
Email: john.russell@douglaspartners.com.au	**Comments:**	**Lab Comments:**	

limited sample pt

Sample information						Tests Required											Comments
Lab Sample ID	Field Sample ID	Depth	Date sampled	Container Type	Type of sample	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn, Mn	TRH/BTEX	PAH (low)	OCP/OPP/ PCB (trace)	Phenols	nitrate/nitrite/ ammonia	Phosphorous	sulphate/ chloride	VOC		Combo	Provide as much information about the sample as you can
1	BH/MW216		1/10/2015	p/g	w	X	X	X	X	X	X	X	X	X		3L	Hydrocarbon odour
2	BH/MW218		1/10/2015	p/g	w	X	X	X	X	X	X	X	X	X		3L	
3	JKBH/MW1	CJK ionth Date	2/10/2015	p/g	w	X	X	X	X	X	X	X	X	X		3L	
4	JKBH/MW16		1/10/2015	p/g	w	X	X	X	X	X	X	X	X	X		3L	
5	JKBH/MW107A		1/10/2015	p/g	w	X	X	X	X	X	X	X	X	X		3L	
6	SW1		1/10/2015	p/g	w	X	X	X	X	X	X	X	X	X		3L	Possibly quite saline
7	SW2		1/10/2015	p/g	w	X	X	X	X	X	X	X	X	X		3L	Possibly quite saline
8	SW3		2/10/2015	p/g	w	X	X	X	X	X	X	X	X	X		3L	Possibly quite saline
9	BD2/011015		1/10/2015	p/g	w	X	X	X	X	X	X	X		X		3L	Possibly quite saline
10	BD1/021015		2/10/2015	p/g	w	X	X	X	X	X	X	X				3L	Please send to ALS
11	R1/021015		2/10/2015	p/g	w	X	X	X	X	X						3L	
12	Spike						X										
13	Blank						X										
14	Spike						X										
15	Blank						X										
extra → 16	BD1/011015	HOLD sa															

ENVIROLAB GROUP

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 135366

Date Received: 2-10-15
Time Received: 1545
Received by: CB
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Relinquished by: Douglas Partners	**Sample Receipt**	***Lab use only:***
Courier (by whom) HUNTER EXPRESS	**Received by (Company):** ELS.	**Samples Received:** Cool or Ambient (circle one)
Condition of Sample at dispatch Cool or Ambient (circle)	**Print Name:** CALUM BONSER.	**Temperature Received at:** 17.8 (if applicable)
Temperature (if Applicable):	**Date & Time:** 2.10.15 1545	**Transported by:** Hand delivered / courier
Print Name: John Russell	**Signature:** CB	
Date & Time 2/10/15; 2pm		
Signature:		

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

SAMPLE RECEIPT ADVICE

Client Details	
Client	Douglas Partners Pty Ltd
Attention	John Russell

Sample Login Details	
Your Reference	71459.03, Moorebank
Envirolab Reference	135368
Date Sample Received	02/10/2015
Date Instructions Received	02/10/2015
Date Results Expected to be Reported	12/10/2015

Sample Condition	
Samples received in appropriate condition for analysis	YES
No. of Samples Provided	16 Waters
Turnaround Time Requested	Standard
Temperature on receipt (°C)	17.8
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments
Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	Phone: 02 9910 6200
Fax: 02 9910 6201	Fax: 02 9910 6201
Email: ahie@envirolabservices.com.au	Email: jhurst@envirolabservices.com.au

Sample and Testing Details on following page

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

Sample Id	*VOCs in water*	*vTRH(C6-C10)/BTEXN in Water*	*svTRH (C10-C40) in Water*	*PAHs in Water - Low Level*	*OCP in water - trace level*	*OP Pesticides -Trace Level*	*PCB in water - trace level*	*Total Phenolics in Water*	*HM in water - dissolved*	*Metals in Waters - Acid extractable*	*Ammonia as N in water*	*Chloride, Cl*	*Nitrate as N in water*	*Nitrite as N in water*	*Sulphate, SO4*	*On Hold*
BH/MW216	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
BH/MW218	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
JKBH/MW1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
JKBH/MW16	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
JKBH/MW107A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
SW1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
SW2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
SW3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
BD2/011015	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		
-																✓
R1/021015		✓	✓	✓	✓	✓	✓	✓	✓							
Spike		✓														
Blank		✓														
Spike		✓														
Blank		✓														
BD1/011015																✓

Appendix I

Data Quality Assurance and Quality Control

Procedures and Results

Appendix I
Data Quality Assurance and Quality Control Procedures and Results

Q1. Data Quality Indicators

Field and laboratory procedures were assessed against the following data quality indicators (DQIs):

- Precision – a measure of variability or reproducibility of data;
- Accuracy – a measure of closeness of the data to the 'true' value;
- Representativeness – the confidence (qualitative) of data representativeness of media present on-site;
- Completeness – a measure of the amount of usable data from a data collection activity; and
- Comparability – the confidence (qualitative) that data may be considered to be equivalent for each sampling and analytical event.

The DQIs were assessed as outlined in the following table.

Table 1: Data Quality Indicators

DQI	Performance Indicator	Acceptable Range
Precision		
Field considerations	SOPs appropriate and complied with	Field staff follow SOPs in the DP *Field Procedures Manual*
Laboratory considerations	field replicates	Precision average relative percent difference (RPD) result <5 times practical quantitation limit (PQL), no limit; results >5 times PQL, 0% - 30%
	laboratory duplicates	Precision average RPD result <5 times PQL, no limit; results >5 times PQL, 0% - 50%
	laboratory-prepared volatile trip spikes	Recovery of 60-140%

DQI	Performance Indicator	Acceptable Range
Accuracy (bias)		
Field considerations	SOPs appropriate and complied with	Field staff to follow SOPs in the DP *Field Procedures Manual*
Laboratory considerations	Analysis of:	
	laboratory-prepared volatile trip spikes	Recovery of 60-140%
	laboratory-prepared trip blanks (field blanks)	<PQL
	rinsate samples	<PQL
	method blanks (laboratory blanks)	Recovery of 60-140%
	matrix spikes	Recovery of 70-130% (inorganics); 60-140% (organics)
	matrix spike duplicates	Recovery of 70-130% (inorganics); 60-140% (organics); Recovery 70 “low” to 130% “high” indicates interference
	surrogate spikes	Recovery of 70-130% (inorganics); 60-140% (organics)
	laboratory control samples	Recovery of 70-130% (inorganics); 60-140% (organics)
Completeness		
Field considerations	All critical locations sampled	All critical locations sampled in accordance with the SAQP
	SOPs appropriate and complied with	Field staff to follow SOPs in the DP *Field Procedures Manual*
	Experienced sampler	Experienced DP Environmental Scientist/Engineer to conduct field work and sampling
	Documentation correct	Maintain COC documentation at all times
	Sample holding times complied with	Sample holding times complied with
Laboratory considerations	All critical samples analysed according to SAQP	All critical locations analysed in accordance with the SAQP
	Appropriate methods and PQLs	Appropriate methods and PQLs have been used by the contract laboratory
	Sample documentation complete	Maintain COC documentation at all times

DQI	Performance Indicator	Acceptable Range
Comparability		
Field considerations	Same SOPs used on each occasion	Field staff to follow SOPs in the DP *Field Procedures Manual*
	Experienced sampler	Experienced DP Environmental Scientist/Engineer to conduct field work and sampling
	Same types of samples collected (filtered)	Field filtering for metals
Laboratory considerations	Sample analytical methods used (including clean-up)	Methods to be NATA accredited
	Sample PQLs (justify/quantify if different)	Consistent PQLs to be used
	Same laboratories (justify/quantify if different)	Same analytical laboratory for primary samples to be used
Representativeness		
Field considerations	Appropriate media sampled according to SAQP	Appropriate media sampled according to SAQP
	All media identified in SAQP sampled	All media identified in SAQP sampled
Laboratory considerations	All samples analysed according to SAQP	All samples analysed according to SAQP

Notes to Table 1:

SOP – Standard Operating Procedure

SAQP – Sampling and Analysis Quality Plan

Q2. Field Quality Assurance and Quality Control

The field QC procedures for sampling as prescribed in standard operating procedures (SOPs) in the Douglas Partners *Field Procedures Manual* were followed at all times during the assessment. All sample locations and media were with reference to the proposed scope in DP's fee proposal.

Q2.1 Sampling Team

Sampling was by an experienced DP Environmental Scientist/Engineer.

Q2.2 Sample Collection and Weather Conditions

Sample collection procedures and dispatch are reported in body of the report. Sampling was undertaken during variable weather conditions noting the number of separate days that sampling of the various media occurred.

Q2.3 Logs

Logs for each soil sampling location were recorded in the field. The individual samples were recorded on the field logs along with the sample identity, location, depth, initials of sampler, duplicate locations, duplicate type and site observations. Logs are included in Appendix E.

Q2.4 Chain of Custody

Chain of custody information was recorded on the Chain of Custody (COC) sheets and accompanied samples to the analytical laboratory. Signed copies of COCs are presented in Appendix H, following the laboratory reports.

Q2.5 Sample Splitting Techniques

Replicate or duplicate soil, soil gas, groundwater / surface water samples were collected in the field as a measure of precision of the results. Field replicates samples for soil were collected from the same location and an identical depth to the primary sample. Equal portions of the primary sample were placed into the sampling jars and sealed. The sample was not homogenised in a bowl to prevent the loss of volatiles from the soil. Replicate samples were labelled with a DP identification number, recorded on DP bore logs, so as to conceal their relationship to their primary sample from the analysing laboratory.

The soil gas (trace non-methane organic compounds (NMOC)) duplicate was collected using a manifold between the primary and duplicate canister.

The groundwater duplicate was taken by filling sample bottles whilst pumping from the one well. The surface water duplicate was collected by filling two sets of sample bottles at the one surface water sampling point.

Q2.6 Replicate and Duplicate Frequency

Field sampling comprised intra-laboratory duplicate sampling, at a rate of approximately one duplicate sample for every ten primary samples.

Q2.7 Trip Spikes

Laboratory prepared trip spikes are to be taken into the field, subjected to the same preservation methods as the field samples, then analysed for volatile contaminants (BTEX in this case), for the purposes of assessing data ‘precision’ and ‘accuracy’ (i.e. potential losses in volatile organics incurred prior to reaching the laboratory). A trip spike was taken into the field on three soil sampling days and the two groundwater / surface water sampling days and were dispatched with the batch sampling run. The result of the laboratory analysis for the trip spikes is shown in the table below.

Table 2: Trip Spike Results (% Recovery)

	Benzene	Toluene	Ethylbenzene	m+p-xylene	o-Xylene
Trip Spike 1 (soil)	101%	100%	98%	101%	100%
Trip Spike 2 (soil)	100%	100%	102%	103%	101%
Trip Spike 3 (soil)	108%	107%	106%	105%	106%
Trip Spike 1 (water)	105%	95%	100%	100%	101%
Trip Spike 2 (water)	104%	94%	100%	101%	102%

Results indicate that the percentage loss for BTEX during the trip was within the acceptable range and therefore loss of volatiles during sample handing and transport of samples is unlikely to have occurred and acceptable data 'precision' and 'accuracy' was achieved.

Q2.8 Trip Blanks

Laboratory prepared soil trip blanks were taken out to the field unopened, subjected to the same preservation methods as the field samples, then analysed for the purposes of assessing data 'accuracy' (i.e. the potential transfer of contaminants into the blank sample incurred prior to reaching the laboratory). The result of the laboratory analysis for the trip blanks is shown in the table below.

Table 3: Trip Blank Results

	TRH C_6-C_{10}	Benzene	Toluene	Ethylbenz.	m+p-xylene	o-Xylene	Naphth.
Trip Blank 1 (soil – mg/kg)	<25	<0.2	<0.5	<1	<2	<1	<1
Trip Blank 2 (soil – mg/kg)	<25	<0.2	<0.5	<1	<2	<1	<1
Trip Blank 3 (soil – mg/kg)	<25	<0.2	<0.5	<1	<2	<1	<1
Trip Blank 1 (groundwater – µg/L)	<10	<1	<1	<1	<2	<1	-
Trip Blank 1 (groundwater – µg/L)	<10	<1	<1	<1	<2	<1	-

Levels of analytes were all below detection limits (i.e. within the acceptable range) and indicate transfer of BTEX contaminants into the trip blanks has not occurred. On this basis, the cross-contamination of samples during handing and transport of samples is considered unlikely to have occurred and acceptable data 'accuracy' was achieved.

Q2.9 Relative Percentage Difference

A measure of the consistency of results for field samples is derived by the calculation of relative percentage differences (RPDs) for duplicate samples. RPDs have only been considered where a concentration is greater than 5 times the PQL.

Q2.9.1 Intra-Laboratory and Inter-Laboratory Replicate Analysis

Replicates were tested to assess data 'precision' and the reproducibility within the primary laboratory (Envirolab Services Pty Ltd - Envirolab) and with a secondary laboratory (ALS) as a measure of consistency of sampling techniques. Replicate samples were analysed at a rate of approximately 10% of primary samples. For soil samples, four intra-laboratory and three inter-laboratory replicates were analysed. For groundwater and surface water, one intra-laboratory and one inter-laboratory duplicates were analysed. The Relative Percent Difference (RPD) between replicate results is used as a measure of laboratory reproducibility and is given by the following:

$$RPD = \frac{ABS\,(Replicate\ result\ 1 - Replicate\ result\ 2)}{(Replicate\ result\ 1 + Replicate\ result\ 2)/2} \times 100$$

The RPD can have a value between 0% and 200%. An RPD data quality objective of up to 30% is considered to be within the acceptable range.

The comparative results of analysis between primary and duplicate samples are summarised in the table below. Where one or both results were below the PQL, an RPD was not calculated,

Table 4a: RPD Results for Soil (mg/kg)

Test Location ID	BD1/070815	JK107a	RPD (%)	BD2/080915	BH213	RPD (%)
Depth (m)	-	1.9-2.35		-	2.9-3.35	
As	8	10	22	5	5	0
Cd	0.6	<0.4	N/A	<0.4	<0.4	N/A
Cr	13	17	27	9	13	36
Cu	49	29	51	42	4	165
Pb	35	98	95	90	18	133
Hg	<0.1	<0.1	N/A	0.1	<0.1	N/A
Ni	43	10	125	6	3	67
Zn	160	110	37	75	27	94
Mn	340	89	117	79	27	98
Test Location ID	BD3/090915	BH212	RPD (%)	BD5/100915	BH207	RPD (%)
Depth (m)	-	2.9-3.35		-	0.9-1.35	
As	4	6	40	6	5	18
Cd	0.5	0.6	18	<0.4	<0.4	N/A
Cr	12	16	29	16	15	6
Cu	27	41	41	56	18	103
Pb	140	130	7	93	21	126
Hg	0.1	0.1	0	<0.1	<0.1	N/A
Ni	8	9	12	10	6	50
Zn	170	240	34	250	55	128
Mn	100	120	18	85	73	15
Test Location ID	*BD4/100915*	BH201	RPD (%)	*BD6/100915*	BH206	RPD (%)

Depth (m)	-	0.9-1.35		-	0.9-1.35	
As	9	4	77	6	8	29
Cd	<1	1	N/A	<1	<0.4	N/A
Cr	18	15	18	8	15	61
Cu	23	79	110	15	22	38
Pb	25	110	126	14	16	13
Hg	<0.1	0.1	N/A	<0.1	<0.1	N/A
Ni	6	9	40	7	11	44
Zn	35	170	132	15	30	67
Mn	254	160	45	152	450	99
Test Location ID	*BD7/100915*	BH208	RPD (%)			
Depth (m)	-	3.9-4.35				
As	10	7	35			
Cd	<1	<0.4	N/A			
Cr	30	30	0			
Cu	13	13	0			
Pb	27	26	4			
Hg	<0.1	<0.1	N/A			
Ni	2	5	86			
Zn	11	16	37			
Mn	<5	6	N/A			

Notes to Table 4a:

Results expressed in mg/kg on dry weight basis

Italics - replicate sample shown in italics is inter-laboratory replicate

Table 4b: RPD Results for Soil (mg/kg)

Test Location ID		BD1/070815	JK107a	RPD (%)	BD2/080915	BH213	RPD (%)
Depth (m)		-	1.9-2.35		-	2.9-3.35	
TRH	C_6 - C_9	<25	<25	N/A	<25	<25	N/A
	C_{10} - C_{14}	<50	<50	N/A	<50	<50	N/A
	C_{15} - C_{28}	<100	<100	N/A	<100	<100	N/A
	C_{29} - C_{36}	<100	<100	N/A	<100	<100	N/A
TRH (NEPC, 2013)	F1 (C_6-C_{10}- BTEX)	<25	<25	N/A	<25	<25	N/A
	F2 (>C_{10}-C_{16} - Naphthalene)	<50	<50	N/A	<50	<50	N/A
	C_6-C_{10}	<25	<25	N/A	<25	<25	N/A
	>C_{10}-C_{16}	<50	<50	N/A	<50	<50	N/A
	>C_{16}-C_{34}	<100	<100	N/A	<100	<100	N/A
	>C_{34}-C_{40}	<100	<100	N/A	<100	<100	N/A
BTEX	Benzene	<0.5	<0.5	N/A	<0.5	<0.5	N/A
	Toluene	<1	<1	N/A	<1	<1	N/A
	Ethyl Benzene	<2	<2	N/A	<2	<2	N/A
	Xylenes	<1	<1	N/A	<1	<1	N/A
PAHs	Naphthalene	<1	<1	N/A	<1	<1	N/A
Test Location ID		BD3/090915	BH212	RPD (%)	*BD4/100915*	BH201	RPD (%)
Depth (m)		-	2.9-3.35		-	0.9-1.35	
TRH	C_6 - C_9	<25	<25	N/A	<25	<25	N/A
	C_{10} - C_{14}	<50	<50	N/A	<50	<50	N/A
	C_{15} - C_{28}	<100	100	N/A	<100	<100	N/A
	C_{29} - C_{36}	<100	250	N/A	<100	110	N/A
TRH (NEPC, 2013)	F1 (C_6-C_{10}- BTEX)	<25	<25	N/A	<25	<25	N/A
	F2 (>C_{10}-C_{16} - Naphthalene)	<50	<50	N/A	<50	<50	N/A
	C_6-C_{10}	<25	<25	N/A	<25	<25	N/A
	>C_{10}-C_{16}	<50	<50	N/A	<50	<50	N/A
	>C_{16}-C_{34}	110	280	87	110	110	0
	>C_{34}-C_{40}	<100	160	N/A	<100	130	N/A
BTEX	Benzene	<0.5	<0.5	N/A	<0.5	<0.5	N/A
	Toluene	<1	<1	N/A	<1	<1	N/A
	Ethyl Benzene	<2	<2	N/A	<2	<2	N/A
	Xylenes	<1	<1	N/A	<1	<1	N/A
PAHs	Naphthalene	<1	<1	N/A	<1	<1	N/A

Notes to Table 4b:

Results expressed in mg/kg on dry weight basis

Italics - replicate sample shown in italics is inter-laboratory replicate

Table 4c: RPD Results for Soil (mg/kg)

Test Location ID	BD1/070815	JK107a	RPD (%)	BD2/080915	BH213	RPD (%)
Depth (m)	-	1.9-2.35		-	2.9-3.35	
Total PAH	<1.45	0.33	N/A	7.5	<1.45	N/A
Naphthalene	<0.1	<0.1	N/A	<0.1	<0.1	N/A
B(a)P	<0.05	0.07	N/A	0.77	<0.05	N/A
B(a)P TEQ	<0.5	<0.5	N/A	1.2	<0.5	N/A
Total OCP	<2.0	<2.0	N/A	<2.0	<2.0	N/A
Aldrin + Dieldrin	<0.2	<0.2	N/A	<0.2	<0.2	N/A
Chlordane	<0.2	<0.2	N/A	<0.2	<0.2	N/A
DDT+DDE+DDD	<0.3	<0.3	N/A	<0.3	<0.3	N/A
Endosulfan	<0.3	<0.3	N/A	<0.3	<0.3	N/A
Endrin	<0.1	<0.1	N/A	<0.1	<0.1	N/A
Heptachlor	<0.2	<0.2	N/A	<0.2	<0.2	N/A
HCB	<0.1	<0.1	N/A	<0.1	<0.1	N/A
Methoxychlor	<0.1	<0.1	N/A	<0.1	<0.1	N/A
Total OPP	<0.8	<0.8	N/A	<0.8	<0.8	N/A
Chlorpyrifos	<0.1	<0.1	N/A	<0.1	<0.1	N/A
PCB	<0.7	<0.7	N/A	<0.7	<0.7	N/A
Total Phenols	<5	<5	N/A	<5	<5	N/A
Total Cyanide	<0.5	<0.5	N/A	<0.5	<0.5	N/A
Test Location ID	BD3/090915	BH212	RPD (%)	*BD4/100915*	BH201	RPD (%)
Depth (m)	-	2.9-3.35		-	0.9-1.35	
Total PAH	3.3	3.9	17	<0.5	0.28	N/A
Naphthalene	<0.1	<0.1	N/A	<0.1	<0.1	N/A
B(a)P	0.4	0.4	0	<0.05	0.05	N/A
B(a)P TEQ	0.6	0.7	15	1.2	<0.5	N/A
Total OCP	<2.0	<2.0	N/A	<2.0	<2.0	N/A
Aldrin + Dieldrin	<0.2	<0.2	N/A	<0.2	<0.2	N/A
Chlordane	<0.2	<0.2	N/A	<0.2	<0.2	N/A
DDT+DDE+DDD	<0.3	<0.3	N/A	<0.3	<0.3	N/A
Endosulfan	<0.3	<0.3	N/A	<0.3	<0.3	N/A
Endrin	<0.1	<0.1	N/A	<0.1	<0.1	N/A
Heptachlor	<0.2	<0.2	N/A	<0.2	<0.2	N/A
HCB	<0.1	<0.1	N/A	<0.1	<0.1	N/A
Methoxychlor	<0.1	<0.1	N/A	<0.1	<0.1	N/A
Total OPP	<0.8	<0.8	N/A	<0.8	<0.8	N/A
Chlorpyrifos	<0.1	<0.1	N/A	<0.1	<0.1	N/A
PCB	<0.7	<0.7	N/A	<0.1	<0.7	N/A
Total Phenols	<5	<5	N/A	<5	<5	N/A
Total Cyanide	<0.5	0.5	N/A	<0.5	<0.5	N/A

Notes to Table 4c:
Results expressed in mg/kg on dry weight basis
Italics - replicate sample shown in italics is inter-laboratory replicate

The calculated RPD values for soil were within the acceptable range of 30% with the exception of those cells shaded grey. However, this is not considered to be significant because:

- The typically low actual differences in the concentrations of the replicate pairs where some RPD exceedances occurred;
- Replicate pairs being generally collected from fill soils within a construction and demolition waste landfill which, by its nature, is considerably heterogeneous;
- Replicates, rather than homogenised replicates were used to avoid volatile loss, hence greater variability can be expected;
- Some of the recorded concentrations being close to the PQL; and
- All other QA/QC parameters generally met the DQIs.

Table 5: RPD Results for Soil Gas (µg/m^3)

Test Location ID	BH/MW216	BD1	RPD
Freon 113	<3.8	<3.8	N/A
2-Propanol	<1.0	<1.0	N/A
Propene	<0.9	<0.9	N/A
Benzene	5	6	18
Toluene	9	8	12
Xylene (m & p)	10	9	11
Xylene (o)	4	3	29
1,2,4-trimethylbenzene	5	5	0
1,3,5-trimethylbenzene	<2.5	<2.5	N/A
Styrene	10	10	0
1,1,1-trichloroethane	<2.7	<2.7	N/A
1,1,2,2-tetrachloroethane	<3.0	<3.0	N/A
1,1,2-trichloroethane	<2.7	<2.7	N/A
1,1-dichloroethene	<2.0	<2.0	N/A
1,2-dichloroethane	<2.0	<2.0	N/A
1,2-dichloropropane	<2.0	<2.0	N/A
Benzyl chloride	<2.6	<2.6	N/A
Bromodichloromethane	<3.0	<3.0	N/A

Test Location ID	BH/MW216	BD1	RPD
Bromoform	<5.0	<5.0	N/A
Carbon tetrachloride	<3.0	<3.0	N/A
Chlorodibromomethane	<1.6	<1.6	N/A
Chloroethane	3	4	29
Chloroform	<2.0	<2.0	N/A
Chloromethane	<1.0	<1.0	N/A
cis-1,2-dichloroethene	6	7	15
cis-1,3-dichloropropene	<2.0	<2.0	N/A
Hexachlorobutadiene	<5.0	<5.0	N/A
Trichloroethene	5	<2.7	N/A
Tetrachloroethene	<3.0	<3.0	N/A
trans-1,2-dichloroethene	<2.0	<2.0	N/A
trans-1,3-dichloropropene	<2.0	<2.0	N/A
Vinyl chloride	<1.0	<1.0	N/A
1,2-dibromoethane	<3.8	<3.8	N/A
Bromomethane	<1.9	<1.9	N/A
Dichlorodifluoromethane	210	230	9
Trichlorofluoromethane	<2.8	<2.8	N/A
1,2,4-trichlorobenzene	<3.7	<3.7	N/A
1,2-dichlorobenzene	<3.0	<3.0	N/A
1,3-dichlorobenzene	<3.0	<3.0	N/A
1,4-dichlorobenzene	<3.0	<3.0	N/A
Chlorobenzene	<2.0	<2.0	N/A
1,3-Butadiene	<1.0	<1.0	N/A
Acrolein	<1.0	<1.0	N/A
Methyl Methacrylate	<2.0	<2.0	N/A
1,4-Dioxane	<1.8	<1.8	N/A
Methyl Ethyl Ketone	<1.5	<1.5	N/A
2-hexanone (MBK)	<2.0	<2.0	N/A
4-Methyl-2-pentanone	<2.0	<2.0	N/A
Carbon disulfide	<1.6	<1.6	N/A

Test Location ID	BH/MW216	BD1	RPD
Cyclohexane	88	98	11
Ethanol	18	19	5
Ethyl acetate	<1.8	<1.8	N/A
Heptane	4	5	22
Hexane	47	53	12
MTBE	<1.8	<1.8	N/A
Tetrahydrofuran	<1.5	<1.5	N/A
Vinyl acetate	<1.8	<1.8	N/A
Naphthalene	7	4	55

Notes to Table 5:
Results expressed in mg/L
Italics - duplicate sample shown in italics is inter-laboratory duplicate

The calculated RPD values for soil gas were within the acceptable range of 30% with the exception of the cell shaded grey (naphthalene). However, this is not considered to be significant because of

- The low actual differences in the concentrations of the replicate pair;
- The recorded concentrations being close to the PQL;
- The majority of the RPD values were within the acceptable range; and
- All other QA/QC parameters generally met the DQIs.

Table 6: RPD Results for Groundwater and Surface Water (mg/L)

Sample ID	JKBH/MW1	*BD1/021015*	RPD (%)	SW2	BD2/011015	RPD (%)
Ammonia (as N)	3.2	2.56	22	8.4	8.2	2
Nitrate (as N)	0.01	0.03	100	0.11	0.16	37
Nitrite (as N)	<0.005	<0.01	N/A	0.08	0.083	4
Arsenic (Filtered)	0.001	0.003	100	0.002	0.002	0
Cadmium (Filtered)	0.0001	<0.0001	N/A	<0.0001	<0.0001	N/A
Chromium (III+VI) (Filtered)	<0.001	<0.001	N/A	<0.001	<0.001	N/A
Copper (Filtered)	0.005	<0.001	N/A	<0.001	<0.001	N/A
Lead (Filtered)	<0.001	<0.001	N/A	<0.001	<0.001	N/A
Manganese (Filtered)	0.95	0.985	4	0.42	0.4	5
Mercury (Filtered)	<0.00005	<0.0001	N/A	<0.00005	<0.00005	N/A
Nickel (Filtered)	0.03	0.046	42	0.005	0.005	0

Sample ID	JKBH/MW1	*BD1/021015*	RPD (%)	SW2	BD2/011015	RPD (%)
Phosphorus	<0.05	3.58	N/A	<0.05	<0.05	N/A
Zinc (Filtered)	0.097	0.245	87	0.005	0.005	0
C10-C16	<0.05	<0.1	N/A	<0.05	<0.05	N/A
C16-C34	<0.1	<0.1	N/A	<0.1	<0.1	N/A
C34-C40	<0.1	<0.1	N/A	<0.1	<0.1	N/A
F2-NAPHTHALENE	<0.05	<0.1	N/A	<0.05	<0.05	N/A
C6 - C9	<0.01	<0.02	N/A	<0.01	<0.01	N/A
C10 - C14	<0.05	<0.05	N/A	<0.05	<0.05	N/A
C15 - C28	<0.1	<0.1	N/A	<0.1	<0.1	N/A
C29-C36	<0.1	<0.05	N/A	<0.1	<0.1	N/A
C6-C10 less BTEX (F1)	<0.01	<0.02	N/A	<0.01	<0.01	N/A
C6-C10	<0.01	<0.02	N/A	<0.01	<0.01	N/A
Benzene	<0.001	<0.001	N/A	<0.001	<0.001	N/A
Ethylbenzene	<0.001	<0.002	N/A	<0.001	<0.001	N/A
Toluene	<0.001	<0.002	N/A	<0.001	<0.001	N/A
Xylene (m & p)	<0.002	<0.002	N/A	<0.002	<0.002	N/A
Xylene (o)	<0.001	<0.002	N/A	<0.001	<0.001	N/A
1,2,4-trimethylbenzene	<0.001	-		<0.001	<0.001	N/A
1,3,5-trimethylbenzene	<0.001	-		<0.001	<0.001	N/A
Isopropylbenzene	<0.001	-		<0.001	<0.001	N/A
n-butylbenzene	<0.001	-		<0.001	<0.001	N/A
n-propylbenzene	<0.001	-		<0.001	<0.001	N/A
p-isopropyltoluene	<0.001	-		<0.001	<0.001	N/A
sec-butylbenzene	<0.001	-		<0.001	<0.001	N/A
Styrene	<0.001	-		<0.001	<0.001	N/A
tert-butylbenzene	<0.001	-		<0.001	<0.001	N/A
1,1,1,2-tetrachloroethane	<0.001	-		<0.001	<0.001	N/A
1,1,1-trichloroethane	<0.001	-		<0.001	<0.001	N/A
1,1,2,2-tetrachloroethane	<0.001	-		<0.001	<0.001	N/A
1,1,2-trichloroethane	<0.001	-		<0.001	<0.001	N/A
1,1-dichloroethane	<0.001	-		<0.001	<0.001	N/A

Sample ID	JKBH/MW1	*BD1/021015*	RPD (%)	SW2	BD2/011015	RPD (%)
1,1-dichloroethene	<0.001	-		<0.001	<0.001	N/A
1,1-dichloropropene	<0.001	-		<0.001	<0.001	N/A
1,2,3-trichloropropane	<0.001	-		<0.001	<0.001	N/A
1,2-dibromo-3-chloropropane	<0.001	-		<0.001	<0.001	N/A
1,2-dichloroethane	<0.001	-		<0.001	<0.001	N/A
1,2-dichloropropane	<0.001	-		<0.001	<0.001	N/A
1,3-dichloropropane	<0.001	-		<0.001	<0.001	N/A
2,2-dichloropropane	<0.001	-		<0.001	<0.001	N/A
Bromochloromethane	<0.001	-		<0.001	<0.001	N/A
Bromodichloromethane	<0.001	-		<0.001	<0.001	N/A
Bromoform	<0.001	-		<0.001	<0.001	N/A
Carbon tetrachloride	<0.001	-		<0.001	<0.001	N/A
Chlorodibromomethane	<0.001	-		<0.001	<0.001	N/A
Chloroethane	<0.01	-		<0.01	<0.01	N/A
Chloroform	<0.001	-		<0.001	<0.001	N/A
Chloromethane	<0.01	-		<0.01	<0.01	N/A
cis-1,2-dichloroethene	<0.001	-		<0.001	<0.001	N/A
cis-1,3-dichloropropene	<0.001	-		<0.001	<0.001	N/A
Dibromomethane	<0.001	-		<0.001	<0.001	N/A
Hexachlorobutadiene	<0.001	-		<0.001	<0.001	N/A
Trichloroethene	<0.001	-		<0.001	<0.001	N/A
Tetrachloroethene	<0.001	-		<0.001	<0.001	N/A
trans-1,2-dichloroethene	<0.001	-		<0.001	<0.001	N/A
trans-1,3-dichloropropene	<0.001	-		<0.001	<0.001	N/A
Vinyl chloride	<0.01	-		<0.01	<0.01	N/A
1,2-dibromoethane	<0.001	-		<0.001	<0.001	N/A
Bromomethane	<0.01	-		<0.01	<0.01	N/A
Dichlorodifluoromethane	<0.01	-		<0.01	<0.01	N/A
Trichlorofluoromethane	<0.01	-		<0.01	<0.01	N/A
1,2,3-trichlorobenzene	<0.001	-		<0.001	<0.001	N/A
1,2,4-trichlorobenzene	<0.001	-		<0.001	<0.001	N/A

Sample ID	JKBH/MW1	*BD1/021015*	RPD (%)	SW2	BD2/011015	RPD (%)
1,2-dichlorobenzene	<0.001	-		<0.001	<0.001	N/A
1,3-dichlorobenzene	<0.001	-		<0.001	<0.001	N/A
1,4-dichlorobenzene	<0.001	-		<0.001	<0.001	N/A
2-chlorotoluene	<0.001	-		<0.001	<0.001	N/A
4-chlorotoluene	<0.001	-		<0.001	<0.001	N/A
Bromobenzene	<0.001	-		<0.001	<0.001	N/A
Chlorobenzene	<0.001	-		<0.001	<0.001	N/A
Hexachlorobenzene	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
Cyclohexane	<0.001	-		<0.001	<0.001	N/A
Acenaphthene	<0.0001	<0.0001	N/A	<0.0001	<0.0001	N/A
Acenaphthylene	<0.0001	<0.0001	N/A	<0.0001	<0.0001	N/A
Anthracene	<0.0001	<0.0001	N/A	<0.0001	<0.0001	N/A
Benz(a)anthracene	<0.0001	<0.0001	N/A	<0.0001	<0.0001	N/A
Benzo(a) pyrene	<0.0001	<0.00005	N/A	<0.0001	<0.0001	N/A
Benzo(b)&(k)fluoranthene	<0.0002	-		<0.0002	<0.0002	N/A
Benzo(g,h,i)perylene	<0.0001	<0.0001	N/A	<0.0001	<0.0001	N/A
Chrysene	<0.0001	<0.0001	N/A	<0.0001	<0.0001	N/A
Dibenz(a,h)anthracene	<0.0001	<0.0001	N/A	<0.0001	<0.0001	N/A
Fluoranthene	<0.0001	<0.0001	N/A	<0.0001	<0.0001	N/A
Fluorene	<0.0001	<0.0001	N/A	<0.0001	<0.0001	N/A
Indeno(1,2,3-c,d)pyrene	<0.0001	<0.0001	N/A	<0.0001	<0.0001	N/A
Naphthalene	<0.0002	<0.0001	N/A	<0.0002	<0.0002	N/A
Phenanthrene	<0.0001	<0.0001	N/A	<0.0001	<0.0001	N/A
Phenolics Total	<0.05	-		<0.05	<0.05	N/A
Pyrene	<0.0001	<0.0001	N/A	<0.0001	<0.0001	N/A
Arochlor 1016	<0.00001	<0.0001	N/A	<0.00001	<0.00001	N/A
Arochlor 1221	<0.00001	<0.0001	N/A	<0.00001	<0.00001	N/A
Arochlor 1232	<0.00001	<0.0001	N/A	<0.00001	<0.00001	N/A
Arochlor 1242	<0.00001	<0.0001	N/A	<0.00001	<0.00001	N/A
Arochlor 1248	<0.00001	<0.0001	N/A	<0.00001	<0.00001	N/A
Arochlor 1254	<0.00001	<0.0001	N/A	<0.00001	<0.00001	N/A

Sample ID	JKBH/MW1	*BD1/021015*	RPD (%)	SW2	BD2/011015	RPD (%)
Arochlor 1260	<0.00001	<0.0001	N/A	<0.00001	<0.00001	N/A
PCBs (Sum of total)	<0.00001	<0.0001	N/A	<0.00001	<0.00001	N/A
4,4-DDE	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
a-BHC	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
Aldrin	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
b-BHC	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
Chlordane (cis)	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
Chlordane (trans)	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
d-BHC	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
DDD	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
DDT	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
Dieldrin	0.000001	<0.00001	N/A	0.000004	0.000004	0
Endosulfan I	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
Endosulfan II	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
Endosulfan sulphate	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
Endrin	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
Endrin aldehyde	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
Endrin ketone	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
g-BHC (Lindane)	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
Heptachlor	<0.000001	<0.000005	N/A	<0.000001	<0.000001	N/A
Heptachlor epoxide	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
Methoxychlor	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
Oxychlordane	<0.000001	<0.00001	N/A	<0.000001	<0.000001	N/A
Azinophos methyl	<0.00001	<0.00002	N/A	<0.00001	<0.00001	N/A
Azinphos Ethyl	<0.00001	<0.00002	N/A	<0.00001	<0.00001	N/A
Chlorfenvinphos E	<0.00001	-		<0.00001	<0.00001	N/A
Chlorfenvinphos Z	<0.00001	-		<0.00001	<0.00001	N/A
Chlorpyrifos	<0.00001	<0.00002	N/A	<0.00001	<0.00001	N/A
Chlorpyrifos-methyl	<0.00001	<0.0002	N/A	<0.00001	<0.00001	N/A
Diazinon	<0.00001	<0.00001	N/A	<0.00001	<0.00001	N/A
Dichlorvos	<0.00001	<0.0002	N/A	<0.00001	<0.00001	N/A

Sample ID	JKBH/MW1	*BD1/021015*	RPD (%)	SW2	BD2/011015	RPD (%)
Dimethoate	<0.00001	<0.00002	N/A	<0.00001	<0.00001	N/A
Ethion	<0.00001	<0.00002	N/A	<0.00001	<0.00001	N/A
Fenitrothion	<0.00001	<0.002	N/A	<0.00001	<0.00001	N/A
Fenthion	<0.00001	<0.00005	N/A	<0.00001	<0.00001	N/A
Malathion	<0.00001	<0.00002	N/A	<0.00001	<0.00001	N/A
Methyl parathion	<0.00001	<0.0005	N/A	<0.00001	<0.00001	N/A
Demeton-S-methyl	<0.00001	<0.00002	N/A	<0.00001	<0.00001	N/A
Parathion	<0.00001	<0.0002	N/A	<0.00001	<0.00001	N/A
Pirimiphos-methyl	<0.00001	<0.00001	N/A	<0.00001	<0.00001	N/A
Pirimphos-ethyl	<0.00001	<0.00001	N/A	<0.00001	<0.00001	N/A

Notes to Table 6:
Results expressed in mg/L
Italics - duplicate sample shown in italics is inter-laboratory duplicate

The calculated RPD values for groundwater / surface water were within the acceptable range of 30% with the exception of those cells shaded grey. However, this is not considered to be significant because:

- The typically low actual differences in the concentrations of the replicate pairs where RPD exceedances occurred;
- The recorded concentrations being close to the PQL;
- The majority of the RPD values were within the acceptable range; and
- All other QA/QC parameters generally met the DQIs.

Q2.9.2 Summary of Field Replicate Results

Whilst some RPDs were outside the acceptable range, the majority were within and the reasons for those being outside are not considered to be significant. Therefore the overall intra-laboratory and inter-laboratory comparisons indicate that the sampling technique was consistent and repeatable and therefore the results are considered useable and representative of the conditions encountered and acceptable 'precision' was achieved.

Q2.10 Rinsate Sample

One equipment rinsate sample was collected by passing de-ionised water over the decontaminated sampling apparatus (groundwater pump) into laboratory supplied sample bottles. The rinsate sample was submitted for laboratory analysis of the target contaminants to assess potential cross

contamination and data 'accuracy'. The results for the rinsate samples are presented in the following table.

Table 7: Rinsate Results (mg/L)

Sample ID	R1/021015
Arsenic (Filtered)	<0.001
Cadmium (Filtered)	<0.0001
Chromium (III+VI) (Filtered)	<0.001
Copper (Filtered)	<0.001
Lead (Filtered)	<0.001
Manganese (Filtered)	<0.005
Mercury (Filtered)	<0.00005
Nickel (Filtered)	<0.001
Zinc (Filtered)	<0.001
C10-C16	<0.05
C16-C34	<0.1
C34-C40	<0.1
F2-NAPHTHALENE	<0.05
C6 - C9	<0.01
C10 - C14	<0.05
C15 - C28	<0.1
C29-C36	<0.1
C6-C10 less BTEX (F1)	<0.01
C6-C10	<0.01
Benzene	<0.001
Ethylbenzene	<0.001
Toluene	<0.001
Xylene (m & p)	<0.002
Xylene (o)	<0.001
Hexachlorobenzene	<0.000001
Acenaphthene	<0.0001
Acenaphthylene	<0.0001
Anthracene	<0.0001

Sample ID	R1/021015
Benz(a)anthracene	<0.0001
Benzo(a) pyrene	<0.0001
Benzo(b)&(k)fluoranthene	<0.0002
Benzo(g,h,i)perylene	<0.0001
Chrysene	<0.0001
Dibenz(a,h)anthracene	<0.0001
Fluoranthene	<0.0001
Fluorene	<0.0001
Indeno(1,2,3-c,d)pyrene	<0.0001
Naphthalene	<0.0002
Phenanthrene	<0.0001
Phenolics Total	<0.05
Pyrene	<0.0001
Arochlor 1016	<0.00001
Arochlor 1221	<0.00001
Arochlor 1232	<0.00001
Arochlor 1242	<0.00001
Arochlor 1248	<0.00001
Arochlor 1254	<0.00001
Arochlor 1260	<0.00001
PCBs (Sum of total)	<0.00001
4,4-DDE	<0.000001
a-BHC	<0.000001
Aldrin	<0.000001
b-BHC	<0.000001
Chlordane (cis)	<0.000001
Chlordane (trans)	<0.000001
d-BHC	<0.000001
DDD	<0.000001
DDT	<0.000001
Dieldrin	<0.000001

Sample ID	R1/021015
Endosulfan I	<0.000001
Endosulfan II	<0.000001
Endosulfan sulphate	<0.000001
Endrin	<0.000001
Endrin aldehyde	<0.000001
Endrin ketone	<0.000001
g-BHC (Lindane)	<0.000001
Heptachlor	<0.000001
Heptachlor epoxide	<0.000001
Methoxychlor	<0.000001
Oxychlordane	<0.000001
Azinophos methyl	<0.00001
Azinphos Ethyl	<0.00001
Chlorfenvinphos E	<0.00001
Chlorfenvinphos Z	<0.00001
Chlorpyrifos	<0.00001
Chlorpyrifos-methyl	<0.00001
Diazinon	<0.00001
Dichlorvos	<0.00001
Dimethoate	<0.00001
Ethion	<0.00001
Fenitrothion	<0.00001
Fenthion	<0.00001
Malathion	<0.00001
Methyl parathion	<0.00001
Demeton-S-methyl	<0.00001
Parathion	<0.00001
Pirimiphos-methyl	<0.00001
Pirimphos-ethyl	<0.00001

Concentrations of analytes in the rinsate sample were below the PQL indicating that cross contamination of the groundwater samples due to insufficient decontamination procedures is unlikely to have occurred and that acceptable data 'accuracy' was achieved.

Q3. Laboratory Quality Assurance and Quality Control

Envirolab was used as the primary laboratory and ALS was the secondary laboratory. Appropriate methods and PQLs were used by the laboratory. Sample methods were NATA accredited.

Q3.1 Surrogate Spike

This sample is prepared by adding a known amount of surrogate, which behaves similarly to the analyte, prior to analysis to each sample. The recovery result indicates the proportion of the known concentration of the surrogate that is detected during analysis and is used to assess data 'accuracy'. Results within acceptance limits indicate that the extraction technique was effective.

Q3.2 Reference and Daily Check Sample Results – Laboratory Control Sample (LCS)

This sample comprises spiking either a standard reference material or a control matrix (such as a blank of sand or water) with a known concentration of specific analytes. The LCS is then analysed and results compared against each other to determine how the laboratory has performed with regard to sample preparation and analytical procedure and is used to assess data 'accuracy'. LCSs are analysed at a frequency of 1 in 20, with a minimum of one analysed per batch.

Q3.3 Laboratory Duplicate Results

These are additional portions of a sample which are analysed in exactly the same manner as all other samples and is used to assess data 'precision'. The laboratory acceptance criteria for duplicate samples is: in cases where the level is <5xPQL – any RPD is acceptable; and in cases where the level is >5xPQL – 0-50% RPD is acceptable.

Q3.4 Laboratory Blank Results

The laboratory blank, sometimes referred to as the method blank or reagent blank is the sample prepared and analysed at the beginning of every analytical run, following calibration of the analytical apparatus and is used to assess data 'accuracy'. This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, it can be determined by processing solvents and reagents in exactly the same manner as for samples. Laboratory blanks are analysed at a frequency of 1 in 20, with a minimum of one per batch.

Q3.5 Matrix Spike

This is a sample duplicate prepared by adding a known amount of analyte prior to analysis, and then treated exactly the same as all other samples. The recovery result indicates the proportion of the known concentration of the analyte that is detected during analysis and is used to assess data

'accuracy'. The laboratory acceptance criteria for matrix spike samples is generally 70-130% for inorganic/metals; and 60-140% for organics; and 10-140% for SVOC and speciated phenols.

Q3.6 Results of Laboratory QC

The laboratory QC for surrogate spikes, LCS, laboratory duplicate results, method blanks and matrix spikes were generally within the acceptance standards. There were, however a few comments made in some of the laboratory reports which are summarised in the table below.

Table 7: Laboratory QA Comments for Results Above QA/QC Criteria

Report No.	Laboratory	Laboratory Comment
134222	Envirolab	Acid Extractable Metals in Soil: The laboratory RPD acceptance criteria has been exceeded for 134222-11 for Mn. Therefore a triplicate result has been issued as laboratory sample number 134222-78. Acid Extractable Metals in Soil: The laboratory RPD acceptance criteria has been exceeded for 134222-41 for Cr and Mn. Therefore a triplicate result has been issued as laboratory sample number 134222-75. Acid Extractable Metals in Soil: The laboratory RPD acceptance criteria has been exceeded for 134222-51 for Cu. Therefore a triplicate result has been issued as laboratory sample number 134222-76. Acid Extractable Metals in Soil: The laboratory RPD acceptance criteria has been exceeded for 134222-61 for Zn. Therefore a triplicate result has been issued as laboratory sample number 134222-77. METALS_S: ## Percent recovery is not possible to report due to the in-homogeneous nature of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS. METALS_S: # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS. PAH in soil: The RPD for duplicate results is accepted due to the non-homogenous nature of the sample/s. sTRH in soil: The RPD for duplicate results is accepted due to the non-homogenous nature of the sample/s. # Percent recovery is not possible to report as the high concentration of analytes in the sample/s have caused interference. OP/PCB in soil: PQL has been raised due to interference from analytes(other than those being tested) in the sample/s.
134222B	Envirolab	Samples requested and analysed out of holding time for TCLP PAH.
135368	Envirolab	MISC_INORG: PQL for Nitrate and Nitrite has been raised due to possible colorimetric interference. Due to strong background colour. MISC_INORG:# Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS. VOC_W: PQL has been raised as the sample/s were foamy and required dilution. TRH_BTEX_W_V: PQL has been raised as the sample/s were foamy and required dilution. OC/OP/PCB's subcontracted to NMI.

Report No.	Laboratory	Laboratory Comment
ES1532954	ALS	BD1/021015 Nitrite as N holding time breach. For some analytes, the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed was insufficient.

The majority of the laboratory quality control samples were within the laboratory acceptance criteria, with the exception of those identified in the above table. The QC non-conformances, where they occurred, are not considered to have significantly impacted the quality of the results overall as the number of non-conformances were minor compared to the overall QC data. It is considered that an acceptable level of laboratory precision and accuracy was achieved and that surrogate spikes, LCS, laboratory duplicate results, method blanks and matrix spike results were of an acceptable level overall. On the basis of this assessment, the laboratory data set is considered to have complied or partially complied with the DQIs.

Q3.7 Overall Assessment of QA/QC

Specific limits associated with sample handling and laboratory Quality Assurance and Quality Control were assessed against the DQIs and a summary is presented in the following table.

Table 8: Data Quality Indicators

DQI	Performance Indicator	Acceptable Range	Compliance
Precision			
Field considerations	SOPs appropriate and complied with	Field staff follow SOPs in the DP *Field Procedures Manual*	C
	field replicates	Precision average relative percent difference (RPD) result <5 times PQL, no limit; results >5 times PQL, 0% - 30%	PC
Laboratory considerations	laboratory duplicates	Precision average RPD result <5 times PQL, no limit; results >5 times PQL, 0% - 50%	PC
	laboratory-prepared volatile trip spikes	Recovery of 60-140%	C

DQI	Performance Indicator	Acceptable Range	Compliance
Accuracy (bias)			
Field considerations	SOPs appropriate and complied with	Field staff to follow SOPs in the DP *Field Procedures Manual*	C
Laboratory considerations	Analysis of:		
	laboratory-prepared volatile trip spikes	Recovery of 60-140%	C
	Laboratory-prepared trip blanks (field blanks)	<PQL	C
	Rinsate samples	<PQL	C
	method blanks (laboratory blanks)	Recovery of 60-140%	C
	matrix spikes	Recovery of 70-130% (inorganics); 60-140% (organics)	C
	matrix spike duplicates	Recovery of 70-130% (inorganics); 60-140% (organics); Recovery 70 “low” to 130% “high” indicates interference	C
	surrogate spikes	Recovery of 70-130% (inorganics); 60-140% (organics)	C
	laboratory control samples	Recovery of 70-130% (inorganics); 60-140% (organics)	PC
Completeness			
Field considerations	All critical locations sampled	All critical locations sampled in accordance with the SAQP	C
	SOPs appropriate and complied with	Field staff to follow SOPs in the DP *Field Procedures Manual*	C
	Experienced sampler	Experienced DP Environmental Scientist/Engineer to conduct field work and sampling	C
	Documentation correct	Maintain COC documentation at all times	C
	Sample holding times complied with	Sample holding times complied with	PC
Laboratory considerations	All critical samples analysed according to SAQP	All critical locations analysed in accordance with the SAQP	C
	Appropriate methods and PQLs	Appropriate methods and PQLs have been used by the contract laboratory	C
	Sample documentation complete	Maintain COC documentation at all times	C

DQI	Performance Indicator	Acceptable Range	Compliance
Comparability			
Field considerations	Same SOPs used on each occasion	Field staff to follow SOPs in the DP *Field Procedures Manual*	C
	Experienced sampler	Experienced DP Environmental Scientist/Engineer to conduct field work and sampling	C
	Same types of samples collected (filtered)	Field filtering for metals	C
Laboratory considerations	Sample analytical methods used (including clean-up)	Methods to be NATA accredited	C
	Sample PQLs (justify/quantify if different)	Consistent PQLs to be used	C
	Same laboratories (justify/quantify if different)	Same analytical laboratory for primary samples to be used	C
Representativeness			
Field considerations	Appropriate media sampled according to SAQP	Appropriate media sampled according to SAQP	C
	All media identified in SAQP sampled	All media identified in SAQP sampled	C
Laboratory considerations	All samples analysed according to SAQP	All samples analysed according to SAQP	C

Notes to Table 8:

C – Compliance

PC – Partial Compliance

NC – Non-Compliance

NA – Not Applicable

SOP – Standard Operating Procedure

SAQP – Sampling and Analysis Quality Plan

A review of the adopted QA/QC procedures and results indicates that the DQIs have generally been met with only minor non-conformances / partial compliance. On this basis, the sampling and laboratory methods used during the investigation were found to meet DQOs for this project.

Appendix J

Geotechnical Methodology for Remediating

Benedict's Moorebank Site (J&K, 2016)

GEOTECHNICAL METHODOLOGY FOR REMEDIATING BENEDICTS' MOOREBANK SITE

The following methodology is proposed, from a geotechnical point of view, to remediate the site for the proposed residential subdivision.

1 Complete the current excavations which are being carried out to remove sources of methane so as to satisfy the environmental requirements.

2 The lateral extent and depth of the excavations to be accurately surveyed and plotted on a site plan. Levels are to be established relative to AHD.

3 Backfill the above excavations to final terrace level –3m. The backfill is to comprise select approved material which must be free of deleterious substances and have a maximum particle size of ⅔ the proposed layer thickness. After removal of all loose material, the backfill must be compacted in layers not greater than 200mm loose thickness to a minimum density of 95% Standard Maximum Dry Density. Thicker compaction layers may be acceptable provided it can be demonstrated that the required density can be achieved over the full depth of the layer. The backfill will need to be keyed into the adjacent existing fill. The selection, placement and compaction of backfill to be carried out under Level 1 testing by a NATA registered laboratory in accordance with AS3798.

4 The entire site is to be excavated, as appropriate, to final terrace level –3m.

5 The exposed subgrade over the entire site to be subjected to High Energy Impact Compaction (HEIC). Recent trials (refer Landpac report October 2015) indicated that 40 passes with an Impact Drum module weight of 14 tonne with a minimum kinetic energy rating of 160kJ was appropriate. The number of passes required to be confirmed on site using appropriate settlement and ground response monitoring systems as well as geotechnical EFCP testing, all under the direction of the geotechnical engineer.

6 Fill the entire site to achieve the final terrace levels (ie. at least 3m of fill as described in Item 5 above). The fill is to be selected, placed and compacted as in Item 3 above. However, a minimum density of 98% SMDD is required.

Appendix D

Remediation action plan for DA 24/2017 at Lot 7 DP 1065574

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Remediation Action Plan

Proposed Residential Development
146 Newbridge Road, Moorebank

Prepared for
Benedict Industries Pty Ltd

Project 71459.06
May 2017



Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	71459.06	Document No.	R.001.Rev4
Document title	Remediation Action Plan Proposed Residential Development		
Site address	146 Newbridge Road, Moorebank		
Report prepared for	Benedict Industries Pty Ltd		
File name	71459.06.R.001.Rev4.RAP		

Document status and review

Status	Prepared by	Reviewed by	Date issued
Draft A	John Russell	J M Nash	2 May 2016
Revision 0	John Russell	J M Nash	19 May 2016
Revision 1	John Russell	J M Nash	20 December 2016
Revision 2	John Russell	J M Nash	27 March 2017
Revision 3	John Russell	J M Nash	10 April 2017
Revision 4	John Russell	J M Nash	3 May 2017

Distribution of copies

Status	Electronic	Paper	Issued to
Draft A	1	0	Ernest Dupere
Revision 0	1	0	Ernest Dupere
Revision 1	1	0	Ernest Dupere
Revision 2	1	0	Ernest Dupere
Revision 3	1	0	Ernest Dupere and Ian Swane
Revision 4	1	0	Ernest Dupere and Ian Swane

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author		3 May 2017
Reviewer		3 May 2017

bsi. ISO 9001 Quality Management

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666
Fax (02) 9809 4095

Executive Summary

This Remediation Action Plan (RAP) prepared by Douglas Partners Pty Ltd (DP) outlines the remediation strategy for a proposed residential development at 146 Newbridge Road, Moorebank. The report was commissioned by Benedict Industries Pty Ltd (Benedict) and was undertaken in accordance with DP's proposal SYD160329 dated 26 April 2016. The following is understood:

- The RAP will be required for submission as part of a development application (DA) for a proposed residential development at the site;
- The proposed development will involve retaining wall construction, bulk earthworks followed by construction of internal roads, associated infrastructure, residential lots and approximately 180 houses; and
- The site is being audited by Dr Ian Swane, a NSW Environment Protection Authority (EPA) accredited Site Auditor, to facilitate the issue of a site audit statement (SAS) Part B confirming the land can be made suitable for the proposed development.

The overall goal of the remediation programme outlined in the RAP is to render the site suitable for the proposed residential development. Further details are provided in Section 12. The objectives of the RAP are to:

- Set remediation goals that are likely to meet the conditions of a Development Consent so that the redevelopment area will be suitable for the proposed residential land uses and will pose no unacceptable risk to human health or the environment;
- Evaluate the range of remediation options available to address the existing site contamination issues, and thereby reduce risks to acceptable levels;
- Document the preferred remediation techniques and procedures;
- Establish the various safeguards required to complete the remediation work in a safe and environmentally acceptable manner;
- Identify the necessary approvals and licences required by regulatory authorities in order to enable the remediation works to proceed;
- Document a remediation strategy that will address on-site issues affecting future migration of contamination from the site; and
- Document a remediation strategy that will complement other regulatory requirements relevant to the remediation of contamination.

These objectives correspond to those given by NSW EPA guidelines, SEPP55 guidelines and Liverpool Council's contaminated land policy.

The site comprises part (generally the northern half) Lot 7 in Deposited Plan 1065574. The street address is 146 Newbridge Road, Moorebank and the site has a total area of approximately 9 ha. Large scale filling and dredging activity occurred at the site between 1991 and 2000. The wider site currently operates under two NSW EPA licences issued under the POEO Act. Based on a review of the NSW EPA information undertaken by Environmental Investigation Services (EIS) (EIS, 2013), the scheduled activities at the site included:

- Crushing, grinding or separating; land-based extractive activity; and water-based extractive activity;

- Storage/transfer/separation of various waste streams;
- Importation of virgin excavated natural material (VENM) and potential acid sulphate soil (PASS) for backfilling sand quarry (according to the site owner, only minor quantities of PASS was ever accepted at the site);
- Dredging activities;
- Landfilling activities; and
- Recovery, storage and processing (non-thermal treatment) of general waste including VENM; general solid waste (non-putrescible); general or specific exempted waste; wood waste; waste; paper or cardboard; gyprock; glass; building and demolition waste; asphalt waste (including asphalt resulting from road construction and waterproofing works); and waste tyres.

A number of previous geotechnical and environmental (contamination) investigations have been carried out at the site. The investigations have generally confirmed the presence of fill containing a component of construction and demolition waste of varying thickness of up to 11.5 m at the southern central portion of the site.

The scope of works comprised the following:

- Undertake a review of the following:
  - Design levels and associated earthworks cut and fill plan;
  - Typical building designs;
  - Geotechnical methodology for ground improvement (i.e. J&K (2016b; 2017));
- Complete a remediation options evaluation for:
  - Residual soil contamination (i.e. capping or excavation and off-site disposal of soil 'hotspots');
  - Landfill gas mitigation measures;
  - Groundwater contamination;
- Establish the preferred remedial option for residual soil contamination, landfill gas mitigation measures and groundwater contamination;
- Prepare this RAP that includes the following:
  - Remediation options evaluation, as discussed above;
  - Nomination of the preferred remediation option, as discussed above;
  - Establishment of remediation acceptance criteria (RAC);
  - Provide concept designs for typical landfill gas mitigation measures for dwellings;
  - Provide a methodology for the validation of remedial work (excluding construction quality assurance (CQA) for gas mitigation measures);
  - Contingency measures for unexpected finds;
  - Reference to community engagement prepared by the developer as part of the Environmental Impact Statement (EIS);
  - Inclusion of a sampling and analysis quality plan (SAQP) which specifies sampling and monitoring requirements during remediation and construction.

Based on the conceptual site model (CSM), the extent of remediation required is summarised as follows:

- Removal of localised soil contamination 'hotspots' or the placement of a physical barrier (e.g. capping) to prevent the exposure of receptors (human and ecological) to the soil contamination; and
- Incorporation of the relevant measure(s) or system element(s) into dwelling construction to achieve a score consistent with what is required based on the characteristic gas situation (CGS) of 3. This will also be relevant to any associated infrastructure in which landfill gas can accumulate.

The remediation options considered for residual soil contamination and landfill gas including their ranking, are summarised in Table E1 and E2, below. Groundwater contamination is to be addressed by validation monitoring and various contingency options.

Consideration of the various options is influenced by the fact that the proposed development involves a 3.0 m thick engineered cap of which the upper 1.6 m will be imported VENM. The options evaluation is outlined in the following table.

Table E1: Remediation Options Evaluation for Residual Soil Contamination

Option	Evaluation	Option Ranking
Option 1: Do nothing	In the context of the proposed development involving a 3.0 m thick engineered cap of which the upper 1.6 m will be imported VENM, this option is not considered appropriate.	Not applicable.
Option 2: On site treatment prior to off-site disposal	There is a significant quantity of fill on the site. The known soil contaminants include inorganics (lead and copper) and organics (TRH, PCB and B(a)P) exceeding NSW EPA soil investigation levels (SIL). With the exception of TRH and PCB, the other contaminants are not readily amenable to treatment (destruction) and therefore this option is not considered appropriate. Notwithstanding, in order to reduce contaminant levels and specifically to neutralise areas of high methane gas generation (hotspots), deep waste (fill) material could be excavated and organic matter (mainly timber) removed by screening and manual removal from the screens). The removed material would be disposed off-site and the remaining materials returned to the excavation. Whilst this method is costly and labour intensive the intention is to reduce contaminant loading (principally in terms of potential ground gas and groundwater (TDS and ammonia, associated with timber) emissions) and although the method will not remove all organic material from the excavated materials it is nevertheless considered to be a both a practical and reasonably efficient means of substantially mitigating potential environmental emissions and thus reducing longer term risks.	Not applicable.
Option 3: Off-site treatment prior to off-site disposal	The known soil contaminants include inorganics (lead and copper) and organics (TRH, PCB and B(a)P). With the exception of TRH and PCB, the other contaminants are not readily amenable to treatment (destruction) and therefore this option is not considered appropriate.	Not applicable.
Option 4: Off-site disposal to landfill	This option is considered to be both feasible and practical for near surface contamination. It is not considered feasible and practical for deeper (e.g. >2 m) contamination. Excavation could be adopted to facilitate the removal and off-site disposal of materials containing 'hotspot' levels of contamination, in particular gas hotspots.	2 Contingency.

Option	Evaluation	Option Ranking
	Excavation could be adopted to facilitate the removal and off-site disposal of materials containing 'hotspot' levels of contamination such as high concentrations of: • Biodegradable material that form gas hotspots and/or generate leachate; • Drummed waste or areas where fuel leaks occurred that pose soil vapour and/or groundwater contamination risks; and • Unexpected finds.	
Option 5: Containment of the impacted soil on site beneath an engineered barrier	In the context of the proposed development involving a 3.0 m thick engineered cap of which the upper 1.6 m will be imported VENM, this option is considered to be both feasible and practical.	1 Preferred

Given the proposed 3.0 m thick engineered cap of which the upper 1.6 m will be imported VENM, the preferred option for residual soil contamination at the site is containment of the impacted soil on site beneath an engineered barrier (Option 5).

Landfill gas monitoring data to date indicates that there is currently an unacceptable risk of the migration of landfill gas into structures (e.g. dwelling) associated with proposed development. The recent monitoring conducted as part of the detailed site investigation (DSI) suggests that a CGS of 3 is appropriate for this site.

The options evaluation is outlined in the following table.

Table E2: Remediation Options Evaluation for Landfill Gas

Option	Evaluation	Option Ranking
Option 1: Do nothing	A potentially complete pathway (explosion and/or asphyxiation risk) exists between the source of the landfill gas and the future site users (dwelling occupants). This option is not considered appropriate.	Not applicable.
Option 2: Complete removal of the landfill gas source	There is a significant quantity of fill (i.e. the primary source of the gas) on the site. Complete removal of the fill is not considered to be feasible or practical. This option is not considered appropriate.	Not applicable.
Option 3: Partial removal of the landfill gas source	There is a significant quantity of fill (i.e. the primary source of the gas) on the site. Partial removal of 'unacceptable' gas generating fill may lower the CGS for the site.	1 Preferred (already being undertaken).

Option	Evaluation	Option Ranking
Option 4: Engineered landfill gas mitigation measures for the entire site	An active system may not be suitable for residential land use because effective long term operation may not be feasible. This option could involve the installation of an array of landfill gas extraction wells fitted with air pumps spread across the site. This could also be incorporated into the 3 m thick 'engineered fill' blanket. This option is likely to involve a significant amount of engineering design and the ongoing maintenance of any active extraction that may be required.	2 Contingency.
Option 5: Engineered landfill gas mitigation measures (passive) for each proposed structure	This option is considered to be both feasible and practical subject to the incorporation of passive measures only.	1 Preferred.
Option 6: Engineered landfill gas mitigation measures (passive and active) for each proposed structure	This option is not considered to be feasible or practical due to the incorporation of active measures that would require ongoing maintenance.	2 Contingency.

It is noted here that Option 5 in the above table applies only for engineered landfill gas mitigation measures for each proposed structure. For this type of 'brown field' site Option 5 remains the only practical and cost effective remedial measure for the proposed residential use of the land and whilst development of landfill gas affected land is this way is fairly new in Australia similar types of development are now quite common in Europe and particularly in UK. In the latter the various authorities have developed considerable amounts of guidance over a number of years (for example Protective measures for housing on gas contaminated land, BSI 8485 (2015) *Code of Practice for Design of Protective Measures for Ground Gases* and accordingly it is considered that there should be no unsurmountable impediments to facilitating a similar type of development at the current site. Such sites when properly engineered have been successfully developed and accepted by both the Local Authorities and future property owners and as such there is no reason why a similar approach should not be adopted at this site. Option 5 above is given a higher ranking than Option 4 on the basis that engineered landfill gas mitigation measures other than the application of a 3.0 m cap are not considered necessary other than in built structures as any gas reaching the surface in these areas will be diluted and dispersed by normal air movements.

The preferred option for landfill gas concentration / volume reduction is the partial removal of the landfill gas source 'hot spots' (already being undertaken) and passive engineered landfill gas mitigation measures for each proposed structure (e.g. venting and/or gas resistant membranes beneath concrete slabs) (Options 3 and 5). Passive measures are considered appropriate for this development as opposed to active measures which would require home owners to maintain an active system.

The partial removal of unacceptable landfill gas sources and associated waste from the fill will have the added benefits of:

- The removal of a portion of metal waste by screening some metal out of the fill prior to its use as backfill. The metal waste in fill is currently leaching dissolved metals into groundwater and is likely to be having a net adverse impact on groundwater quality beneath the site;
- The removal of a portion of timber and other general waste by screening timber and other general waste out of the fill prior to its use as backfill. The timber and other general waste in fill is currently leaching contaminants such as dissolved metals, degradable by-products (ammonia, nutrients), OCPs (assuming discarded containers of OCP are present) and TDS into groundwater and is likely to be having a net adverse impact on groundwater quality beneath the site; and
- Removal and disposal of bonded ACM from excavated waste.

Additional benefits of removing unacceptable landfill gas sources include:

- Reduce the degree of reliance on landfill gas mitigation measures since landfill gas levels remaining at depth at the site would be reduced to the extent practicable;
- Reduce greenhouse gas emissions to the extent practicable; and
- Reduce the leachate generation of the landfill waste to the extent practicable.

Given that Option 5 has been adopted, it must be understood that a final validation report and a Section A Site Audit Statement (SAS) will not be provided until all building structure / foundations had been constructed.

Remediation will occur in three distinct stages being:

- Stage 1: Site Preparation Earthworks;
  - Stage 1a: Areas Requiring Deep Excavation;
  - Stage 1b: General Site Preparation Earthworks;
- Stage 2: VENM Capping; and
- Stage 3: Installation of Landfill Gas Mitigations.

The Stage 3 landfill gas mitigations can be divided into two sub-stages as follows:

- Stage 3a: Design the measure(s) or system element(s) to achieve a score consistent with what is required based on the CGS of 3 (i.e. 4.5 points); and
- Stage 3b: Installation of the measure(s) or system element(s) and compliance with the relevant CQA.

Stage 3 works will be done as part of the future detailed design and separate Development Application (DA) of the individual homes.

The relevant landfill gas mitigation measure(s) or system element(s) required will be subject to detailed design. It is envisaged that detailed design will occur in consultation with the project design team as it will form an integral component of the building / construction drawings that will need to be prepared prior to construction. This RAP puts forward a concept design only.

In conclusion, it is considered that remediation of the site in accordance with the procedures and validation methods outlined in this RAP will render the site suitable for the proposed residential development.

The proposed validation monitoring of landfill gas and surface water may also allow modifications (e.g. a lowering of the CGS for the site) to the proposed scope and general methodology of remediation that has been recommended in this RAP. Any modifications would be subject to approval by the Site Auditor and agreement with the Geotechnical Consultant.

The detailed design of buildings incorporating the required gas mitigation measure(s) or system element(s) will necessarily be undertaken at the appropriate point in time of the project and under a separate DA associated with Stage 3 of the remediation.

DP considers that this RAP has met the objectives of an RAP specified in NSW EPA guidelines, SEPP55 guidelines and Council's contaminated land policy. These objectives are to:

- Set remediation goals that are likely to meet the conditions of a Development Consent so that the redevelopment area will be suitable for the proposed residential land uses and will pose no unacceptable risk to human health or the environment;
- Evaluate the range of remediation options available to address the existing site contamination issues, and thereby reduce risks to acceptable levels;
- Document the preferred remediation techniques and procedures;
- Establish the various safeguards required to complete the remediation work in a safe and environmentally acceptable manner;
- Identify the necessary approvals and licences required by regulatory authorities in order to enable the remediation works to proceed;
- Document a remediation strategy that will address on-site issues affecting future migration of contamination from the site; and
- Document a remediation strategy that will complement other regulatory requirements relevant to the remediation of contamination.

The proposed remediation strategy has included tasks that will address uncertainties that currently exist in relation to groundwater quality, composition of the 3 m 'engineered fill blanket' and the finalised GSV and CGS, as required by the NSW OEH (2011) guidelines.

DP considers that the site can be made suitable for its intended residential land use if the site is remediated in accordance with this RAP, and managed in accordance with a Long Term (passive) EMP, as required by NSW OEH (2011) guidelines.

Table of Contents

Page

1. Introduction 1
2. Background Information 2
   - 2.1 Site Identification 2
   - 2.2 Site Condition and Surrounding Environment 2
   - 2.3 Groundwater Dependant Ecosystems 2
3. Proposed Development 3
4. List of Previous Reports 4
5. Scope of Works 6
6. Subsurface Conditions 7
   - 6.1 Geology 7
   - 6.2 Fill 7
   - 6.3 Acid Sulphate Soil Risk 8
   - 6.4 Hydrogeology 8
7. Summary of Site History 9
8. Summary of Relevant Previous Investigations 10
   - 8.1 DP (2002b) 10
   - 8.2 EIS (2013) 11
   - 8.3 EIS (2014a) 14
   - 8.4 EIS (2014b) 15
   - 8.5 EIS (2014c) 16
   - 8.6 EIS (2014d) 17
   - 8.7 EIS (2014e) 18
   - 8.8 DP (2014a) 21
   - 8.9 DP (2014b) 21
   - 8.10 DP (2016) 21
   - 8.11 Summary Results of Previous Investigations 25
   - 8.12 Uncertainties and Data Gaps in Assessments 25
9. Conceptual Site Model 25
10. Remediation Trials 31
    - 10.1 Overview 31
    - 10.2 Small Scale Treatment Trials 31

10.3 Larger Scale Treatment Trials 32
10.3.1 Potential Acid Sulphate Soil at the Base of Current Trial Remediation Excavation 34
10.3.2 Results of Testing Associated with the Current Trial Remediation Excavation 34
10.4 Compaction Trials on Landfilled Waste 36
11. Geotechnical Site Improvement 36
12. Identification of Remediation Goals 38
13. Extent of Remediation Required 39
14. Remediation Options Evaluation and Preferred Remediation Option 39
14.1 General 39
14.2 Remediation Options for Residual Soil Contamination 41
14.3 Remediation Options for Landfill Gas 43
14.4 Remediation Options for Contaminated Groundwater 45
14.5 Summary of Preferred Remediation Options 46
15. Remediation Acceptance Criteria 47
15.1 Upper 3 m of Soil 47
15.2 Remediation Acceptance Criteria – Soil Quality below 3 m 52
15.3 Landfill Gas 53
15.4 Groundwater and Surface Water 59
15.5 Remediation Acceptance Criteria – Geotechnical 59
15.6 Modifications to Remediation Acceptance Criteria 61
16. Sequence of Remediation 61
16.1 Preliminary Work 61
16.1.1 Overview 61
16.1.2 Preliminary Work – Duty to Report 63
16.1.3 Regulatory Approvals and Licenses 64
16.1.4 Remediation Excavation Trial Reporting 64
16.1.5 Detailed Design of Landfill Gas Mitigation Measures 64
16.1.6 Clearance of Suspect Areas 67
16.1.7 Acid Sulfate Soil Investigation 67
16.1.8 Validation Landfill Gas and Surface Water Monitoring Programme 67
16.1.9 Preliminary Long Term Environmental Management Plan 68
16.1.10 Supplementary Geotechnical Assessments 69
16.2 Stage 1: Site Preparation Earthworks 69
16.2.1 Removal and/or Replacement of Existing Buried Services 69
16.2.2 Winning On-site Material for Backfill and Cap Construction 70
16.2.3 Removal of Hotspots 73
16.2.4 General Site Preparation Earthworks 74
16.2.5 Installation of Deeply Buried Services 76

16.2.6 Accurate Surveys 76
16.3 Stage 2: VENM Capping 77
16.3.1 Hold Point Requirements 77
16.3.2 Work Procedures 77
16.3.3 Geotechnical Validation 78
16.3.4 Stages 1 and 2 Validation Report 78
16.4 Stage 3: Installation and Verification of Landfill Gas Mitigation Measures 78
16.4.1 Minimum Requirements 79
16.4.2 Installation and Verification Plan 79
16.4.3 Hold Point Requirements 79
16.4.4 Installation of Landfill Gas Mitigation Measures 79
16.4.5 Verification of Landfill Gas Mitigation Measures 80
16.4.6 Stage 3 Validation Report 80
16.5 Contingencies for Unexpected Finds 81
16.6 Ground Gas Contingency Measures 82
16.7 Roles and Responsibilities 83
16.8 Site Supervision 84
16.9 Environmental Monitoring Programme 85
17. Management and Waste Classification of Excavated Material 86
17.1 Stockpiling of Contaminated Material 86
17.2 Waste Classification 86
17.3 Spoil Contingency Plan 87
17.4 Loading and Transport of Spoil 88
17.5 Disposal of Material 88
18. Imported VENM for Cap 89
18.1 Imported VENM for Cap 89
18.2 Other Materials Required by the Remediation / Redevelopment Work 89
19. Site Validation 90
19.1 Validation Sample Collection and Analysis 90
19.1.1 Existing Fill to be Incorporated into the 3 m Thick Engineered Fill Blanket 90
19.1.2 Contingency Excavation of 'Hotspots' Encountered During Earthworks 92
19.1.3 Backfill Placed below Subgrade Level 92
19.1.4 Geotechnical Validation 92
19.2 Stage 3 – Validation of the Landfill Gas Mitigation Measures 93
20. Quality Assurance Plan 95
20.1 Sample Collection and Handling 95
20.2 Field QA/QC 95
20.3 Laboratory Quality Assurance and Quality Control 96

20.4 Data Quality Objectives and Indicators 96
21. General Environmental Management Plan 97
21.1 General 97
21.2 Vibration Control 97
21.3 Dust Control 97
21.4 Odour Control 98
21.5 Stormwater Management and Control 98
21.6 Occupational Health and Safety 98
21.6.1 Management of Landfill Gas During Earthworks and Construction 99
21.7 Hours of Operation 100
21.8 Contingency Plans to Respond to Site Incidents 100
21.9 Identify Regulatory Compliance 100
21.10 Community Engagement 100
21.11 Contact Details 101
22. Provisional Project Timeframe 102
23. Validation Report 103
24. Long Term Environmental Management Plan 104
25. Conclusion 105
26. References 106
27. Limitations 108

Appendices

Appendix A:	Notes about this Report
	Drawing 1 Site Locality
	Drawing 2 Previous Test Locations on Aerial Photograph
	Flown 13 February 2016
Appendix B:	Drawings of the Proposed Development
Appendix C:	Drawings DP (2016)
Appendix D:	Summary of Soil Results (DP, 2016)
Appendix E:	Summary of Landfill Gas Results (DP, 2016)
	Summary of Non-Methane Organic Compound Results (DP, 2016)
Appendix F:	Summary of Groundwater and Surface Water Results (DP, 2016)
Appendix G:	Summary of EIS Soil and Groundwater Results (EIS, 2013)
Appendix H:	Reports on Validation of the Screening Process
	Current Trial Remediation Excavation
Appendix I:	J&K (2016b)
	J&K (2017)
Appendix J:	Fill Management Protocol for Imported VENM Cap Construction
Appendix K:	Moorebank East Development Proposal Fact Sheet

Remediation Action Plan
Proposed Residential Development
146 Newbridge Road, Moorebank

1. Introduction

This Remediation Action Plan (RAP) prepared by Douglas Partners Pty Ltd (DP) outlines the remediation strategy for a proposed residential development at 146 Newbridge Road, Moorebank. The report was commissioned in an email dated 27 April 2016 by Mr Ernest Dupere of Benedict Industries Pty Ltd (Benedict) and was undertaken in accordance with DP's proposal SYD160329 dated 26 April 2016. The following is understood:

- The RAP will be required for submission as part of a development application (DA) for a proposed residential development at the site; and
- The site is being audited by Dr Ian Swane, a NSW Environment Protection Authority (NSW EPA) accredited Site Auditor, to facilitate the issue of a site audit statement (SAS) Part B confirming the land can be made suitable for the proposed development.

The overall goal of the remediation programme outlined in the RAP is to render the site suitable for the proposed residential development. Further details are provided in Section 12. The objectives of the RAP are to:

- Set remediation goals that are likely to meet the conditions of a Development Consent so that the redevelopment area will be suitable for the proposed residential land uses and will pose no unacceptable risk to human health or the environment;
- Evaluate the range of remediation options available to address the existing site contamination issues, and thereby reduce risks to acceptable levels;
- Document the preferred remediation techniques and procedures;
- Establish the various safeguards required to complete the remediation work in a safe and environmentally acceptable manner;
- Identify the necessary approvals and licences required by regulatory authorities in order to enable the remediation works to proceed;
- Document a remediation strategy that will address on-site issues affecting future migration of contamination from the site; and
- Document a remediation strategy that will complement other regulatory requirements relevant to the remediation of contamination.

These objectives correspond to those given by NSW EPA guidelines, SEPP55 guidelines and Liverpool Council's contaminated land policy.

A site plan and locality map is shown on Drawing 1, Appendix A. A site plan of previous test locations overlaid on a recent Nearmap aerial photograph flown 13 February 2016 is shown on Drawing 2, Appendix A.

2. Background Information

2.1 Site Identification

The site comprises part (generally the northern half) Lot 7 in Deposited Plan 1065574. The street address is 146 Newbridge Road, Moorebank and the site has a total area of approximately 9 ha.

The site boundary is shown on Drawing 1, Appendix A. The drawing also shows land to the south of the 'site' which is the remainder of Lot 7 in Deposited Plan 1065574. It is understood that this southern portion is also proposed to be developed as a marina and that this development is the subject of a separate DA and is covered by other documentation not relevant to this RAP.

A copy of the latest survey plan of the site showing topographic contours is included in Appendix B.

2.2 Site Condition and Surrounding Environment

The site comprises a recycling facility involving the storage / transfer / separation of various waste streams for crushing, grinding and processing into recycled building products. The site is unsealed and several stockpiles of recycled products are present. A residential dwelling is present at the north-eastern corner of the site. Over the previous months, the number and volume of stockpiled products have been slowly depleting and site infrastructure such as the weighbridge and above-ground storage tank (AST) is being decommissioned.

Low lying parts of the Moorebank area adjacent to the Georges River are flood prone, but the site is already above the 1 in 100 year flood level. Notwithstanding redevelopment of the site will require the present ground surface to be raised by approximately 1.6 m for site formation and civil purposes. The need to raise the ground surface for construction purposes has been considered when assessing remediation options for the site.

No major structures or buried services remain at the site.

The immediate surrounds of the subject site included the following land uses:

- North – Newbridge Road and an industrial area beyond;
- South – Ponds associated with the wider site;
- East – The "Flowerpower" (a garden centre) site is located to the north-east of the subject site. Dense bushland is located to the south-east and Georges River beyond; and
- West – Entry/access road to the west and bushland beyond.

2.3 Groundwater Dependant Ecosystems

Information on groundwater dependant ecosystems (GDEs) at and in the vicinity of the site is available from the Bureau of Meteorology (BOM) GDE Atlas. A review of the atlas indicates that no GDEs are present at or adjacent to the site.

3. Proposed Development

The proposed development will involve retaining wall construction, bulk earthworks followed by construction of internal roads, associated infrastructure, residential lots and houses. The bulk earthworks will involve cut and fill of existing material with a net deficit of soil. The net deficit will require an average 1.6 m thickness of imported virgin excavated natural material (VENM) fill across the site.

The construction of the retailing wall along the western site boundary is the subject of a separate DA. Works undertaken associated with the construction of the retaining wall should be done with reference to DP (2015a) *Construction Environmental Management Plan, Proposed Retaining Wall, 146 Newbridge Road, Moorebank, NSW*. This RAP relates to the remaining work associated with the proposed residential development.

The approximately 180 residential dwellings will comprise a mix of terrace homes, duplex (semi-detached) homes and detached homes. The final lot layout may be subject to minor changes as detailed design progresses. Notwithstanding, any such changes should not affect the overall remediation strategy documented in this RAP as the entire development area is to be remediated to a condition suitable for residential land use as defined in NEPC (2013) under land-use setting 'Residential A'.

The following drawings that depict the various aspects of the proposed development are provided in Appendix B:

- Drawing 14005-FILL2 Preliminary Fill Plan of the Residential Portion of Lot 7 DP1065574 Above the Bottom of the Capping Layer (i.e. 3 m below FSL), dated 1 September 2016;
- Drawing 14005E10 Overall Plan Showing Catchments, dated 20 November 2016; and
- Drawing MP01-B-01-12-2016 Concept Plan Reduced Site Area Option 20y, dated 21 November 2016.

The residential houses will be Torrens Title and have private ownership (no body corporate) with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms may also present. Construction of houses would via conventional building construction techniques using licensed builders rather than being supervised by qualified civil engineers as noted in BS8485:2015 (see text box below), thus requiring separate construction quality control and supervision during the installation of the landfill gas mitigation system (see Section 16.4).

BS8485:2015 (page 21), defines:

- Type A building as "private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms present. Probably conventional building construction **(rather than civil engineering)**. Examples include private housing and some retail premises."
- Type B building as "private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium size rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels."
- Type C building as "commercial building with central building management control of any alterations to the building or its uses and central building management control of the maintenance of the building, including the gas protection measures. Single occupancy of ground floor and basement areas. Small to large size rooms with active ventilation or good passive ventilation of all rooms and other internal spaces throughout ground floor and basement areas. Probably civil engineering construction. Examples include offices, some retail premises, and parts of some public buildings (such as schools, hospitals, leisure centres and parts of hotels).

4. List of Previous Reports

A number of previous investigations have been undertaken at the site by DP, Dames and Moore Pty Ltd (D&M), Environmental Investigation Services (EIS) and Jeffery and Katauskas Pty Ltd (J&K) (EIS is a division of J&K).

A summary of the relevant reports that are known to DP is provided in Table 1, below. The summary is not an exhaustive list, however, indicates the site has been subject to several investigations in the past.

Table 1: List of Previous Reports

Author	Year	Project No.	Report Title / Letter Report Title
D&M	1994	unknown	Report on Groundwater Sampling
DP	1999	27879	Proposed Environmental Monitoring Program, Sorting, Recovery and Transfer (SRT) Facility, 146 Newbridge Road, Moorebank
D&M	2000	unknown	Landfill Groundwater and Surface Water Monitoring and Assessment Program
DP	2002a	30410	Preliminary Geotechnical Assessment, 146 Newbridge Road, Moorebank
DP	2002b	30410	Report on Preliminary Contamination Assessment, Proposed Residential Development, 146 Newbridge Road, Moorebank
DP	2002c	30410	Geotechnical Assessment, 146 Newbridge Road, Moorebank
DP	2005	43479	Proposed Mixed Commercial / Residential Development, 146 Newbridge Road, Moorebank
DP	2008	45642.00	Preliminary Desktop Review, Benedict Sand and Gravel, Moorebank
DP	2009a	45642.01	Desktop Review, Benedict Sand and Gravel, Moorebank
DP	2009b	45642.02	Environmental and Geotechnical Advice, Benedict Sand and Gravel, 146 Newbridge Road, Moorebank
DP	2009c	45642.03	Review of Foundation Options, Proposed Residential Development, 146 Newbridge Road, Moorebank
DP	2009d	71459.00	Compaction and Grading, 146 Newbridge Road, Moorebank
EIS	2013	E26930KBrpt	Stage 1 Environmental Site Assessment for Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
J&K	2013	26930Zrpt	Geotechnical Investigation for Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
EIS	2014a	E26930KBrpt -HGG	Preliminary Hazardous Ground Gas Screening for the Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
EIS	2014b	E26930KBlet -HGGR2	Hazardous Ground Gas (HGG) Screening Results (Round 2), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
EIS	2014c	E26930KBlet -HGGR3	Hazardous Ground Gas (HGG) Screening Results (Round 3), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
EIS	2014d	E26930KBlet -HGGR4	Hazardous Ground Gas (HGG) Screening Results (Round 4), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
EIS	2014e	E26930KBlet -HGGR5	Hazardous Ground Gas (HGG) Screening Results (Round 5), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
DP	2014a	71459.01	Initial Comments on the Design of Landfill Gas Mitigation Measures 146 Newbridge Road, Moorebank Stage 1

Author	Year	Project No.	Report Title / Letter Report Title
DP	2014b	71459.01	Draft Concept Design for Landfill Gas Mitigation Measures 146 Newbridge Road, Moorebank Stage 1
EMM	2015	J14149RP1	Preliminary Investigation of Contamination, Proposed Georges Cove Marina
DP	2015a	71459.02	Construction Environmental Management Plan, Proposed Retaining Wall, 146 Newbridge Road, Moorebank, NSW
DP	2015b	71459.02	Sampling and Analysis Quality Plan, Proposed Residential Subdivision, 146 Newbridge Road, Moorebank, NSW
DP	2015c	71459.04	Report on Geotechnical Investigation, Proposed Residential Subdivision, 146 Newbridge Road, Moorebank
DP	2015d	71459.05	Report on Geotechnical Investigation, Retaining Wall, 146 Newbridge Road, Moorebank
EMM	2016a	J14149RP1	Supplementary Preliminary Investigation, Proposed Georges Cove Marina
EMM	2016b	J14149RP1	Remediation Action Plan, Proposed Georges Cove Marina
DP	2016	71459.03 Rev1	Detailed Site Investigation, Proposed Residential Development, 146 Newbridge Road, Moorebank
J&K	2016a	26930Zrpt Rev3	Geotechnical Evaluation for Proposed Residential Subdivision at 146 Newbridge Road, Moorebank, NSW
J&K	2016b	26903Zemail 3	Response to RAP Comments
DP	2017a	71459.06	Groundwater Data Review, Proposed Residential Development, 146 Newbridge Road, Moorebank
J&K	2017	26930Zrpt Rev5	Geotechnical Evaluation for Proposed Residential Subdivision at 146 Newbridge Road, Moorebank, NSW
DP	2017b	71459.06	Sampling and Analysis Quality Plan, Validation Monitoring, Proposed Residential Development, 146 Newbridge Road, Moorebank

5. Scope of Works

The scope of works comprised the following:

- Undertake a review of the following:
  - Design levels and associated earthworks cut and fill plan;
  - Typical building designs;
  - Geotechnical methodology for ground improvement (i.e. J&K (2016b; 2017));
- Complete a remediation options evaluation for:
  - Residual soil contamination (i.e. capping or excavation and off-site disposal of soil 'hotspots');
  - Landfill gas mitigation measures;

  - Groundwater contamination;
- Establish the preferred remedial option for residual soil contamination, landfill gas mitigation measures and groundwater contamination;
- Prepare this RAP that includes the following:
  - Remediation options evaluation, as discussed above;
  - Nomination of the preferred remediation option, as discussed above;
  - Establishment of remediation acceptance criteria (RAC);
  - Provide concept designs for typical landfill gas mitigation measures for dwellings;
  - Provide a methodology for the validation of remedial work (excluding construction quality assurance (CQA) for gas mitigation measures);
  - Contingency measures for unexpected finds;
  - Reference to community engagement prepared by the developer as part of the Environmental Impact Statement (EIS);
  - Inclusion of a sampling and analysis quality plan (SAQP) which specifies sampling and monitoring requirements during remediation and construction.

6. Subsurface Conditions

6.1 Geology

A review summarised in EIS (2013) of the regional geological map of Penrith (1991) indicates that the site is underlain by the following formations:

- South and central sections – Quaternary aged deposits of medium grained sand and silty clay; and
- North, east and south-east sections – Tertiary aged deposits of clayey quartzose sand and clay.

Mapping and previous drilling indicates that the Tertiary and Quaternary deposits are underlain by shale bedrock.

6.2 Fill

Fill encountered at the site during DP (2016) comprised sand, clay, silty clay, clayey sand, sandy clay, crushed sandstone, gravel, crushed glass (fine sand to silt particle size), in filling to depths of 0.7 m to 9.2 m and to borehole termination (typically refusal on buried obstructions in the filling) in BH201 at 3.8 m, BH202 at 6.1 m, BH203 at 4.5 m, BH205 at 4.9 m, BH209 at 5.4 m, BH210 at 4.05 m, BH212 at 6.0 m, BH213 at 3.8 m, BH215 at 3.7, BH218 at 8.35, BH220 at 2.6 m, BH221 at 4.9 m, BH222 at 2.9 m and BH118a at 6.4 m. Anthropogenic materials (typically construction and demolition waste including concrete, timber, glass, brick, asphalt, steel, plastic, terracotta and cotton / fabric) were observed throughout the filling at the majority of boreholes consistent with the known history of burial of demolition waste at the site. Bonded asbestos containing material (ACM) and fibrous asbestos and asbestos fines (FA/AF) has also been detected in the fill that was excavated from the trial remediation

excavations (refer to Section 10.3). Assuming an average thickness of fill at the site of 4.0 m, the total quantity of fill would be 360,000 m^3.

The fill is likely to have been placed in an uncontrolled manner without geotechnical compaction. The fill is compressible and the site will require a program of geotechnical ground improvement as part of site remediation and development work (refer to Section 11). Drawing 2, extracted from DP (2015c) showing fill thickness contours across the site is included in Appendix A.

6.3 Acid Sulphate Soil Risk

A review summarised in EIS (2013) of the acid sulphate soil (ASS) risk map for Liverpool prepared by Department of Land and Water Conservation (1997) indicates that the site is located in the following ASS risk area:

- High Probability Risk Area – south and west sections of the site associated with low lying swamp areas. The depth of occurrence in this area is between 1 m and 3 m below ground level (bgl) associated with alluvial plains, alluvial swamps, alluvial levees and sand plains; and
- Disturbed Terrain – north, central and east sections of the site associated with the filled areas. The classification is adopted in large scale filled areas which often occur during reclamation of low lying swamps for urban development, in areas which may have been mined or dredged or have undergone heavy ground disturbance through general urban development or the construction of dams and levees.

6.4 Hydrogeology

A review summarised in EIS (2013) of groundwater bores registered with the NSW Office of Water (NOW) was undertaken. The search was limited to registered bores located within approximately 1 km radius of the site. The search indicated that two registered bores were located within this radius. The boreholes were registered for irrigation (GW024357) and domestic (GW023146) purposes. The irrigation bore is located approximately 800 m to the east of the site beyond Georges River. The domestic bore is located approximately 1.2 km to the north-east of the site. Both the bores are in close proximity of Georges River and the associated flood plain. Based on the distance of the bores and the regional topography, these bores were not considered to be potential receptors of any contamination that may be present at the site.

EIS (2013) noted that the stratigraphy of the site is expected to consist of relatively high permeability alluvial soils overlying deep shale bedrock. Based on these conditions and the results of the groundwater bore search, groundwater may be a potential resource in the vicinity of the site.

Groundwater wells at the site, including those installed by J&K, were surveyed using a dGPS. Groundwater levels were gauged on 17 September 2016 using an electronic oil/water interface meter prior to developing the wells. The measured water levels were between 1.76 m bgl (1.09 m AHD) and 6.43 m bgl (0.72 m AHD) prior to development of the wells as gauged on 17 September 2015. Groundwater was also measured at similar depths when sampled.

Based on the groundwater level measurements, flow was to the north towards Newbridge Road, east towards the Georges River, to the south towards the ponds and to the west towards the open drainage channel. The inferred groundwater level contours are shown on Drawing 7 and 8, Appendix C. Essentially groundwater appears to be mounded within the site and flowing radially towards adjacent water bodies and low points. This is to be expected as the permeability of fill at the site is likely to be variable but higher than the natural landforms surrounding the site and water bodies are located to the east, south and west of the site.

7. Summary of Site History

The detailed site history information is provided in DP (2002b) and EIS (2013). A summary of the site history information extracted from the EIS (2013) report is provided in Table 2, below.

Table 2: Summary of Site History (EIS, 2013)

Timeline	Details / Summary	Source of Information
1884 to 1924	The site was owned by private citizens and The Church of England Property Trust Diocese of Sydney. A portion of the land was owned by Perpetual Trustee Company Limited between 1920 and 1923. Based on a review of the 1930 aerial photograph, it is assumed that the site was predominantly vacant prior to 1930.	Land Title Records & Aerial Photos
1923 to 1947	The site was owned by New Bankstown Limited and The Greenacre Park Limited. A section of the site was also owned by private citizens between 1924 and 1965. A review of the 1943 historical aerial photograph indicates that cattle raising and grazing activity had commenced at the site after 1930. Sections of the site had been cleared of vegetation during this period.	Land Title Records & Aerial Photos
1947 to 1997	The site was owned by Echo Dairies Pty Ltd and a few private individuals including Anthony Francis Brady (a dairyman). A review of the historical aerial photographs indicates that large sections of the site were cleared during this period for cattle grazing. Warehouses were constructed at the site and low lying areas in some sections were filled to achieve level ground. A dam was created in the north section of the site which was subsequently filled. A storm water channel/drain was created along the west site boundary. The aerial photos indicate that the dairy activity at the site appeared to have ceased some time prior to 1982. Large sections of the site were filled between 1982 and 1991. Stockpiles were visible at the site in the 1991 aerial photograph which indicates the commencement of waste processing/dredging activity at the wider site (i.e. to the south of the proposed development area).	Land Title Records & Aerial Photos
1997 to present	The site as at present is owned by Tanlane Pty Ltd. Large scale filling and dredging activity has occurred between 1991 and 2000. The site Land Title Records started to appear similar to the present layout from at least 2005. Council records indicate that a DA was submitted for the	Historical Aerial Photos, Council and NSW EPA records

Timeline	Details / Summary	Source of Information
	construction of a new road bridge at the subject site. A statement of environmental effects was prepared and submitted to council for the proposed development. The NSW EPA has issued two licences (No. 4612, dated 2000 and 10490, dated 2001) under the POEO Act for the wider site. A number of variation notices were subsequently issued under s.58 of the Act between 2002 and 2013. Based on a review of the NSW EPA information, the scheduled activities at the site included: • Crushing, grinding or separating; land-based extractive activity; and water-based extractive activity; • Storage/transfer/separation of various waste streams; • Importation of VENM and potential acid sulphate soil (PASS) for backfilling sand quarry (according to the site owner, only minor quantities of PASS was ever accepted at the site); • Dredging activities; • Landfilling activities; • Recovery, storage and processing (non-thermal treatment) of general waste including VENM; general solid waste (non-putrescible); general or specific exempted waste; wood waste; waste; paper or cardboard; gyprock; glass; building and demolition waste; asphalt waste (including asphalt resulting from road construction and waterproofing works); and waste tyres. A clean up notice (No. 1051596) was issued under s.91 of the Act to Benedict Reclamations in October 2005. The notice was for the clean-up of bonded asbestos containing material (bonded ACM) – fibro encountered in some stockpiles at the site.	

8. Summary of Relevant Previous Investigations

The following subsections provide a summary of the conclusions and/or recommendations of those reports most relevant to the known site contamination issues.

8.1 DP (2002b)

DP was commissioned to undertake a Preliminary Contamination Assessment (PCA) for the proposed residential development at the site in 2002. The PCA was confined to the subject site which was formerly identified as Lot 1 in DP515738. The PCA was undertaken in conjunction with a geotechnical investigation commissioned for the proposed development. The objectives of the PCA were to:

- Determine the general level of potential contamination;
- Identify the potential for off-site migration of contamination; and

- Provide a preliminary view of the suitability of the site for the proposed development.

The investigation included:

- Drilling 12 boreholes in selected areas across the site; and
- Sampling the fill and natural soil profiles; and analysis of selected samples for a range of organic and inorganic contaminants.

The results of the investigation are summarised below:

- The boreholes encountered fill material ranging in depth from approximately 3.7 m to 8.7 m bgl. The fill contained inclusions of gravel and sand with some concrete, bricks, wood and clay;
- Natural alluvial soil comprising clay and sand was encountered beneath the fill;
- Groundwater seepage was encountered in the boreholes at depths of approximately 3.5 m to 5.8 m bgl;
- The majority of the analytical results were below the adopted site assessment criteria (SAC) which included the former Health Investigation Levels (HILs) Category A 'Residential Sites with Gardens and Accessible Soil' and the threshold concentrations for sensitive sites outlined in the NEPC (1999) *National Environment Protection (Assessment of Site Contamination) Measure 1999*, which has recently been superseded by NEPC (2013) *National Environment Protection (Assessment of Site Contamination) Measure 1999* as amended 2013;
- Elevations of lead above the SAC were encountered in four samples. However, the statistical analysis undertaken on the lead results indicated that the results were below the SAC;
- An elevated concentration of benzo(a)pyrene (B(a)P) above the SAC was encountered in one sample. However, the statistical analysis undertaken on the B(a)P results indicated that the results were below the SAC;
- The exceedances were not considered to pose a significant risk to human health; and
- Elevations above the provisional phyto-toxicity based guidelines levels (PPILs) (now superseded by EILs in NEPC (2013)) were encountered for cadmium and zinc in two samples. These samples were obtained from depths of approximately 2 m and 4 m below ground level and were not considered to pose a risk to the shallow plant root zone (particularly in the context of a proposed cap at the site).

Based on the findings of the PCA, DP concluded that the site may be suitable for the proposed residential development provided further testing is undertaken to adequately characterise the groundwater and soil gas quality at the site.

8.2 EIS (2013)

The EIS (2013) investigation was limited to the subsurface soil profile, with the stockpile located on site at the time not being subject to the investigation. The objectives of the Stage 1 Environmental Site Assessment (ESA) were to identify the key areas of environmental concern (AEC) and to prepare a preliminary conceptual site model (PCSM) for the site. The objectives also included identifying widespread soil and groundwater contamination issues and the potential for the occurrence of acid sulphate soil (ASS) and hazardous ground gases (HGG) at the site.

The results of laboratory chemical analysis on the selected soil samples indicated the following:

- Monocyclic aromatic hydrocarbons (benzene, toluene, ethylbenzene and xylenes – BTEX), volatile organic compounds (VOC), organochlorine pesticides (OCP), organophosphorus pesticides (OPP) and polychlorinated biphenyls (PCB) were below the adopted SAC;
- The majority of the results for metals were below the HIL-A SAC. One fill sample JK16/0.0-0.2 had an elevated concentration of lead of 350 mg/kg above the SAC of 300 mg/kg. The elevated lead result was less than 250% of the SAC and the 95% upper confidence limit (UCL) of the arithmetic mean was calculated using the lead data from the fill soil samples. The 95% UCL for lead was 107 mg/kg which was below the HIL-A of 300 mg/kg. The Standard Deviation (SD) was less than 50% of the SAC;
- One fill sample JK7/2.7-3.0 recorded a total chromium concentration of 2800 mg/kg which was above the adopted Environmental Investigation Level (EIL) of 413 mg/kg;
- The majority of the results were below the Health Screening Level (HSL) A SAC. One surficial fill sample JK13/0.0-0.2 encountered an elevated concentration of total recoverable hydrocarbons (TRH) >C_{10}-C_{16} (TRH F2) of 190 mg/kg above the SAC of 110 mg/kg. The elevated TRH F2 result was less than 250% of the SAC and within the acceptance criteria outlined in Section 3. The 95% UCL was calculated using the TRH F2 data from the fill soil samples. The 95% UCL for TRH F2 was 43.94 mg/kg which is below the HSL-A of 110 mg/kg. The SD was less than 50% of the SAC. Seven individual fill samples encountered mid to heavy fraction TRH concentrations which were above the adopted Environmental Screening Levels (ESLs);
- The majority of the results for polycyclic aromatic hydrocarbons (PAH) were below the HIL-A SAC. One fill sample JK12/1.3-1.5 encountered an elevated concentration of B(a)P toxicity equivalency quotient (TEQ) of 13 mg/kg above the SAC of 3 mg/kg. The elevated B(a)P TEQ result was greater than 250% of the SAC (i.e. is a 'hotspot'). Twelve fill samples had elevated B(a)P concentrations which were above the adopted ESL criteria;
- Asbestos was encountered in JK10/7.3 -7.5, no other asbestos was detected in any of the other boreholes. Seven fibre cement fragments from the surface of the site were tested for asbestos with six pieces confirmed to be bonded asbestos containing materials (ACM); and
- Acid sulphate soil results indicated that the majority of the results (eight samples only, five of fill, three of natural) were within the acidic to very acidic range. The adopted S_{POS} criterion of 0.03% was exceeded for samples of both fill and natural soils, suggesting that some potential acid sulphate soils may have been used to fill the site. The calculated preliminary liming rate required for neutralisation ranged from 2 kg Ca_3/tonne to 15 kg Ca_3/tonne.

The results of laboratory chemical analysis on the groundwater samples collected from the four groundwater monitoring wells by EIS indicated the following:

- TRH, BTEX, OCP, VOC and PCB were all below the adopted groundwater investigation levels (GILs);
- Detectable concentrations of OCP (DDE, DDT and dieldrin) were recorded at some monitoring wells, however, at concentrations below the GIL;
- Elevated concentrations of individual metals were recorded above the ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* GILs as follows:
    - Arsenic at MW9 recorded a concentration of 33 µg/L which exceeded the GIL of 24 µg/L;

  - Copper at MW9 and MW16 recorded a concentration of 12 µg/L and 2 µg/L, respectively, which exceeded the GIL of 1.4 µg/L;
  - Lead at MW9 recorded a concentration of 4 µg/L which exceeded the GIL of 3.4 µg/L;
  - Nickel at MW9 and MW16 recorded a concentration of 120 µg/L and 26 µg/L, respectively, which exceeded the GIL of 11 µg/L;
  - Zinc at MW9 and MW12 recorded a concentration of 200 µg/L and 39 µg/L, respectively, which exceeded the GIL of 8 µg/L;
- The majority of results for PAH were below the GILs. MW16 recorded a detectable concentration of naphthalene at 0.2 µg/L, which exceeded the USEPA criterion for tap water of 0.14 µg/L but below the ANZECC 2000 GIL; and
- Detectable concentrations of chlorpyrifos were recorded in the majority of the groundwater samples. The concentrations were above ANZECC 2000 GIL of 0.01µg/L. However, all of the results were below the NHMRC (2011) *Australian Drinking Water Guidelines* GILs.

The main areas of environmental concern (AEC) identified by EIS are summarised as follows:

- Uncontrolled large scale filling activity has been historically undertaken at the site associated with the commercial land uses. This has occurred since at least the 1950s and was not regulated during the initial years;
- The preliminary screening has indicated the presence of HGG at the site. The main source of HGG is considered to be the organic inclusions in the deeper filled areas. However, there may also be a potential for HGG generation to be associated with the swampy alluvial soils;
- The site has formerly been used as a dairy and for cattle grazing purposes. Some sections of the site were filled during this land use;
- Commercial activities associated with the current use of the site for resource recovery and waste processing could have a potential impact on the site; and
- Hazardous building material associated with the demolition of built structures can result in site contamination.

Data gaps identified by EIS include:

- Specific point sources of potential contamination associated with the AEC have not been adequately investigated;
- Deep fill at the site has not been adequately characterised;
- Large sections of the site have not been investigated (the NSW EPA sampling design guidelines recommend 107 evenly spaced sampling points);
- The occurrence of HGG has not been adequately characterised; and
- Inaccessible areas (buildings and densely vegetated areas along the east west site boundaries) have not been investigated.

Based on the scope of works undertaken, EIS were of the opinion that the AEC at the site pose a risk to the identified receptors. EIS considered that the site can be made suitable for the proposed residential land use provided that suitable measures are untaken to address the data gaps and risks identified at the site. EIS recommended undertaking the following additional work:

- A preliminary HGG assessment should be undertaken to better characterise the risk associated with HGG. The assessment should include a PCSM for HGG; and
- A Stage 2 ESA should be undertaken to meet the NSW EPA recommended sampling density. The Stage 2 ESA should target the data gaps identified in their report.

Based on the findings of the above investigations, EIS noted that consideration should be made to address the following:

- A remediation strategy to render the site suitable for the proposed residential land use;
- Assess the requirement for a Quantitative Health Risk Assessment (in accordance with enHealth and Appendix VII of the Guidelines for the NSW Site Auditor Scheme, 2006) for HGG and other remnant contamination that may remain on site; and
- Assess the requirements for an Environmental Management Plan (EMP) for the ongoing management of contamination remaining on site.

8.3 EIS (2014a)

The EIS (2014a) investigation involved the design and implementation of a field sampling program which included installation of monitoring wells to assess HGG. The initial sampling plan proposed 19 HGG sampling locations, but due to site access constraints, only 13 locations were drilled with four existing groundwater monitoring wells utilised as HGG sampling locations. The spacing of the wells varies and is generally in the order of 30 m to >60 m apart.

The HGG monitoring data in EIS (2014a) is summarised as follows:

- Methane concentrations ranged from 0.01 %v/v to 30 %v/v. The majority of the higher CH_4 concentrations were associated with the deep fill areas;
- Carbon dioxide concentrations ranged from 0.05 %v/v to 31.2 %v/v. The higher CO_2 concentrations were generally associated with the higher CH_4;
- Oxygen concentrations ranged from 0 %v/v to 30.6 %v/v. The O_2 concentrations generally decreased with higher CH_4 concentrations in the deeper fill areas;
- Carbon monoxide[1] concentrations ranged from 0 ppm to 117 ppm. There was no major trend observed in the CO concentrations;
- Hydrogen sulphide concentrations ranged from 0 ppm to 40 ppm. Higher values of H_2S were recorded in the boreholes during drilling when compared to readings obtained from monitoring wells on completion of drilling; and

[1] Carbon monoxide and hydrogen sulphide are both reported in EIS reports as percent, however, DP assumes that this unit should be in parts per million (ppm) which is the common unit on landfill gas analysers and we have changed it accordingly.

- Atmospheric pressure readings ranged from 1013 hPa to 1024 hPa.

Based on the scope of works undertaken, EIS were of the opinion that the HGG encountered at the subject site poses a risk to the receptors and future development of the site. Prior to remediation/management of the site, EIS recommended undertaking the following additional work to better characterise the risks:

- "Long term monitoring of HGG should be undertaken at the site. Considering the end land use for residential with gardens, the CIRIA (2007) *C665 Assessing Risks Posed by Hazardous Ground Gases to Buildings* recommends a minimum monitoring period of 24 months;
- Additional HGG monitoring wells should be installed when site access becomes available to better assess the source and generation of HGG. The CIRIA C665 guideline recommends a grid spacing of <25 m for sensitive sites such as residential houses with gardens;
- A Stage 2 ESA should be undertaken to meet the NSW EPA (1995) *Sampling Design Guidelines* recommended sampling density;
- A Quantitative Health Risk Assessment (in accordance with enHealth guidelines and Appendix VII of the DEC (2006) *Guidelines for the NSW Site Auditor Scheme*) should be undertaken by a suitability qualified risk assessor for the contamination remaining on site;
- In the event site remediation is chosen (either excavation and removal of fill or capping and passive / active gas venting), a Remediation Action Plan (RAP) should be prepared for the site;
- In the event the capping / management options are chosen, a Construction Management Plan (CMP) should be prepared to document the gas mitigation / management measures required to be implemented during construction;
- A Validation Assessment (VA) report should be prepared to document the remediation action undertaken at the site;
- An Environmental Management Plan (EMP) should be prepared for the ongoing management of contamination remaining on site. The EMP will require establishment of appropriate public notification under Section 149(2) of the *Environmental Planning and Assessment Act* NSW 1979 or a covenant registered on the title to land under Section 88B of the *Conveyancing Act* NSW 1919;
- Prepare an appropriate work, health and safety plan (WHS) for the contaminants encountered at this site; and
- Inspections during demolition and excavation work to assess any unexpected conditions or subsurface facilities that may be discovered between investigation locations. This should facilitate appropriate adjustment of the works program and schedule in relation to the changed site conditions. Inspections should be undertaken by experienced environmental personnel."

8.4 EIS (2014b)

The EIS (2014b) investigation involved a continuation (Round 2) of the monitoring to assess HGG. The monitoring was undertaken on 21 February 2014.

The HGG monitoring data in EIS (2014b) was summarised by EIS as follows:

- The CH_4 concentrations ranged from 0 %v/v to 28.4 %v/v. The majority of the higher concentrations were associated with the deep fill areas;
- The CO_2 concentrations ranged from 0.5 %v/v to 31.3 %v/v. The high CO_2 concentrations were generally associated with the high CH_4 concentrations in the deeper fill areas of the site;
- The O_2 concentrations ranged from 0 %v/v to 18.7 %v/v. The O_2 concentrations generally decreased with higher CH_4 concentrations in the deeper fill areas of the site;
- The CO concentrations ranged from 0 ppm to 2 ppm. There was no major trend observed by EIS in the CO concentrations;
- The H_2S concentrations ranged from 0 ppm to 4 ppm. Higher values of H_2S were noted in the boreholes during drilling (see (EIS, 2014a) report) when compared to readings obtained during this screening;
- The atmospheric pressure reading during the screening ranged from 1016 hPa to 1019 hPa. A difference of 3 hPa was recorded; and
- The peak flow ranged from 0 L/hr to 4.7 L/hr over the monitoring duration of three minutes at each location.

A preliminary qualitative risk assessment (PQRA) was presented in EIS (2014a). The report recommended reviewing the PQRA based on the results of subsequent monitoring. EIS used the additional flow data obtained during the second round of screening to calculate the Gas Screening Value (GSV) and the Characteristic Gas Situation (CGS) in order to comment on the level of protection required for future development of the site.

The GSV for the site was calculated by EIS to be 2.82 L/hr. The GSV was used to calculate a CGS of 3 using the modified Wilson and Card classification which is in the moderate risk category. EIS concluded that for the proposed low density residential development with a CGS of 3, protection measures should be adopted to achieve a protection score of four or higher.

8.5 EIS (2014c)

The EIS (2014c) investigation involved a continuation (Round 3) of the monitoring to assess HGG. The monitoring was undertaken on 7 March 2014.

The HGG monitoring data in EIS (2014c) was summarised by EIS as follows:

- The CH_4 concentrations ranged from 0 %v/v to 35 %v/v. The majority of the higher concentrations were associated with the deep fill areas;
- The CO_2 concentrations ranged from 0.1 %v/v to 33.1 %v/v. The high CO_2 concentrations were generally associated with the high CH_4 concentrations in the deeper fill areas of the site;
- The O_2 concentrations ranged from 0 %v/v to 20.2 %v/v. The O_2 concentrations generally decreased with higher CH_4 concentrations in the deeper fill areas of the site;
- The CO concentrations ranged from 0 ppm to 2 ppm. There was no major trend observed by EIS in the CO concentrations;

- The H_2S concentrations ranged from 0 ppm to 18 ppm. Higher values of H_2S were noted in the boreholes during drilling (see EIS HGG (2014a) report) when compared to readings obtained during this screening;
- The atmospheric pressure reading during the screening ranged from 1018 hPa to 1021 hPa. A difference of 3 hPa was recorded; and
- The peak flow ranged from -0.1 L/hr to 7.3 L/hr over the monitoring duration of three minutes at each location.

The GSV for the site was calculated by EIS to be 5.11 L/hr (with EIS noting the uncertainty relating to the sampling device). The GSV was used to calculate a CGS of 4 using the modified Wilson and Card classification which is in the moderate to high risk category.

EIS concluded that for the proposed low density residential development with a CGS4, protection measures should be adopted to achieve a protection score of six or higher. EIS also noted that NSW EPA guidelines recommend adopting pathway intervention and a high level of management for residential development at CGS4 and above and that consideration should also be made to undertaking a Level 2 risk assessment.

8.6 EIS (2014d)

The EIS (2014d) investigation involved a continuation (Round 4) of the monitoring to assess HGG. The monitoring was undertaken on 1 April 2014.

The HGG monitoring data in EIS (2014d) was summarised by EIS as follows:

- The CH_4 concentrations ranged from 0.1 %v/v to 37.2 %v/v. The majority of the higher concentrations were associated with the deep fill areas. There was a general increase in the concentrations when compared to the previous rounds;
- The CO_2 concentrations ranged from 0.3 %v/v to 35.2 %v/v. The high CO_2 concentrations were generally associated with the high CH_4 concentrations in the deeper fill areas of the site. There was a general increase in the concentrations when compared to the previous rounds;
- The O_2 concentrations ranged from 0 %v/v to 5 %v/v. The O_2 concentrations generally decreased with higher CH_4 concentrations in the deeper fill areas of the site. There was a general decrease in the concentrations when compared to the previous rounds;
- The CO concentrations ranged from 0 ppm to 1 ppm. There was no major trend observed by EIS in the CO concentrations;
- The H_2S concentrations ranged from 0 ppm to 177 ppm. Higher values of H_2S were noted in the boreholes during drilling (see EIS HGG 2014a report) when compared to readings obtained during this screening. Monitoring well JK118 encountered a very high concentration of H2S of 177 ppm. The previous maximum concentration encountered in this monitoring well was 21 ppm during drilling on 28 January 2014;
- The atmospheric pressure reading during the screening was 1020 hPa; and

- The peak flows recorded using the GA5000 ranged from 0.1 L/hr to 4.5 L/hr over the monitoring duration of 3 minutes at each location. The peak flows recorded using the GFM unit ranged from 0 L/hr to 3.6 L/hr at selected locations. The peak flows recorded using the Risiteck unit ranged from 0.13 L/hr to 1.65 L/hr at selected locations.

The comparison of the flow rates in monitoring wells JK104, JK107 and JK119 indicated that the readings recorded by the GA5000 and the GFM units were generally within the same range. The results obtained from the Risiteck unit were not considered to be sufficiently accurate for further consideration.

The GSV for the site was calculated by EIS to be 2.72 L/hr. The GSV was used to calculate a CGS of 3 using the modified Wilson and Card classification which is in the moderate risk category. EIS concluded that for the proposed low density residential development with a CGS of 3, protection measures should be adopted to achieve a protection score of four or higher.

8.7 EIS (2014e)

The EIS (2014e) investigation involved a continuation (Round 5) of the monitoring to assess HGG. The monitoring was undertaken on 11 April 2014.

The HGG monitoring data in EIS (2014e) was summarised by EIS as follows:

- The CH_4 concentrations ranged from 0 %v/v to 65.4 %v/v. Monitoring well JK103 encountered a very high reading of 65.4 %v/v. The concentrations were rechecked at separate intervals during the monitoring event to validate the reading. The repeat monitoring results from JK103 were 58 %v/v and 63.6 %v/v. The majority of the higher concentrations were associated with the deep fill areas;
- The CO_2 concentrations ranged from 0.4 %v/v to 21.2 %v/v;
- The O_2 concentrations ranged from 0 %v/v to 21.2 %v/v. The O_2 concentrations generally decreased with higher CH_4 concentrations in the deeper fill areas of the site;
- The CO concentrations ranged from 0 ppm to 6 ppm. There was no major trend observed by EIS in the CO concentrations;
- The H_2S concentrations ranged from 0 ppm to 206 ppm. Higher values of H_2S were noted in the boreholes during drilling (see EIS HGG 2014a report) when compared to readings obtained during this screening. Monitoring well JK118 encountered a very high concentration of H_2S of 206 ppm. The previous maximum concentration encountered in this monitoring well was 177 ppm during the fourth round;
- The atmospheric pressure reading during the screening was 1003 hPa. The atmospheric pressure had been falling steadily from a high of 1025 hPa recorded at the BOM weather station at Bankstown Airport on Monday 7 April 2014; and
- The peak flow ranged from -5.4 L/hr to 2.3 L/hr over the monitoring duration of 3 minutes at each location.

The GSV for the site was calculated by EIS to be 4.77 L/hr. The GSV was used to calculate a CGS of 4 using the modified Wilson and Card classification which is in the moderate to high risk category. EIS concluded that for the proposed low density residential development with a CGS4, protection measures should be adopted to achieve a protection score of six or higher.

A summary of the five HGG monitoring rounds extracted from EIS (2014e) is shown on Figure 1, below.

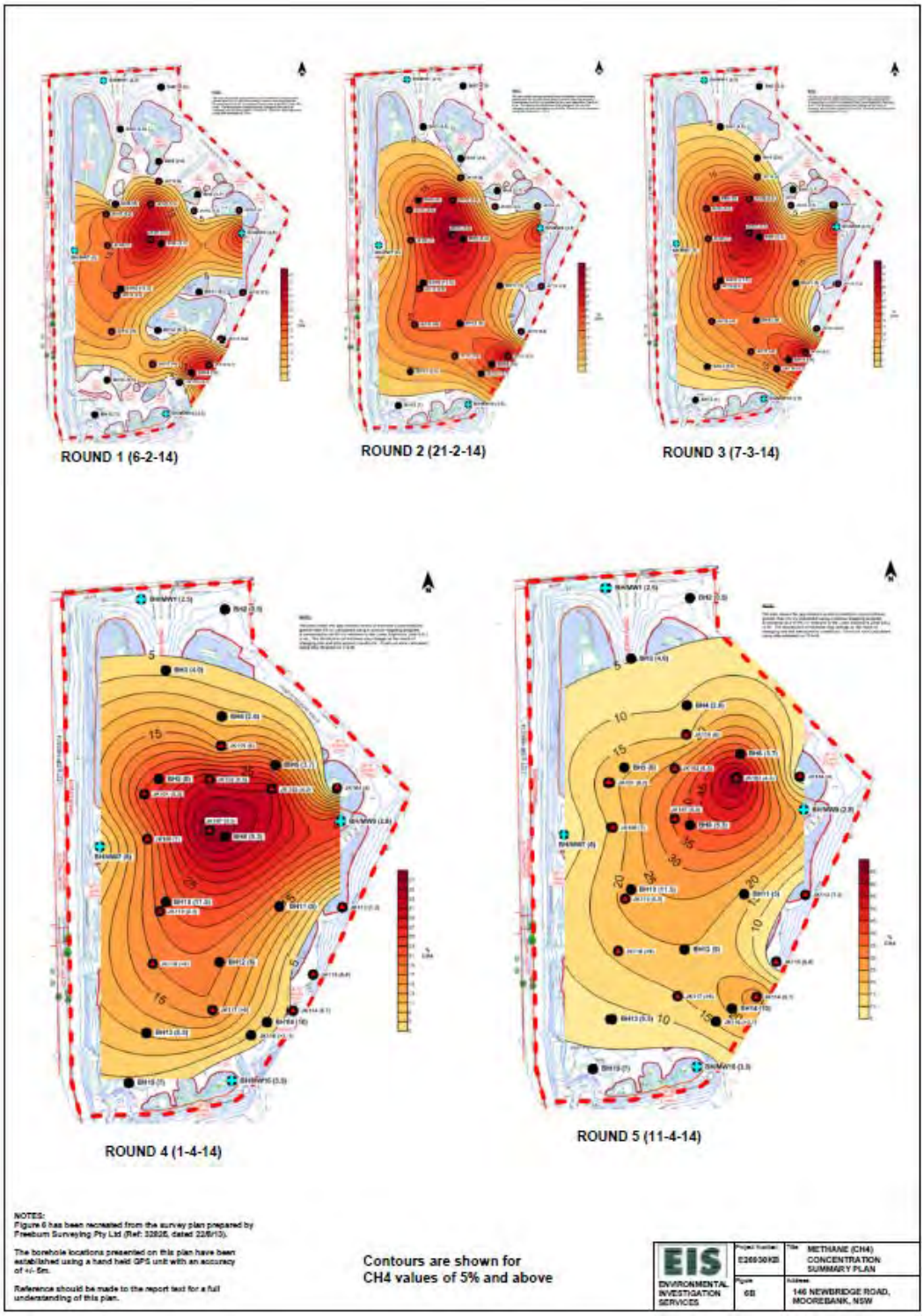


Figure 1: Methane Concentration Summary Plan (EIS, 2014e)

8.8 DP (2014a)

DP initially proposed four tasks namely:

- Review of the site investigation reports by EIS particularly the EIS (2014a);
- Provision of concept landfill gas mitigation design for low - medium density residential development including the likely development scenarios (e.g. residential house with slab, external services and public open space);
- Preliminary discussions with the builder (Mirvac Group) to discuss the build-ability of the concept landfill gas mitigation system(s) and initial discussions with the Site Auditor (yet to be confirmed at the time) to confirm in principal agreement; and
- Provision of a Stage 1 report for auditor review.

The DP (2014a) review concluded that, given the data to date it should be assumed that a minimum of three levels of gas mitigation is required. DP recommended that further monitoring works are undertaken to avoid overly conservative design requirements. In this regard, it was also recommended that a review of the earthworks requirements are undertaken with a view to establishing if the earthworks can be incorporated into the mitigation design (e.g. low permeable capping layer).

8.9 DP (2014b)

The scope of DP (2014b) was to provide the concept landfill gas mitigation design as discussed in Section 8.8 above.

The DP (2014b) draft concept design concluded that monitoring by EIS has indicated a CGS of 4 requiring a gas mitigation system design with a score of at least six. A passive landfill gas mitigation system design comprising at least three (and likely four) levels of protection was therefore required. The proposed concept design comprised several main elements as outlined in the report including: a clay cap, a gas drainage (collection and dispersal system) layer, a gas protective membrane and sealed concrete slab.

DP concluded that combined these should afford a score of >6 points as required by NSW EPA (2012) *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases*.

The report also noted that final design, specifications and suppliers can be provided once the initial concept design is reviewed and agreed by the Site Auditor and is demonstrably buildable.

8.10 DP (2016)

Conclusions

The findings of the DSI, DP (2016), were generally consistent with previous investigations insofar as the drilling programme encountered uncontrolled filling with a component of construction and demolition waste to thicknesses of up to 9.2 m. Many boreholes met refusal on buried obstructions in the filling.

A site plan of previous test locations overlaid on a recent Nearmap aerial photograph flown 13 February 2016 is shown on Drawing 2, Appendix A. For reference, the Drawing set from DP (2016) is reproduced in Appendix C.

The contaminant concentrations in soil were generally consistent with previous investigations with the exception of the PCB hotspot encountered at BH220. PCB has not previously been detected at the site, but this is most likely attributable to the heterogeneous nature of the waste filling.

Ongoing landfill gas monitoring has confirmed CGS3 and thus the need to incorporate gas mitigation systems into the building design for proposed residential dwellings.

Some contaminants in soil at the site including various metals have been detected at elevated concentrations in groundwater, in particular, zinc. TCLP testing on a limited number of samples also indicates some degree of leachability for some metals including zinc. Concentrations of zinc in surface water bodies adjacent to the site were, however, lower than concentrations in the groundwater.

Under certain circumstances, the OCP Aldrin will oxidise to form Dieldrin. Detectable concentrations of Dieldrin were recorded in all (serviceable) groundwater monitoring wells at the site and in the dredge pond and Georges River surface water bodies. Aldrin and/or Dieldrin have been detected in soil at the site at concentrations below the HIL. It is possible that the source of the Dieldrin in groundwater and surface water is the fill at the site.

In addition, the DSI (DP 2016) found exceedances of ammonia above the ANZECC (2000) guideline levels for the protection of 95% of species. Various heavy metals and pesticides were also present in groundwater at levels exceeding the guidelines. It is considered more than likely that these contaminants are derived from the materials buried in the landfill, or possibly from other upstream diffuse sources. The likely receptor for groundwater migrating from the site is the Georges River and its related ecosystem (as it is unlikely that a groundwater dependent ecosystem exists between (or beneath) the site and the Georges River), and as such this receptor i.e. the reach along and down gradient of the site boundary would represent the most adjacent compliance point.

DP (2009) indicated that monitoring wells installed along the Georges River riparian strip to the south east of the site (wells BS-1-BS-4) indicated that results in 2007 were found to be consistent with the (adopted) trigger values for the period before landfilling practices took place on the site.

Background water quality data from the Georges River indicate that environmental values in the Georges River have already been degraded (upstream of the landfill) and accordingly it would be reasonable to adopt a modified set of values at the receptor. Accordingly it was proposed that the existing testing data, augmented by an ongoing programme of monitoring for the duration of the construction programme, is subject to Mann-Kendall trend analysis to determine whether the reported levels are stable or declining (or otherwise) and depending on the results that a separate groundwater ecological risk assessment be provided as part of the site validation documentation (refer to Section 16.1.8). This will require additional monitoring wells to be installed within the site (i.e. replacement wells for those wells recently destroyed) and along the site perimeter in order to provide a fate and transport model with respect to the principal contaminants. Depending on the results measures to mitigate groundwater impacts beyond the site boundary may be necessary, but in all likelihood will be predicated on partial removal and reduction of the main contaminant sources in the landfill and if necessary the construction of a groundwater (reactive) barrier which selectively removes or reduces

the contaminant loading whilst allowing unimpeded groundwater flow. Validation of the success of this arrangement would most likely involve a programme of ongoing monitoring administered via an EMP with the objective of ensuring compliance with the agreed groundwater target values. Construction of any necessary barrier, and any related ongoing groundwater or surface water monitoring, if considered necessary, can take place as a separate exercise without interfering with the main remediation and validation programme. It is noted that subsequent surface water monitoring has resulted in a modification to the monitoring requirements set out in the DSI. These are set out in Section 16.1.8, Section 16.9 and Section 23.

The PAH that was detected in filling does not appear to be leaching and migrating vertically to groundwater. This is probably due to the low solubility of the majority of PAH compounds. TCLP testing on a limited number of samples also indicates the PAH is unlikely to leach. PAH was not detected in any groundwater or surface water samples with the exception of JKBH/MW16 as reported in EIS (2013).

Based on the findings of DP (2016) which is considered to have sufficiently characterised the site under the requirements of NEPM (2013) and generally in accordance with guidelines made or approved by EPA under the CLMA and in general compliance with SEPP-55 (1995), it was considered that the site can be made suitable for the proposed residential development subject to the development of a suitable RAP and the implementation of appropriate site remediation as per the recommendations outlined in DP (2016) and reproduced below.

The site Environment Protection Licence – 10490 version dated: 10-Sep-2015 under Section O5.6 required that: *the last licensee must prepare and submit to the EPA within three months of cessation all activities at the premises permitted by this licence, a closure plan in accordance with section 76 of the Protection of the Environment Operations Act 1997*. This process will need to be integrated with the DA process and site remediation activities.

Advice on the geotechnical considerations for the project was being provided to Benedict by J&K. The geotechnical methodology for remediating the site from a geotechnical standpoint (i.e. ground improvement) was summarised by J&K. The summary was provided in Appendix J of DP (2016). This summary has since been superseded by J&K (2016b and 2017). Reference to the J&K (2016a; 2016b and 2017) should not be interpreted to imply that DP endorses the proposed methodology for geotechnical site improvement.

Recommendations

A RAP should be prepared with reference to NSW OEH (2011) that outlines the requirements for site remediation necessary in order to render the site suitable for the proposed residential development.

There are several ‘hotspots’ of soil contamination that will require remediation. The RAP should determine which ‘hotspots’ (if any) will need to be remediated and this will be determined based on the proposed final site levels and the thickness of imported VENM that will be used to cap the site.

Based on the ongoing landfill gas monitoring at the site, gas mitigation systems will need to be incorporated into the building design for proposed dwellings.

Additional landfill gas monitoring wells should be installed, in particular, in the footprint on any remediation excavations following the screening and backfilling process. They should also be installed at previously inaccessible areas of the site when stockpiles have been moved. The additional monitoring data should be used to finalise the levels of gas mitigation that will be required.

The recent monitoring conducted as part of this DSI suggests that a CGS of 3 is likely to be appropriate for this site as opposed to the previously recommended CGS of 4. The historical worst case CGS of 4 appears to be an outlier in the overall monitoring dataset. With reference to NSW EPA (2012), a CGS of 3 is typical of "old inert waste landfill" which is consistent with the filling at this site. Ongoing monitoring will be required to confirm the CGS.

The following table provides a summary of the GSV and CGS for the four monitoring events reported in DP (2016).

Table 3: Summary of Maximum Results for the Four Landfill Gas Monitoring Events

Date	Flow Rate Peak	Methane Peak %	GSV	CO_2 Peak %	GSV	CGS [1]
19/08/15	0.9	24.6	0.22	15.9	0.14	2
1/10/15	0.7	24.2	0.17	14.5	0.10	2
27/10/15	0.6	32.5	0.20	13.8	0.08	2
10/02/16	6.8	25.3	1.72	23.8	1.62	3

Notes to table:

1. Where methane >1% or CO_2 >5% CGS was increased to Situation 2 as per Table 6 of NSW EPA (2012)

The landfill gas results indicate that over the four monitoring events, a worst case CGS of 3 was recorded using the modified Wilson and Card classification which is in the moderate risk category.

The RAP will thus need to outline the relevant measure or system element to achieve a score consistent with what is required based on the CGS of 3.

The site remediation will need to be integrated with the geotechnical site improvements (i.e. as per J&K geotechnical reports).

All or some of the following additional soil investigations were recommended when stockpiles have been removed from the site and a decision is finalised on the thickness of imported VENM that will be used to cap the site to achieve final design levels:

- Targeted near surface sampling at the diesel above ground storage tank (AST) and the drum storage area following their decommissioning;
- Delineation testing in the area of the PCB, PAH and lead 'hotspots' (if required); and
- Grid based sampling across the site with a focus on previously inaccessible areas (i.e. beneath existing stockpiles) in order to meet the NSW EPA (1995) *Sampling Design Guidelines* recommended sampling density.

DP (2016) also recommended ongoing landfill gas monitoring be undertaken including the installation of additional monitoring wells as discussed above.

8.11 Summary Results of Previous Investigations

The summary results tables from the DP (2016) and EIS (2013) including analytical results and relevant assessment criteria are appended as follows:

- Appendix D: Summary of Soil Results (DP, 2016);
- Appendix E: Summary of Landfill Gas Results and Summary of Non-Methane Organic Compound Results (DP, 2016);
- Appendix F: Summary of Groundwater and Surface Water Results (DP, 2016); and
- Appendix G: Summary of EIS Soil and Groundwater Results (EIS, 2013).

8.12 Uncertainties and Data Gaps in Assessments

Despite the volume of testing undertaken on the site various uncertainties and data gaps still exist. Clarification of these uncertainties and/or plugging of the data gaps from the current assessments will be addressed by additional investigations / site work undertaken as part of the proposed remediation works. These issues and sections in the RAP where the proposed strategies are set out include:

- Groundwater contamination assessments that address issues that include, but may not be limited to, natural background groundwater quality, environmental values to be protected, groundwater quality migrating off-site, site-specific risk assessment, fate-and-transport, management response to contamination, clean-up to the extent practical – The proposed strategy is documented in Section 16.1.1;
- Practicality assessments into measures to reduce landfill gas and leachate generation. The proposed strategy is documented in Section 10.1; and
- The geotechnical performance of the as-constructed cap and building foundations to be supported by the cap – The proposed strategy is documented in Section 19.1.4.

9. Conceptual Site Model

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors (linkages). The CSM provides the framework for identifying how the site became contaminated and how potential receptors may be exposed to contamination either in the present or the future i.e. it enables an assessment of the potential source – pathway – receptor linkages. A preliminary CSM was developed by EIS in EIS (2013) and several investigations have been undertaken since that time. The refined CSM based on those investigations is reproduced herein.

The potential sources of contamination and contaminants of concern within the site have been identified and summarised in the Table 4, below.

Table 4: Potential Contamination Sources and Contaminants of Concern

Potential Source	Description of Potential Contaminating Activity	Contaminants of Concern
1. Large scale filling	Filling activity has occurred at the site since the use of the site for agricultural/commercial purposes (from at least 1950s). During the early years, due to lack of regulation, uncontrolled filling could have occurred. Filling of low lying swamps/vegetation could result in the generation of ground gasses. The site drainage has been significantly altered and artificial drainage including dams, channels/drains etc. have been created. Large scale filling at the site appeared to have occurred between 1982 and 1991 associated with the commercial use for waste processing / dredging and recycling activities. A review of the NSW EPA records indicate that various waste streams including wood, tyres, general solid waste (non-putrescible) etc. were permitted to be imported onto the site. The boreholes drilled for previous investigations encountered deep fill in the central and south sections of the site where the majority of the filling has occurred. The batters along the subject site boundary provide an indication of the level of filling. The contaminants in filling may provide a diffuse source of groundwater (and possibly surface water) contamination.	Metals, TRH, BTEX, VOC, PAH, OCP, OPP, PCB, asbestos, nutrients (nitrate, nitrite and phosphorous) and HGG including methane, carbon dioxide, carbon monoxide and hydrogen sulphide, trace NMOC in soils and groundwater, and ammonia (in water only) which may affect environmental quality and or recreational users of the Georges River.
2. Past agricultural activities	Prior to commercial operations the site was used for dairy and cattle grazing. Potential contamination during this period could have occurred with the use of pesticides and herbicides.	Metals, OCP and OPP
3. Current site use for Resource Recovery and Processing	The site is licenced to receive various waste streams, including general solid waste (non-putrescible), wood, tyres, asphaltic gravel etc. The site is also licenced to carry out extractive activities, with various metals used in the extraction process. Petroleum hydrocarbons including oil, diesel etc. are used and kept on site along with car batteries. Asbestos (typically bonded ACM) has previously been found in stockpiles, in fill and at the ground surface within the site. Generation of asbestos fibres caused by the crushing and/or processing of waste containing bonded asbestos fragments.	Metals, TRH/BTEX, PAH, OCP, OPP, PCB, oil and grease, sulphuric acid (associated with batteries) and asbestos

Potential Source	Description of Potential Contaminating Activity	Contaminants of Concern
4. Hazardous building materials	Former buildings within the site may have contained hazardous building materials (e.g. bonded ACM). A single storey cottage located within the site may contain hazardous building materials. Buried services containing asbestos which may affect maintenance workers / utility workers.	Asbestos, SMF, lead and PCB

Notes to Table 4:
TRH – Total recoverable hydrocarbons including light, mid and heavy fractions
BTEX – Monocyclic aromatic hydrocarbons – benzene, toluene, ethylbenzene and xylenes
VOC – Volatile organic compounds includes BTEX compounds
PAHs – Polycyclic aromatic hydrocarbons
OCPs – Organochlorine pesticides
OPPs – Organophosphorus pesticides
PCBs – Polychlorinated Biphenyls
SMF – Synthetic mineral fibres

The potential contamination sources (S) on the site are therefore:

- S1 – Large scale filling;
- S2 – Past agricultural activities which may have used pesticides or herbicides;
- S3 – Current site activities which may contribute to contaminants entering the soil; and
- S4 – Buildings that could have been constructed using asbestos, or other hazardous building materials.

The following potential human receptors (R) have been identified:

- R1 – Current site users;
- R2 – Construction workers (during site redevelopment);
- R3 – Future site users (including occupants) following construction of the proposed residential development;
- R4 – Residents and users of surrounding lands; and
- R5 – Maintenance workers undertaking excavation work within or below the 3 m thick 'engineered fill' blanket.

The following potential ecological receptors (ER)[2] have been identified:

- ER1 – Local ecology (upper 2.0 m of the proposed final landform);
- ER2 – Open drainage channel located on along the western boundary of the site;
- ER3 – Dredge ponds and associated aquatic ecosystem located to the south of the site; and

[2] Note that available data indicate that groundwater dependant ecosystems are not a potential ecological receptor, as shown by the data provided in Sections 2.3 and 8.10.

- ER4 – Georges River located approximately 120 m to the east of the site. The Georges River is located adjacent to the southern end of the site. When the dredge ponds are removed and reinstated to become a marina the area will be opened to the river as part of a future development that is proposed to be constructed under a separate DA.

Potentially complete exposure pathways (P) for contamination to impact on the identified receptors include the following:

Primarily relevant to human receptors:

- P1 – Ingestion and dermal contact;
- P2 – Inhalation of dust and/or vapours including HGG;
- P3 – Explosion and/or asphyxiation due to the accumulation of HGG in structures (existing or proposed); and
- P4 – Abstraction and use (e.g. for drinking or irrigation) of contaminated groundwater;
- P5 – Recreational (human health) impacts on Georges River users.

Primarily relevant to ecological receptors:

- P6 – Direct contact with local ecology (upper 2.0 m of the proposed final landform);
- P7 – Surface water run-off;
- P8 – Leaching of contaminants from soil / fill and vertical migration to groundwater; and
- P9 – Lateral migration of contaminants in groundwater which provides base flow to water bodies (e.g. lateral transport of ammonia, chlorpyrifos and/or zinc via groundwater which discharges to the Georges River or open drainage channel), i.e. impacts on Georges River ecosystem. [Note: groundwater dependent ecosystems are unlikely and if present are likely to have already been substantially modified by the existence of the landfill for over 20 years.]

A ‘source–pathway–receptor’ approach has been used to assess the potential risks of harm being caused to current and future human, water or environmental receptors from contamination sources on or in the vicinity of the site, via exposure pathways. The possible pathways between the above sources (S1, S2, S3 and S4) and receptors (R1-R4, ER1-ER4) are provided in the table below.

Table 5: Conceptual Site Model

Source	Exposure Pathway	Receptor	Comment
S1: Large scale filling S2: Past agricultural activities S3: Current site uses S4: Hazardous building material	P1 – Ingestion and dermal contact.	R1/R2/R3/R5: Current site users, construction workers, future site users and maintenance workers.	- Complete exposure pathway considered to exist. - Can be managed by adoption of appropriate work health and safety procedures during remediation. The remediation strategy can render the exposure pathway incomplete for future site users (including occupants).
	P2 – Inhalation of dust and/or vapours including HGG.	R1/R2/R3/R4/R5: Current site users, construction workers, future site users, users of adjacent lands and maintenance workers.	- Complete exposure pathway considered to exist for inhalation of dust. - Incomplete exposure pathway considered to exist for vapours given the general absence of structures at the site. - Can be managed by adoption of appropriate work health and safety procedures during remediation. The remediation strategy to be adopted will render the exposure pathway incomplete for future site users (including occupants) when structures in which gas can accumulate will be present at the site and also to adjacent land users.
	P3 – Explosion and/or asphyxiation due to the accumulation of HGG in structures (existing or proposed).	R1/R2/R3: Current site users, construction workers, and future site users (post redevelopment).	- Incomplete exposure pathway considered to exist for HGG given the general absence of structures at the site. - Can be managed by adoption of appropriate work health and safety procedures during remediation. The remediation strategy can render the exposure pathway incomplete for future site users (including occupants).
	P4 – Abstraction and use (e.g. for drinking or irrigation) of contaminated groundwater.	R1/R3/R4: Current site users, future site users, and adjacent site users.	- Incomplete exposure pathway considered to exist given the general absence of groundwater abstraction at the site. - No known groundwater abstraction in the immediate vicinity of the site. - The remediation strategy to be adopted will render the exposure pathway incomplete for future site users (including occupants) by imposing restrictions on groundwater abstraction (i.e. future groundwater abstraction from the site would be restricted by the need for land owners to comply with a long term (passive) EMP).

Source	Exposure Pathway	Receptor	Comment
	P5 – Recreational (human health) impacts on Georges River users	R4: Adjacent site users.	- Potentially complete exposure pathway considered to exist, however, further investigations would be required to confirm whether lateral migration is occurring and to evaluate any adverse impacts to the receptors.
	P6 – Direct contact with local ecology (upper 2.0 m of the proposed final landform).	ER1 – Local ecology.	- Complete exposure pathway considered to exist. - The remediation strategy can render the exposure pathway incomplete for the upper ~2.0 m of the proposed final landform.
	P7 – Surface water run-off.	ER1/ER2/ER3/ER4 – Local ecology, open drainage channel (west), dredge ponds (south), Georges River (east).	- Complete exposure pathway considered to exist, however, further investigations would be required to evaluate any adverse impacts to the receptors.
	P8 – Leaching of contaminants from soil / fill and vertical migration to groundwater.	ER2/ER3/ER4 – Open drainage channel (west), dredge ponds (south), Georges River (east).	- Complete exposure pathway dependent on P8 discussed below.
	P9 – Lateral migration of contaminants in groundwater which provides base flow to water bodies.	ER1/ER2/ER3/ER4 – Local ecology, open drainage channel (west), dredge ponds (south), Georges River (east).	- Potentially complete exposure pathway considered to exist, however, further investigations would be required to confirm whether lateral migration is occurring and to evaluate any adverse impacts to the receptors.

Notes to table:
S2, S3 and S4 are generally considered comparably insignificant to S1 and generally indistinguishable to the release and transport of contaminants which may have occurred due to S1

10. Remediation Trials

10.1 Overview

The redevelopment of the site from a landfill and waste processing facility to a residential estate has the potential to provide significant environmental and community benefits. These benefits include:

- Improvement of amenity;
- Placement of a cap and therefore improvements to local groundwater and surface water quality; and
- Public access to a proposed marina development located to the south of the site (offsite) and Georges River.

The remediation of the site presented a number of technological challenges, which included:

- Small scale treatment trials to reduce landfill gas hotspots and leachate generating waste;
- Larger scale treatment trial; and
- Compaction trials on landfill waste.

These challenges have been addressed through a program of trials, which are described in the following sections.

10.2 Small Scale Treatment Trials

Trial remediation excavations were initiated by Benedict in the vicinity of landfill gas wells JK102 and JK107 (now destroyed). The intention of the excavations was to stockpile screen and backfill the trial excavations and monitor landfill gas in the vicinity of the backfilled excavations to evaluate whether the process resulted in a significant reduction in the methane production (concentrations). The screening process is understood to have included the removal of methane generating timber from the fill that was retained on the screen prior to backfilling with the remaining material.

Both monitoring wells (JK102 and JK107 (now destroyed) had previously recorded methane concentrations of around 30 %v/v. JK102 was retained following backfilling of the excavation and has since recorded methane concentrations of between 12 %v/v and 13.2 %v/v over three monitoring events suggesting a reduction in methane concentration volume of two thirds of those prior to excavations.

JK107 (destroyed) was replaced by JKBH/MW107a following backfilling of the excavation. A shallow gas well JK107b was installed adjacent to JKBH/MW107a. The wells have recorded methane concentrations of:

- JKBH/MW107a – between 3 %v/v (first monitoring event following backfilling) and 16.4 %v/v (most recent monitoring event following backfilling) over three monitoring events suggesting a gas concentration reduction of half; and
- JK107b – between 10.2 %v/v (first monitoring event following backfilling) and 17.3 %v/v (most recent monitoring event following backfilling) over three monitoring events suggesting a gas concentration reduction of half to one third.

The results at JKBH/MW107a and JK107b had indicated a trending increase in methane concentrations but still significantly less than the original results. The on-going landfill gas monitoring (Section 16.1.8) will provide further data on the trial remediation excavations. Results yet to be formally reported have indicated a stabilising concentration of methane and flow rate at JKBH/MW107a and JK107b consistent with a CGS of 2.

A survey of these excavations was not undertaken and the lateral and vertical extent of the excavation was determined by Benedict. The excavations were inspected by DP and fill excavated contained a component of construction and demolition rubble including timber and other organic material. The separation / screening of excavated material and backfilling of these excavations was undertaken by Benedict and it is understood from Benedict that timber removed from the fill was transported to their Menangle timber recycling facility.

Removal of methane generating timber also has the potential to reduce leachate generation impacts to groundwater.

10.3 Larger Scale Treatment Trials

Another trial remediation excavation has been excavated at the central 'deep fill' portion of the site encompassing BH/MW218. The excavation footprint is visible on Drawing 2, Appendix A. The primary purpose of the trial, as with the earlier trial, was to stockpile screen and backfill the excavation and monitor landfill gas in the vicinity of the backfilled excavation to evaluate whether the process resulted in a significant reduction in methane production (concentrations) in the relevant adjacent wells. There are also anticipated benefits to groundwater quality beneath this portion of the site As removal of methane generating timber also has the potential to reduce leachate generation impacts to groundwater. The secondary purpose of the trial was associated with geotechnical site improvement.

The screening process is understood to have included the removal of methane generating timber from the fill that was retained on the screen prior to backfilling with the remaining material. Monitoring following backfilling would also be required to fully assess the result of the trial remediation excavation at this location. The approximate outline of the current trial remediation excavation and its lateral dimensions are shown in Figure 2, below.

It is understood that excavated site materials have been used to backfill (minus screened out timber) along with other stockpiled materials currently on site (refer to Section 10.3.2).

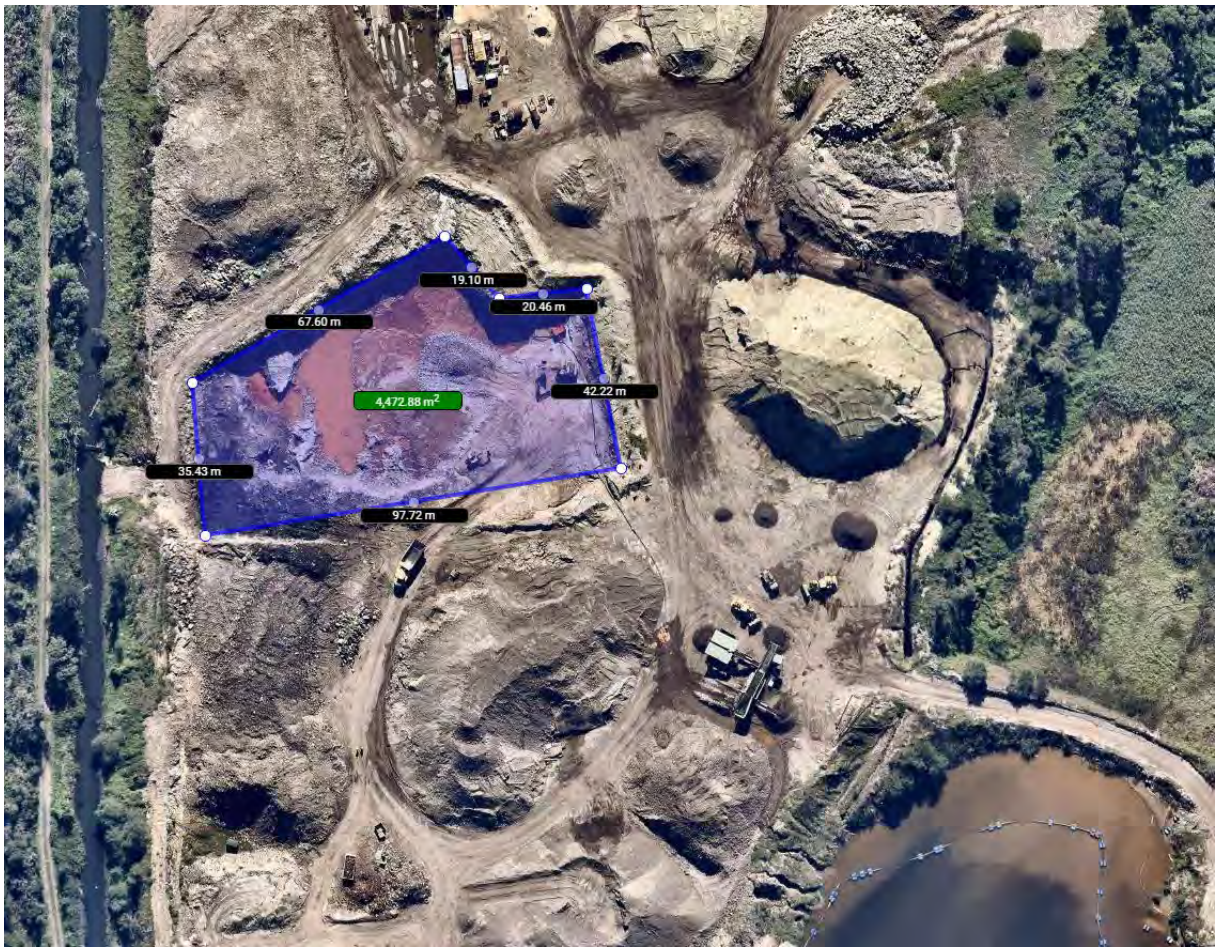


Figure 2: Excavation at the deep fill portion of the site (source: Nearmap, flown 5 May 2016)

The excavation was inspected by DP and the Site Auditor on 5 May 2016. Benedict staff provided an overview of the operation which involved the following:

- The excavation was being dewatered by a pump and dewatered fluid was discharged overland to flow into the dredge ponds located to the south of the proposed development;
- Excavation of those fill materials that presently comprise a significant contribution to landfill gas and leachate, followed by their separation into various product / waste streams;
- Oversize concrete and brick (>120mm) was to be crushed and reused on-site as a coarse fill;
- Soils were being screened and then hand-picked to remove unsuitable materials. The screen fractions were <16 mm, 16 – 40 mm and 40 – 120 mm;
- Timber waste was being removed from the fill and recycled at a licensed Benedict green waste facility;
- Metal waste was being removed from the fill and recycled by a metal waste recycler;
- Other deleterious materials extracted from the excavated material (e.g. rubber, plastics, vegetation, asbestos, bitumen, drums/containers) were being removed from the fill and disposed to landfill; and
- Coarse fill and soils are to be treated and validated to criteria specified in this RAP and validated by the Environmental Consultant. These materials are then to be backfilled and compacted in accordance with directions from the project Geotechnical Engineer (J&K) (refer to Section 11).

10.3.1 Potential Acid Sulphate Soil at the Base of Current Trial Remediation Excavation

Iron staining at the base of the excavation was observed. The staining may be indicative of the oxidation of naturally occurring acid sulphate soils beneath the fill. It is recommended that testing of the soils and water at the base of the excavation is undertaken to evaluate whether:

- Potential acid sulphate (PASS) soils are being oxidised;
- The pH and dissolved metal concentrations in the dewatered fluid is being affected by the generation of sulphuric acid; and
- Liming of the excavation base should occur to neutralise the acid generating capacity of any exposed PASS (if present).

As necessary, reference was made to the procedures outlined in the acid sulphate soil management plan provided in the CEMP (DP, 2015a).

10.3.2 Results of Testing Associated with the Current Trial Remediation Excavation

Stockpiled material from the excavation (stockpile SSP1) was tested and reported (Validation of Screening Process) on 8 June 2016, and subsequently on 5 October and 13 October 2016. The assessment comprised:

- Testing of approximately 4400 m^3 of <16 mm screened material from stockpile 1' (SSP1); and
- Testing at the base of the excavation (acid sulphate soil sample and dewater sample).

In summary the testing determined that:

- The acid sulphate soil results indicated that one of the two samples is potential acid sulphate soil (PASS). The water sample (field filtered) collected from the ponded water at the base of excavation had relatively low concentrations of dissolved metals compared to those detected in groundwater wells in the vicinity of the excavation;
- Organic matter results on soil ranged from 18,000 mg/kg to 23,000 mg/kg suggesting on the micro to macro scale that organic matter in the screened soil is 1.8% to 2.3%;
- The foreign materials content test on soil (bulk >10L sample) ranged from 1% to 2.4% (i.e. <5% which was the nominal target set by the RAP);
- A grid-based walkover over accessible areas of the northern 'raw feed' stockpile was undertaken and four fragments of asbestos containing material (ACM) were observed. The southern 'raw feed' stockpile was inaccessible due to steep stockpile walls; and
- Asbestos (ACM or fibrous asbestos (FA) and asbestos fines (AF)) was detected in five of the eight 500 ml samples and the concentration of FA and AF in one sample exceeded the NEPC (2013) residential land use criterion of 0.001% w/w.

PCB was recorded in all soil samples, however, at concentrations that were below the adopted remediation acceptance criteria (RAC) of 1 mg/kg.

The following summary was provided by Benedict Industries Pty Ltd (Benedict) in relation to the screening process for materials from SSP1:

- *Prior to processing the material is dampened or is damp due to the nature of the material and the location it has been removed from;*
- *Whilst screening the material to remove timber and other contaminants no asbestos pieces are or have been picked/removed during the screening process;*
- *All pickers (labourers) on the conveyer wear PPE gear which includes eye, hearing, hard hats, gloves and P2 respirator masks;*
- *Since commencing screening operations on 3 March 2016 and 14 June 2016, Presna (NATA accredited environmental consultants) have been contracted to carry out airborne asbestos monitoring on site at Moorebank whilst screening operations are active;*
- *237 individual (air) monitoring samples have been tested;*
- *The airborne asbestos monitors are placed on picking platforms adjacent to pickers and inside earthmoving equipment such as excavators and wheel loaders which are working on the screening process;*
- *Of the 237 individual monitor samples, no asbestos fibres have been recorded in the samples;*
- *During the placement of the screened material, which has recently commenced, airborne asbestos monitoring has been conducted and a water cart has been used to dampen the material (if required); and*
- *Benedict will continue to monitor for the duration of the screening and placing of site materials at Moorebank.*

The report dated 5 October 2016 and related results as well as a subsequent report and 13 October 2016 which describe a similar process involving the excavation of a further 7000 m^3 of materials are provided in Appendix H. Additional data collected associated with this trial remediation excavation consists of soil testing data and inspection records. This information will be incorporated into a report prepared by the Environmental Consultant during the preliminary works stage, as discussed in Section 16.1.4.

The potential for reduction in leachate generation from the treatment trials will be assessed through an additional surface water investigations undertaken as part of preliminary work, as described in Section 16.1.8.

10.4 Compaction Trials on Landfilled Waste

Based on information provided to DP (full details provided in DP (2015c)), two Trial Areas A and B were subjected to forty passes of a three sided roller. Landpac's report is included in Appendix D. The results of the high energy impact compaction (HEIC) trial indicated that after 40 passes of HEIC, the near surface profile appears to have been compacted in both trial areas based on the low to medium results of the 'continuous impact response'.

The measured settlements (obtained by GPS methods) indicate an average settlement of 63 mm for Area A and 60 mm for Area B. The range of settlement, however, indicated that the settlement for Area A ranged from less than 20 mm to 200 mm with some minor areas up to 300 mm. Area B has a similar range of settlement. The difference in settlements is often expressed over a short distance and is not necessarily 'uniform' across the site.

HEIC is generally considered to be effective over depths of about 1 - 2 m for clayey material which appears to make up most of the filling material. Therefore, it could be expected that HEIC has created a compacted layer of approximately 1 m to 2 m thick across the trail area. However, the filling beneath 'compacted layer' is expected to have not been noticeably affected by the HEIC.

Landpac concluded that the HEIC provided a relatively uniform subgrade over the trial areas except for one localised area in Area A.

11. Geotechnical Site Improvement

Advice on the geotechnical considerations for the project is currently being provided to Benedict by the project Geotechnical Consultant J&K. The geotechnical methodology for remediating the site from a geotechnical standpoint (i.e. ground improvement) is outlined in J&K (2016a). Auditor comments on geotechnical aspects of the project prompted the issue of a response by J&K dated 22 August 2016 (J&K, 2016b). Additional comments were addressed in an update of the J&K (2016a) report in J&K (2017). J&K (2016b; 2017) are included in Appendix I.

In order to assess the total and differential settlement at the surface of the subdivision site, a geotechnical model was prepared by J&K. This geotechnical model was used in their numerical analysis. The model divides the subsurface profile into a number of soil units. Geotechnical

parameters were selected for each unit based on the borehole and CPT information, available literature and case studies (J&K 2017).

Figure 3, below, extracted from J&K (2017) shows a long section of the site model with the existing fill and proposed 3 m thick 'engineered fill' blanket that was used in the analysis to predict long term settlement.

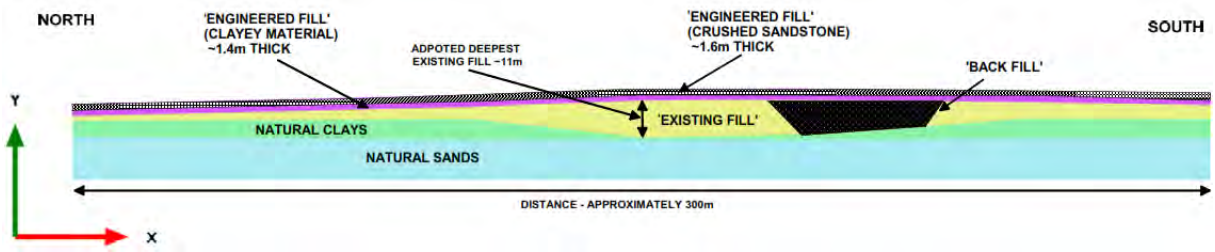


Figure 3: Long Section of Site with Proposed 'Engineered Fill' Blanket (J&K, 2016a)

It is understood that in order to further address geotechnical issues identified as part of the site audit process beyond that provided by J&K (2016b), the following has been undertaken in order to refine the design:

- The geotechnical settlement analysis that evaluates the predicted total and differential settlements was be re-run; and
- As part of the analysis, consideration was given to the decay of organic material within the site fill based on existing and recently obtained soil organic content data.

J&K (2017) notes that, "settlement due to decomposition of organics present in subsoils can occur. Although significant organics were removed from the 'existing fill' in the methane hotspot areas, we consider that it is those very organics causing the high methane. In the overall 'existing fill', we have assumed an organic content of about 5% (i.e. higher than the organics measured by DP (the project environmentalist) in the 'existing fill' after selection and blending for use as 'backfill'. As the organics are expected to be spread throughout the 'existing fill' mass and given their age, we do not expect that they will be significant relative to the ongoing creep settlement of the 'existing fill' nor are they expected to affect likely differential settlements. Further, we anticipate that the creep settlement recommended for landfills includes an element of decomposition. The presence of organics has therefore been ignored in our analyses."

J&K (2017) note further that, based on their modelling, "the maximum settlement of about 60mm after 50 years occurs in the area of deeper 'existing fill', to the north of the area which was excavated and backfilled for environmental reasons. Over the remainder of the site, the total settlement varies between about 10 mm (over the north) and 40 mm (towards the south) depending on the depth of 'existing fill'. However, a maximum differential settlement over a distance of 30 m of about 40 mm is indicated. This differential settlement occurs in an area which straddles the 'existing fill' – 'backfill' interface."

Based on a review of the J&K (2017) report and input from the client, and relevant to the site remediation aspect of the project, the following is understood:

- There is a net deficit of soil / fill at the site to reach final design levels;
- The entire site area will be excavated to 3 m below the design subgrade level (i.e. the subgrade level being the top level of the 3 m thick 'engineered fill' blanket);
- Based on the current site levels and the current Fill Plan (Appendix B), the placement of the 3 m thick 'engineered fill' blanket equates to 1.4 m of site derived fill and 1.6 m of imported fill;
- The earthworks of the 3 m thick 'engineered fill' blanket will comprise of two distinct layers being:
    - Lower 1.4 m of site derived fill (over 8 ha being a compacted in-situ volume of approximately 126,000 m^3); and
    - Upper 1.6 m imported VENM fill (over 9 ha being a compacted in-situ volume of approximately 144,000 m^3).

Therefore, on the basis of the required earthworks for geotechnical site improvements, the proposed development will necessarily involve the placement of a 1.6 m thick engineered VENM cap (e.g. crushed sandstone) across the site. This VENM cap will therefore be taken into consideration in the selection of the appropriate remediation option(s).

12. Identification of Remediation Goals

The goals of the remediation are to render the site suitable for the proposed development. In doing so, the potentially complete exposure pathways between identified site contamination (i.e. localised soil contamination and landfill gas) between the source and receptors will need to be rendered incomplete.

Additional remediation goals include:

- Demonstrating that the proposed remediation strategy for the site is environmentally justifiable, practical and technically feasible;
- Adopting remediation criteria appropriate for the future use of the site to mitigate possible impacts to human health and the environment;
- Mitigating possible off-site migration of contaminants;
- Consideration of the principles of ecologically sustainable development in line with Section 9 of the Contaminated Land Management Act 1997;
- Minimising waste generation under the Waste Avoidance and Resource Recovery Act 2001; and
- Demonstrating that the plans for site management of remediation work considers issues related to worker health and safety, environmental management, community relations and site contingencies such as unexpected finds.

13. Extent of Remediation Required

Based on the CSM, the extent of remediation required is summarised as follows:

- Removal of localised soil contamination 'hotspots' or the placement of a physical barrier (e.g. capping) to prevent the exposure of receptors (human and ecological) to the soil contamination;
- Incorporation of the relevant measure(s) or system element(s) into dwelling construction based on a CGS of 3 and a gas protection score of 4.5, as defined by NSW EPA (2012) and British Standard BS 8485:2015. This will also be relevant to any associated infrastructure in which landfill gas can accumulate, such as services, hardstand areas etc. Open landscaped areas are not considered likely to pose a risk as any landfill gas (methane) which finds its way to the surface through the proposed capping system in these areas will dissipate (dilute and disperse) into the atmosphere to levels which do not pose a significant risk and as such will not pose a hazard or cause any reduction in amenity to site users;
- Excavation and removal of major sources of methane gas generation at the site (where practicable);
- Excavation and removal of sources of major groundwater contamination at the site (where practicable);
- Construction of a 3 m thick cap to cover and preclude exposure to remaining contamination or aesthetic impacts arising from buried waste;
- Removal of hazardous building waste if any from demolition of existing or former structures; and
- Removal of abandoned buried services (if any).

Groundwater and surface water data suggests that some contaminants likely to be from filling have migrated into groundwater. Further investigations are proposed to evaluate the background surface water quality and leachability of fill soils using a neutral leaching test procedure.

With regard to the extent of the proposed landfill gas mitigation measures i.e. other than the 3.0 m thick site capping, these additional measures (see Section 14.3) will be restricted to residential footprints and service corridors because of the higher risk that would occur should gas reach the surface and become confined in constructed voids or cavities within built structures. Under such circumstances soil gas (principally) methane may accumulate to levels which become flammable or explosive, whereas in open space areas the gas would disperse to safe levels.

14. Remediation Options Evaluation and Preferred Remediation Option

14.1 General

In general, options for remediation include the following, given in the NSW EPA's preferred order (DEC, 2006):

- On-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;
- Off-site treatment of excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site;

- Removal of contaminated soil to an approved site or facility, followed where necessary by replacement with clean fill; and
- Consolidation and isolation of the soil by on-site containment within a properly designed barrier.

These options were considered in light of the known conditions on the site and the practicality and cost associated with on-site treatment, off-site treatment and wholesale excavation. In the case of the latter removal of all materials would simply burden another site and comprise a waste of diminishing landfill resources and would in any event be contrary to the principals of waste minimisation and sustainability espoused by the NSW EPA. Moreover, the proposal to retain waste materials on site complies with NSW EPA's waste hierarchy as follows:

- **Waste Avoidance -** including action to reduce the amount of waste generated by households, industry and all levels of government;
- **Resource recovery** - including re-use, recycling, reprocessing and energy recovery, consistent with the most efficient use of the recovered resources; and
- **Waste disposal** - including management of all disposal options in the most environmentally responsible manner.

As shown in Figure 4 below disposal of waste is the least preferred option whereas waste avoidance as proposed at this site, is the most preferable option.

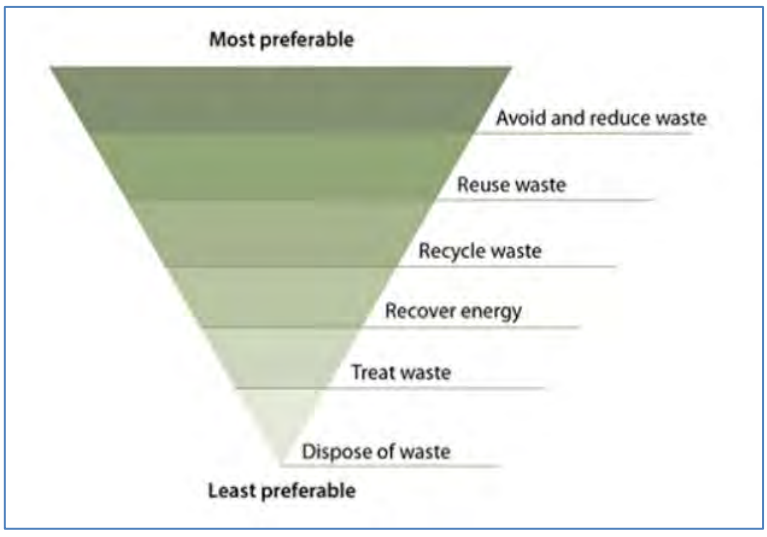


Figure 4: NSW EPA Waste hierarchy http://www.epa.nsw.gov.au/wastestrategy/waste-hierarchy.htm

The RAP has evaluated remediation options for the three types of materials that need to be remediated, these being:

- Contaminated soil (Section 14.2);
- Landfill gas (Section 14.3); and
- Groundwater (Section 14.4).

Development of the site will require the elevation of the ground surface to be raised by 1.6 m once cut to fill exercises are complete and to facilitate final land form shaping and capping (including road levels and drains) to proposed design surfaces. The upper 1.4 m of the site soils will also need to be

excavated and re-compacted as part of a geotechnical ground improvement program to form a 3 m thick 'engineered fill' blanket. This site development work has the potential to address some of the issues posed by contamination at the site and has been considered when evaluating remediation options.

14.2 Remediation Options for Residual Soil Contamination

The proposed development will necessarily involve the placement of a 3.0 m thick engineered cap of which the upper 1.6 m will be imported VENM across the site.

Options for soil remediation include:

- Option 1: Do nothing;
- Option 2: On site treatment prior to off-site disposal;
- Option 3: Off-site treatment prior to off-site disposal;
- Option 4: Off-site disposal to landfill; and
- Option 5: Containment of the impacted soil on site beneath an engineered barrier.

Consideration of the various options is influenced by the fact that the proposed development involves a 1.6 m thick engineered VENM cap. The options evaluation is outlined in the following table.

Table 6: Remediation Options Evaluation for Residual Soil Contamination

Option	Evaluation	Option Ranking
Option 1: Do nothing	In the context of the proposed development involving a 3.0 m thick engineered cap of which the upper 1.6 m will be imported VENM, this option is not considered appropriate.	Not applicable.
Option 2: On site treatment prior to off-site disposal	There is a significant quantity of fill on the site. The known soil contaminants exceeding NSW EPA soil investigation levels (SIL) include inorganics (lead and copper) and organics (TRH, PCB and B(a)P). With the exception of TRH and PCB, the other contaminants are not readily amenable to treatment (destruction) and therefore this option is not considered appropriate. Notwithstanding, in order to reduce contaminant levels and specifically to neutralise areas of high methane gas generation (hotspots), deep waste (fill) material could be excavated and organic matter (mainly timber) removed by screening and manual removal from the screens). The removed material would be disposed off-site and the remaining materials returned to the excavation. Whilst this method is costly and labour intensive the	Not applicable.

Option	Evaluation	Option Ranking
	intention is to reduce contaminant loading (principally in terms of potential ground gas and groundwater (TDS and ammonia, associated with timber) emissions) and although the method will not remove all organic material from the excavated materials it is nevertheless considered to be a both a practical and reasonably efficient means of substantially mitigating potential environmental emissions and thus reducing longer term risks.	
Option 3: Off-site treatment prior to off-site disposal	The known soil contaminants include inorganics (lead and copper) and organics (TRH, PCB and B(a)P). With the exception of TRH and PCB, the other contaminants are not readily amenable to treatment (destruction) and therefore this option is not considered appropriate.	Not applicable.
Option 4: Off-site disposal to landfill	This option is considered to be both feasible and practical for near surface contamination. It is not considered feasible and practical for deeper (e.g. >2 m) contamination. Excavation could be adopted to facilitate the removal and off-site disposal of materials containing 'hotspot' levels of contamination such as high concentrations of: • Biodegradable material that form gas hotspots and/or generate leachate; • Drummed waste or areas where fuel leaks occurred that pose soil vapour and/or groundwater contamination risks; and • Unexpected finds.	2 Contingency.
Option 5: Containment of the impacted soil on site beneath an engineered barrier	In the context of the proposed development involving a 3.0 m thick engineered cap of which the upper 1.6 m will be imported VENM, this option is considered to be both feasible and practical.	1 Preferred

Given the proposed 3.0 m thick engineered cap of which the upper 1.6 m will be imported VENM, the preferred option for residual soil contamination at the site is containment of the impacted soil on site beneath an engineered barrier (Option 5). In the context of a proposed capping strategy, the additional targeted sampling recommended in the DSI (DP, 2016) at soil contamination 'hotspots', are not considered to be necessary (refer to comment on Option 4, below). Targeted sampling should, however, be undertaken following decommissioning of the diesel AST. Option 4 is considered feasible to address contamination hotspots at the site, which are found to be generating high amounts of landfill gas or had the potential to impact groundwater quality migrating off-site or air quality during earthworks. An investigation program to locate these hotspots is proposed as part of preliminary works at the site, which is discussed in Section 16.1.

14.3 Remediation Options for Landfill Gas

Landfill gas monitoring data to date indicates that there is currently an unacceptable risk of the migration of landfill gas into structures (e.g. dwelling) associated with proposed development. The recent monitoring conducted as part of this DSI suggests that a CGS of 3 is appropriate for this site.

Options for landfill gas remediation include:

- Option 1: Do nothing;
- Option 2: Complete removal of the landfill gas source;
- Option 3: Partial removal of the landfill gas source (partial solution that would need to be coupled with Option 4 or Option 5). Partial removal would involve either:
  - o removal of pockets of fill with high organic content;
  - o removal of pockets of fill with high organic content and screening a proportion of the organic material out of the fill prior to its re-use to backfill excavation(s);
- Option 4: Engineered landfill gas mitigation measures for the entire site (e.g. drainage blanket across the entire site likely coupled with active landfill gas extraction system);
- Option 5: Engineered landfill gas mitigation measures (passive) for each structure (e.g. venting and/or gas resistant membranes beneath concrete slabs); and
- Option 6: Engineered landfill gas mitigation measures (passive and active) for each structure (e.g. active venting and/or gas resistant membranes beneath concrete slabs).

The options evaluation is outlined in the following table.

Table 7: Remediation Options Evaluation for Landfill Gas

Option	Evaluation	Option Ranking
Option 1: Do nothing	A potentially complete pathway (explosion and/or asphyxiation risk) exists between the source of the landfill gas and the future site users (dwelling occupants). This option is not considered appropriate.	Not applicable.
Option 2: Complete removal of the landfill gas source	There is a significant quantity of fill (i.e. the primary source of the gas) on the site. Complete removal of the fill is not considered to be feasible or practical. This option is not considered appropriate.	Not applicable.
Option 3: Partial removal of the landfill gas source	There is a significant quantity of fill (i.e. the primary source of the gas) on the site. Partial removal of 'unacceptable' gas generating fill may lower the CGS for the site.	1 Preferred (already being undertaken).
Option 4: Engineered landfill gas mitigation measures for the entire site	An active system may not be suitable for residential land because effective long term may operation not be feasible. This option could involve the installation of an array of landfill gas extraction wells fitted with air pumps spread across the site. This could also be incorporated into the 3 m thick 'engineered fill' blanket. This option is likely to involve a significant amount of engineering design and the ongoing maintenance of any active extraction that may be required. This contingency is discussed in Section 16.6.	2 Contingency.
Option 5: Engineered landfill gas mitigation measures (passive) for each proposed structure	This option is considered to be both feasible and practical subject to the incorporation of passive measures only.	1 Preferred.
Option 6: Engineered landfill gas mitigation measures (passive and active) for each proposed structure	This option is not considered to be feasible or practical due to the incorporation of active measures that would require ongoing maintenance.	2 Contingency.

It is noted here that Option 5 in the above table applies only for engineered landfill gas mitigation measures for each proposed structure. For this type of 'brown field' site Option 5 remains the only practical and cost effective remedial measure for the proposed residential use of the land and whilst development of landfill gas affected land is this way is fairly new in Australia similar types of development are now quite common in Europe and particularly in UK. In the latter the various authorities have developed considerable amounts of guidance over a number of years (for example Protective measures for housing on gas contaminated land, BSI 8485 (2015) *Code of Practice for Design of Protective Measures for Ground Gases* and accordingly it is considered that there should be no unsurmountable impediments to facilitating a similar type of development at the current site. Such sites when properly engineered have been successfully developed and accepted by both the Local Authorities and future property owners and as such there is no reason why a similar approach should

not be adopted at this site. Option 5 above is given a higher ranking than Option 4 on the basis that engineered landfill gas mitigation measures other than the application of a 3.0 m cap are not considered necessary other than in built structures as any gas reaching the surface in these areas will be diluted and dispersed by normal air movements.

The preferred option for landfill gas concentration / volume reduction is the partial removal of the landfill gas source 'hot spots' (already being undertaken) and passive engineered landfill gas mitigation measures for each proposed structure (e.g. venting and/or gas resistant membranes beneath concrete slabs) (Options 3 and 5). Passive measures are considered appropriate for this development as opposed to active measures which would require home owners to maintain an active system (which is not considered practical or feasible).

The partial removal of unacceptable landfill gas sources and associated waste from the fill will have the added benefits of:

- The removal of a portion of metal waste by screening some metal out of the fill prior to its use as backfill. The metal waste in fill is currently leaching dissolved metals into groundwater and is likely to be having a net adverse impact on groundwater quality beneath the site;
- The removal of a portion of timber and other general waste by screening some timber and other general waste out of the fill prior to its use as backfill. The timber and other general waste in fill is currently leaching contaminants such as dissolved metals, degradable by-products (ammonia, nutrients), OCPs (assuming discarded containers of OCP are present) and TDS into groundwater and is likely to be having a net adverse impact on groundwater quality beneath the site; and
- Removal and disposal of bonded ACM from excavated waste.

Additional benefits of removing unacceptable landfill gas sources include:

- Reduce the degree of reliance on landfill gas mitigation measures since landfill gas levels remaining at depth at the site would be reduced to the extent practicable;
- Reduce greenhouse gas emissions to the extent practicable; and
- Reduce the leachate generation of the landfill waste to the extent practicable.

14.4 Remediation Options for Contaminated Groundwater

The condition of groundwater beneath the site is not considered likely to require further remediation but will be subject to further surface water monitoring (groundwater discharge point) during site remediation and construction. In the unlikely event that surface water monitoring shows a decline in conditions groundwater remediation options could involve the following:

- A 'do nothing' strategy;
- Selective source removal;
- A long term MNA programme to demonstrate a continued decrease in key contaminants emanating for the site (as represented by water quality in the dredge pond i.e. proposed marina with a contingency for groundwater investigation if considered necessary);

- Installation of an impermeable barrier wall to prevent the flow of contaminant-impacted groundwater to the point(s) of compliance (i.e. adjacent surface water bodies); or
- Installation of a permeable reactive barrier wall to treat contaminant-impacted groundwater prior to its discharge to the point(s) of compliance (i.e. adjacent surface water bodies).

Source removal is the NSW EPA's preferred strategy with construction of a cut of wall not preferred.

14.5 Summary of Preferred Remediation Options

In summary, the preferred remediation options are:

- Soil – containment of the impacted soil on site beneath an engineered barrier (Option 5) coupled with the selective excavation and removal of hotspots from buried fill;
- Landfill gas –removal of all unacceptable landfill gas sources (already being undertaken) and installation of engineered landfill gas mitigation measures for each proposed structure (e.g. venting and gas resistant membranes beneath concrete slabs) (Options 3 and 5). This option has the added benefit of the selective removal of some waste from deep fill areas impacting groundwater quality;
- Groundwater and surface water – monitoring of dredge pond and Georges River water quality during remediation and construction (for a period of 12 months from the date of this RAP) to demonstrate that groundwater impacts are not occurring at the nearest sensitive receptor and that trends in improved water quality, since dredging ceased, continue and are thus not likely to impact the Georges River when the marina is opened;
- General:
    - Removal of hazardous building materials from former building areas; and
    - Removal of buried services that may contain asbestos/wastes.

The RAP has assumed that the preferred remediation strategy is to be applied across the whole site. Should the Environmental Consultant consider that the preferred remediation strategy is not required at an area, then a report justifying variations to the RAP for the area shall be prepared by the Environmental Consultant in accordance with NSW EPA guidelines. The report is to be reviewed and approved by the Site Auditor prior to the commencement of Stage 1 work.

The establishment of whether any groundwater and/or surface water remediation is required (considered unlikely) will be evaluated as part of the proposed validation surface water monitoring programme (refer to Section 16.1.8 and DP (2017b)).

15. Remediation Acceptance Criteria

15.1 Upper 3 m of Soil

As described in Section 11, a 3 m thick 'engineered fill' blanket is required to be placed across the site for geotechnical purposes. Based on the current site levels and the current Fill Plan (Appendix B), the placement of the 3 m thick 'engineered fill' blanket will comprise 1.4 m of site derived fill, overlain by 1.6 m of imported VENM fill. The RAC for the upper 3 m of soil has been derived with this in mind and the RAP therefore requires that the 3 m thick 'engineered fill' blanket comprises a 'clean soil' cap.

The upper surface of the 3 m thick 'engineered fill' blanket is defined as the underside level of the house ground slab. A basic schematic of the configuration of the upper 3 m of soil (cap) is shown in Figure 5, below.

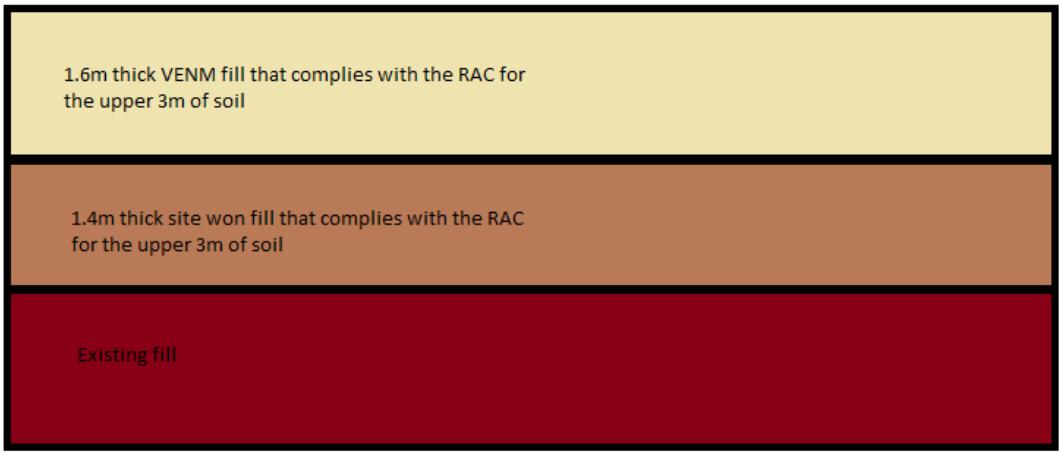


Figure 5: Configuration of the Upper 3 m of Soil with Underlying 'Existing Fill'

The following drawing included in Appendix B, shows the typical details of cap depth, location of house slab and the proposed benching of the site at the individual lot scale that will impact upon the cap post-placement and which locally will reduce the cap thickness because of cut to fill operations to form the slab area in each house lot and to form the gravel blankets (part of the LFG mitigation system):

- Drawing 14005E15 Typical House Benching Section Showing Cut and Fill within the Capping Layer, dated 13 March 2017.

In the absence of a Tier 2 site-specific human health risk assessment from which to derive site-specific clean-up criteria, relevant generic Tier 1 health-based investigation levels (HILs), health-based screening levels (HSL) ecological investigation levels (EIL), ecological screening level (ESL) and 'management limits' have been adopted as the remediation acceptance criteria (RAC) for the upper 3 m of soil. The criteria are the same as those adopted for the DP (2016) DSI for residential land use.

The following general assumptions have been applied in the derivation of the RAC for the upper 3 m of soil:

- The HILs are generic to all soil types and apply generally to a depth of 3 m below the surface for residential use. This is consistent with the thickness of the proposed 3 m thick 'engineered fill' blanket;
- On this basis, the HILs are considered appropriate to adopt as the RAC for the upper 3 m of soil;
- The HSLs are depth and soil type dependant. Fill at the site is highly variable. The HSLs for 0 to <1 m for sand soil are considered appropriate to adopt as the RAC for the upper 3 m of soil;
- EILs and ESLs generally apply to the upper 2 m of soil. The upper 1.6 m of soil will be imported VENM with the remaining 1.4 m being site derived filling. On this basis, the EILs and ESLs derived to evaluate soil for the DSI (DP, 2016) for the upper 3 m of soil will be adopted as the RAC. NEPC (2013) guidelines do not provide EILs for cadmium, mercury (inorganic) and manganese and site-specific values were not derived by past site investigations. In light of this data gap, EILs for these three metals are based on the Column 3 (absolute maximum value) criteria in the ENM Order 2014; and
- The RAC for each contaminant of concern corresponds to the lowest concentration in each case.

DEC (2006) (and updates) indicate that, '…*soil investigation and screening levels* (i.e. NEPM, 2013) *are not appropriate for assessing fill material that has recently been received or is intended to be received on site*…'. VENM is defined in the Waste Classification Guidelines (NSW EPA, 2014) but no specific testing regime or comparative criteria are specified. Accordingly in order to assess imported fill all VENM to be received at the site will also require to comply with the criteria set out in the FMP (Appendix J).

Table 8a: Remediation Acceptance Criteria (HIL and HSL) for the Upper 3 m of Soil (mg/kg)

Contaminants		Direct Contact	Vapour Intrusion
		Resident / Site user HIL/HSL-A	Resident / Site user (sand) HSL-A
Metals	Arsenic	100	-
	Cadmium	20	-
	Chromium (VI)	100	-
	Copper	6000	-
	Lead	300	-
	Mercury (inorganic)	40	-
	Nickel	400	-
	Zinc	7400	-
	Manganese	3800	-
PAH	Benzo(a)pyrene TEQ [1]	3	-
	Total PAH	300	-
	Naphthalene	1400	3
TRH	$C_6 - C_{10}$ (less BTEX) [F1]	4400	40 (silt)
	$>C_{10}-C_{16}$ (less Naphthalene) [F2]	3300	110
	$>C_{16}-C_{34}$	4500	-
	$>C_{34}-C_{40}$	6300	-
BTEX	Benzene	100	0.5
	Toluene	14,000	160
	Ethyl Benzene	4500	55
	Xylene	12,000	40
OCP/ OPP	Aldrin + Dieldrin	6	-
	Chlordane	50	-
	DDT+DDE+DDD	240	-
	Endosulfan	270	-
	Endrin	10	-
	Heptachlor	6	-
	HCB	10	-
	Methoxychlor	300	-
	Chlorpyrifos	160	-
PCB		1	-
Phenols		3000	-

Notes to Table 8a:

1 - sum of carcinogenic PAH

Table 8b: Remediation Acceptance Criteria (EIL) for the Upper 3 m of Soil (mg/kg)

Analyte		EIL	ENM Order 2014
Metals	Arsenic	100	-
	Cadmium	NC	1
	Chromium (III)	450	-
	Copper	230	-
	Lead	1100	-
	Mercury (inorganic)	NC	1
	Nickel	300	-
	Zinc	850	-
	Manganese	NC	-
OCP	DDT	180	-
PAH	Naphthalene	170	-

Notes to Table 8b:
NC - No Criteria

Table 8c: Remediation Acceptance Criteria (ESL) for the Upper 3 m of Soil (mg/kg)

Analyte		ESL	Comments
TRH	$C_6 – C_{10}$ (less BTEX) [F1]	180*	All ESLs are low reliability apart from those marked with * which are moderate reliability
	$>C_{10}-C_{16}$ (less Naphthalene) [F2]	120*	
	$>C_{16}-C_{34}$ (F3)	300	
	$>C_{34}-C_{40}$ (F4)	2800	
BTEX	Benzene	50	
	Toluene	85	
	Ethyl Benzene	70	
	Xylenes	105	
PAH	B(a)P	0.7	

Table 8d: Remediation Acceptance Criteria (Management Limits) for the Upper 3 m of Soil (mg/kg)

Analyte		Management Limit
TRH	$C_6 - C_{10}$ (F1)	700
	$>C_{10}-C_{16}$ (F2)	1000
	$>C_{16}-C_{34}$ (F3)	2500
	$>C_{34}-C_{40}$ (F4)	10,000

Notes to Table 8d:

Separate management limits for BTEX and naphthalene are not available hence these should not be subtracted from the relevant fractions to obtain F1 and F2

Any asbestos-impacted soil to be re-used on site must be validated in accordance with the methods described in DoH (2009) to demonstrate that asbestos is below the relevant criteria as follows:

- Asbestos containing material (ACM) 0.01% w/w;
- Fibrous asbestos and asbestos fines (FA and AF) 0.001% w/w; and
- No visible asbestos for surface soils.

Aesthetic considerations relevant to the upper 3 m of soil at this site with reference to NEPC (2013) include:

- Highly malodorous soils;
- Discoloured chemical deposits or soil staining; and
- The presence of a deep-fill profile of green waste or large quantities of timber waste that could generate hazardous levels of methane.

In order to address aesthetic considerations outlined above, the following RAC for the upper 3 m of soil will be applied:

- No malodorous soils;
- No significant discoloured chemical deposits or soil staining;
- A significant reduction in organic matter (approximately ≥70%); and
- Anthropogenic materials ≤ 5%.

The RAC for anthropogenic materials of ≤ 5% and for a 'significant reduction in organic matter' for the lower 1.4 m of the 3 m thick engineered cap are provisional. The refinement of these RAC should be based on initial testing results of screened site-won material.

Tolerances for the thickness of the 1.6 m thick VENM layer, the overall thickness of the 3.0 m thick 'engineered fill' blanket, and the top level of the 3.0 m thick blanket are as follows:

- Thickness of the VENM layer (nominally 1.6m) is not less than 1.50 m except in localised areas of construction (see below);
- The overall thickness of the 'engineered fill' blanket (nominally 3.0 m) is generally not less than 2.50 m in housing lots, or 2.30 m locally where construction of the houses takes place (noting that during slab construction up to 0.5 m (0.7 m where a gravel blanket is to be placed) of the

engineering fill may need to be stripped locally to form the final building platforms (see Sections 6.4, 7.2 and 7.4 of J&K (2017) and JMD drawing in Appendix B);

- The overall thickness of the 'engineered fill' blanket is not less than 1.0 m where the main sewer is to be installed (see Sydney Water Drawing at Appendix B); and
- The elevation of the top level of the 'engineered fill' blanket is within ± 100 mm of the design level except as noted above.

These tolerances may be subject to relative change depending on the progress of earthworks which may involve an increase to the thickness of the VENM layer and a proportional decrease to the thickness of site-won material incorporated into the cap.

15.2 Remediation Acceptance Criteria – Soil Quality below 3 m

For soils below the proposed 3 m thick 'engineered fill' blanket, no soil chemical criteria or asbestos criteria would apply for exposure pathways involving ingestion, dermal contact and dust inhalation because future land use at the site would be subject to compliance with a long-term EMP, which will prevent disturbance to soils below the 3 m blanket layer and the extraction of groundwater.

For other exposure pathways, soils below the proposed 3 m thick 'engineered fill' blanket must meet the following soil chemical criteria:

- VOC concentrations in soil are below the NEPM (2013) soil vapour criteria;
- Soils do not produce leachate that pose a hazard to the environment (as required by NSW EPA (2007) groundwater guidelines and Sections 10.2 and 10.3 of the NSW EPA (2016) Solid Waste Landfill Guidelines); and
- The investigation and validation data satisfy Data Quality Objectives (DQOs) meeting NSW EPA endorsed guidelines.

If any of these criteria are exceeded, then remedial measures must be implemented to eliminate hazards to health and the environment.

In relation to the VOC issue, the dataset for soil at the site indicates that volatile fraction TRH is not a ubiquitous characteristic of the fill. Moreover, landfill gas mitigation systems are proposed that would also, to some degree, minimise risks from any deep VOC contamination that may be present, accordingly it is unlikely that this issue will require soil removal off site. On this basis, and subject to validation of the soil beneath the diesel AST, this issue is not considered further.

For screened soils i.e. those being returned as fill following bulk excavations and screening during works at the two trial excavation areas a maximum organic content of 10% soil organic matter (SOM) should apply for the purposes of reducing the potential for the materials to generate methane. Without excavation the SOM in other areas cannot be quantified or amended.

15.3 Landfill Gas

The RAC for landfill gas mitigation is to limit the migration of landfill gas into the structures (e.g. residential dwellings) such that no unacceptable risk is posed to future site users. It is pointed out that further remediation work at the site will require ongoing monitoring and in this regard, ongoing development and refinement of the landfill gas RAC designed on the basis of the HGG risk assessment process recommended in NSW EPA (2012).

Adopted RAC provided in NSW EPA endorsed guidelines, which comprise the following:

- NSW EPA (2016) Environmental Guidelines: Solid Waste Landfills [Second Edition 2016] (note: this guideline is not listed as being made or endorsed under S.105 of the CLMA);
- NSW EPA (2012) Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases;
- BSI 8485 (2015) Code of Practice for Design of Protective Measures for Ground Gases (note: this guideline is not listed as being made or endorsed under S.105 of the CLMA);
- CIRIA (2007) C665 Assessing Risks Posed by Hazardous Ground Gases to Buildings;
- CIRIA (2014) C735 Good Practice on the Testing and Verification of Protection Systems for Buildings against Hazardous Ground Gases (note: this guideline is not listed as being made or endorsed under S.105 of the CLMA); and
- Relevant Australian Standards (note: AS are not listed as being made or endorsed under S.105 of the CLMA).

Meeting the RAC will be achieved by validation of the CQA of relevant measure(s) or system element(s) required to achieve a score consistent with what is required based on the CGS of 3. The landfill gas management approach adopted by the NSW EPA (2012) guidelines was based on British Standard BS 8485:2007, which was superseded by the 2015 version. BS 8495:2015 resulted in some changes to the required gas protection guidance values and scoring system for protection measures that were provided in Tables 7 and 8 of the NSW EPA (2012) guideline. These differences are illustrated below in Tables 9a and 9b (Tables 7 and 8 extracted from NSW EPA (2012) and Tables 9c to 9f (Tables 4 to 7 from BS 8485:2015).

Relevant measure(s) or system element(s) that could be considered and the corresponding point scores from NSW EPA (2012) and BS 8485:2015 as reproduced in Tables 9a to 9f below. The landfill gas mitigation measures adopted for this site must be based on the most conservative outcome provided by the NSW EPA (2012) guideline and BS 8485:2015.

Table 9a: Guidance Values for Gas Protection (NSW EPA, 2012)

Characteristic gas situation (CS)	Required gas protection guidance value				
	Low density residential	Medium–high density residential (strata title)	Public buildings, schools, hospitals, shopping centres	Standard commercial buildings (offices, etc.)	Large commercial (warehousing) and industrial buildings
1	0	0	0	0	0
2	3	3	3	2	1 (a)
3	4	3	3	2	2
4	6 (b)	5 (b)	5	4	3
5	6 (b)	6 (b)	6 (c)	5	4
6	6 (b)	6 (b)	6 (c)	6	6

(a) If maximum measured methane concentration exceeds 20%, increase to CS3.
(b) Residential development not recommended at CS4 and above without pathway intervention and high level of management.
(c) Consideration of evacuation issues and social risks required.

Table 9b: Scores for Protection Measures (NSW EPA, 2012)

Measure or system element	Score	Comments
Venting and dilution measures		
Passive sub-floor ventilation with very good performance (steady state concentration of methane over 100% of ventilation layer remains below 1% v/v at a wind speed of 0.3 m/s)	2.5	
Passive sub-floor ventilation with good performance (steady state concentration of methane over 100% of ventilation layer remains below 1% v/v at a wind speed of 1 m/s and below 2.5% v/v at a wind speed of 0.3 m/s)	1	If passive ventilation cannot meet this requirement an active system will be required.
Subfloor ventilation with active abstraction or pressurisation	2.5	Robust management systems must be in place to ensure long-term operation and maintenance.
Ventilated car park (basement or undercroft)	4	Assumes that car park is vented to deal with exhaust fumes in accordance with BCA[a] requirements.
Floor slabs		
Reinforced concrete ground bearing floor slab	0.5	It is good practice to install ventilation in all foundation systems to effect pressure relief as a minimum. Breaches in floor slabs, such as joints, have to be effectively sealed against gas ingress to maintain these performances.
Reinforced concrete ground bearing foundation raft with limited service penetrations cast into slab	1	
Reinforced concrete cast in situ or post-tensioned suspended slab with minimal service penetrations and water bars around all penetrations and at joints	1.5	
Fully tanked basement	2	
Membranes		
Taped and sealed membrane to reasonable levels of workmanship with inspection and validation	0.5	The performance of membranes is dependent upon the design and quality of the installation, protection from and resistance to damage post installation and the integrity of joints in membranes that require joints. Materials that offer some degree of self-sealing and repair are preferred.
Proprietary gas-resistant membrane to reasonable levels of workmanship under independent construction quality assurance (CQA)	1	
Proprietary gas resistant membrane to reasonable levels of workmanship under independent CQA with integrity testing and independent validation	2	
Monitoring and detection (alarms)		
Intermittent monitoring using hand-held equipment	0.5	Monitoring and alarm systems are only valid as part of a combined gas protection system. Where fitted, permanent systems should be installed in the underfloor venting system but can also be provided in the occupied space as a back-up.
Permanent monitoring system installed in the occupied space of the building	1	
Permanent monitoring system installed in the underfloor venting / dilution system	2	
Pathway intervention		
Vertical barriers	–	Required for residential and public buildings at CS4 and above.
Vertical venting systems	–	

[a] Building Code of Australia

Table 9c: Gas Protection Score by CGS and Type of Building (BS 8495:2015)

CS	Minimum gas protection score (points)			
	High risk		Medium risk	Low risk
	Type A building	Type B building	Type C building	Type D building
1	0	0	0	0
2	3.5	3.5	2.5	1.5
3	4.5	4	3	2.5
4	6.5[A)]	5.5[A)]	4.5	3.5
5	—[B)]	6.5[A)]	5.5	4.5
6	—[B)]	—[B)]	7.5	6.5

[A)] Residential buildings should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g. in institutional and/or fully serviced contractual situations.
[B)] The gas hazard is too high for this empirical method to be used to define the gas protection measures.

Table 9d: Gas Protection Scores for the Structural Barrier (BS 8495:2015)

Floor and substructure design (see Annex A)	Score [A)]
Precast suspended segmental subfloor (i.e. beam and block)	0
Cast in situ ground-bearing floor slab (with only nominal mesh reinforcement)	0.5
Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations	1 or 1.5 [B)]
Basement floor and walls conforming to BS 8102:2009, Grade 2 waterproofing [C)]	2
Basement floor and walls conforming to BS 8102:2009, Grade 3 waterproofing [C)]	2.5

[A)] The scores are conditional on breaches of floor slabs, etc., being effectively sealed.
[B)] To achieve a score of 1.5 the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations cast in (see A.2.2.2).
[C)] The score is conditional on the waterproofing not being based on the use of a geosynthetic clay liner waterproofing product (see C.3, Note 4).

Table 9e: Gas Protection Scores for Ventilation Protection Measures (BS 8495:2015)

Protection element/system	Score	Comments
(a) Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building)	0.5	Whenever possible a pressure relief pathway (as a minimum) should be installed in all gas protection measures systems. If the layer has a low permeability and/or is not terminated in a venting trench (or similar), then the score is zero.
(b) Passive sub floor dispersal layer: Very good performance: Good performance: Media used to provide the dispersal layer are: • Clear void • Polystyrene void former blanket • Geocomposite void former blanket • No-fines gravel layer with gas drains • No-fines gravel layer	 2.5 1.5	Performance criteria for methane and carbon dioxide are shown in Figure B.6 and Figure B.7, respectively. The ventilation effectiveness of different media depends on a number of different factors including the transmissivity of the medium, the width of the building, the side ventilation spacing and type and the thickness of the layer. The selected score should be assigned taking into account the recommendations in Annex B. Passive ventilation should be designed to meet at least "good performance", see Annex B.
(c) Active dispersal layer, usually comprising fans with active abstraction (suction) from a subfloor dilution layer, with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers	1.5 to 2.5	This system relies on continued serviceability of the pumps, therefore alarm and response systems should be in place. There should be robust management systems in place to ensure the continued maintenance of the system, including pumps and vents. Active ventilation should always be designed to meet at least "good performance", as described in Annex B.
(d) Active positive pressurization by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket	1.5 to 2.5	This system relies on continued operation of the pumps, therefore alarm and response systems should be in place. The score assigned should be based on the efficient "coverage" of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least "good performance".
(e) Ventilated car park (floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park)	4	Assumes that the car park is vented to deal with car exhaust fumes, designed to *Buildings Regulations 2000, Approved Document F* [9].

Table 9f: Gas Protection Scores for the Gas Resistant Membrane (BS 8495:2015)

Protection element/system	Score	Comments
Gas resistant membrane meeting all of the following criteria: • sufficiently impervious to the gases with a methane gas transmission rate <40.0 ml/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method); • sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; • sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floor slab); • sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc); • capable, after installation, of providing a complete barrier to the entry of the relevant gas; and • verified in accordance with CIRIA C735 [N1]	2	The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and integrity of joints. For example, a minimum 0.4 mm thickness (equivalent to 370 g/m² for polyethelene) reinforced membrane (virgin polymer) meets the performance criteria in Table 7 (see C.3). If a membrane is installed that does not meet all the criteria in column 1 then the score is zero.

Specifically, the RAC are:

- The landfill gas mitigation measures are designed for a CGS of 3 (possibly revised to CGS 2 pending further validation monitoring) and a gas protection score of 4.5 (possibly revised to a lower required score pending further validation monitoring), as defined by the NSW EPA (2012) and subsequently BS8485:2015;
- Sources of excessive methane gas should be removed to the extent practicable in order to minimise the explosive / health risks, reduce the period that elevated methane concentrations remain at the site, minimise future land use restrictions, and reduce future greenhouse gas emissions to the extent practicable. The data provided in the DP (2016) DSI indicated that prior to the trial excavation in 2015 – 2016, most areas of the site measured peak methane concentrations <10% v/v. The main area of exceedance corresponded to the trial excavation area. The maximum allowable methane levels within the site will be < 10% methane v/v averaged across the site and < 25% methane v/v in any single monitoring location;
- A surface emission criterion of 0.05% v/v methane measured at the end of the Stage 2 work and at any stage during subsequent monitoring. The criteria corresponds to the NSW EPA surface emission criterion given in Sections 5.2 and 10.2 of the NSW EPA (2016) and Section 3.6.2 of EPA (2012);
- Subsurface landfill gas should continue to be monitored at the site during construction and the results provided in the site validation report o be agreed by the Site Auditor;
- The Construction Quality Assurance Plan and Construction Quality Assurance Report for the landfill gas mitigation measures is prepared in accordance with Section 11 of NSW EPA (2016), BS8485:2015, CIRIA (2014) C735 and relevant Australian Standards, with the intention that peak methane levels within buildings and structures constructed at the site remain at levels of < 1% v/v, as recommended in Section 5.4 of the NSW EPA (2016).

The preferred remediation strategy for landfill gas requires that only passive gas management measures, as defined by the NSW EPA (2012) guideline, should be used in order that a Section A SAS can be issued at the end of the Stage 3 construction work.

The detailed design of the landfill gas mitigation measures should be reviewed, approved, and documented by the Site Auditor in a Section B SAS submitted to the Planning Authority prior to the commencement of Stage 3 and prior to the issuing of a Construction Certificate for the proposed housing at the site.

15.4 Groundwater and Surface Water

Groundwater and surface water data collected to date suggests that some contaminants likely to be from filling have migrated into groundwater. Further investigations are proposed to evaluate both the surface water quality (and current trends compared with earlier water quality results) and the leachability of fill soils using a neutral leach test. Notwithstanding current dredge pond monitoring results provided by Benedict suggest that water quality in the pond (future marina) has improved since the cessation of dredging.

The trial remediation excavation (refer to Section 10.3) and validation of the screening process has removed a significant component of material from the waste mass that has been and would have continued to contribute to the groundwater contaminant mass loading over time. It is proposed that neutral leach tests of screened soils are undertaken prior to their backfilling in order to assess the longer term risks posed to groundwater and adjacent surface water bodies from site-won filling.

A surface water and contingency groundwater monitoring programme will be undertaken for the duration of remediation work. The data will be used to assess contaminant concentration trends and whether further action is required as outlined in DP (2017b). All monitoring reports would be reported separately to those aspects of site remediation and validation related to soil and landfill gas in order to compartmentalise the reporting on the various site issues. Further details are provided in Section 16.1.8.

Relevant environmental values that the local community and the NSW EPA have adopted for the Georges River[3] include a healthy aquatic ecology, safe swimming, water looking pleasant and clean, unpolluted water to ensure the long-term viability of ecosystems and a diversity of habitats for native plants and animals. These environmental values are to be adopted as RAC.

15.5 Remediation Acceptance Criteria – Geotechnical

Geotechnical RAC are specified by J&K (2016b; 2017) (Appendix I). The J&K (2016b) report indicates the following geotechnical RAC for the geotechnical operations required on the site:

(i) Proof-roll the base of the proposed 'backfill' areas in accordance with the criteria indicated in AS2798 (Section 5.5: Test Rolling);

(ii) 'Backfill' to be carried out as follows:

[3] As described at http://www.environment.nsw.gov.au/ieo/GeorgesRiver/report-01.htm#P49_7497

- The excavated material can be used as backfill subject to approval by the geotechnical engineer prior to, and on completion of, sorting to remove deleterious matter and to remove particle sizes greater than 75mm. The approved material can then be placed in layers not greater than 200mm loose thickness and compacted to a density between 95% and 97% of SMDD. If clayey materials are used, the compacted moisture content should be within 2% of SOMC. Compaction may be carried out in thicker layers using larger particle sizes, subject to confirmation that the required density can be achieved through the full layer thickness. Over compaction should be avoided as this would result in too much of a contrast between the 'existing fill' and the 'backfill' with associated large differential settlements over short horizontal distances. Similarly, under-compaction is undesirable as the creep settlement within the 'backfill' will increase and may also result in larger differential settlements.
- Particular care is required to achieve edge compaction where access for rollers is difficult. Benching the sides of the excavation will facilitate edge compaction.
- The backfill must be subjected to Level 1 testing, carried out at the frequency indicated in AS32798 for the volume of fill involved. The Geotechnical Consultant should be engaged directly on behalf of the client and not as part of the earthworks contractor.

(iii) High Energy Impact Compaction (HEIC) acceptance criteria, based on initial field trials:

- Settlement: average compaction settlement must meet the specification set by the Geotechnical Engineer.
- Uniformity: Soil response based on Continuous Impact Response technology (medium or better).

(iv) 'Engineered Fill' to be carried out as follows:

- The site should be backfilled using select material to achieve the design surface grades, with an 'engineered fill' blanket being no less than 3 m thick. The 'engineered fill' should comprise a well graded granular material (such as ripped or crushed sandstone), which is free of deleterious substances, and has a maximum particle size of 75 mm.
- The fill should be compacted in layers of not greater than 200mm loose thickness, to a minimum density of 98% SMDD. Compaction may be carried out in thicker layers using larger particle sizes, subject to confirmation that the required density can be achieved through the full layer thickness.
- Level 1 density testing should be carried out at the frequency indicated in AS3798 to confirm that the above specifications have been achieved. Preferably the Geotechnical Technical Authority should be engaged directly on behalf of the client and not as part of the earthworks contract.

Further geotechnical RAC are provided in Section 7.2 of J&K (2017).

Relevant to the landfill gas mitigation infrastructure, which may include sub-slab membranes, is the predicted differential settlement. The predicted long-term differential settlements, possibly including circumstances where higher than predicted settlements occur, will need to be accommodated by the detailed design of all gas mitigation measure(s) and system element(s).

15.6 Modifications to Remediation Acceptance Criteria

Modifications to the RAC proposed by the Environmental Consultant and/or Geotechnical Consultant during the course of the project as a result of ongoing monitoring data and/or verification data or final design elements must meet NSW EPA endorsed guidelines and be approved in writing by the Site Auditor prior to the commencement of work that relies on the use of the criteria.

16. Sequence of Remediation

16.1 Preliminary Work

16.1.1 Overview

Approval for remediation earthworks is set out in the development application issued to the Department of Planning and Environment (DPE) as per the request for the Secretary's Environmental Assessment Requirements (SEARs) for the preparation of an EIS. The SEARs letter (SEAR No. 1102) dated 16 November 2016 provides the requirements for the preparation of an EIS. Specially in relation to the RAP the SEARs letter sets out various requirements (see the FMP in Appendix J), including details of the remediation works and details of the types of materials to be received at the site as capping (FMP).

The SEARs letter indicates that the proposed development falls within both the designated and integrated development categories and seeks staged approval of works including contaminated soil treatment works. NSW EPA provided input to the SEARs letter following consultation with DPE.

NSW EPA's main issues were:

- Suitability of the proposed RAP;
- Impacts on water quality and site water management;
- Waste management and disposal;
- Impacts on air quality and any potential odour emissions; and
- Potential noise impacts.

The responsibility for obtaining necessary licenses, permits and approvals and determining the detailed procedures for and sequence of the remediation work will rest with the Contractor and will depend upon the equipment to be used and the overall sequence of the development. Such issues will be dealt with by the EIS. The EIS will be required as part of the DA to be lodged within two years of the issue date of the SEARs letter,

It is the Contractor's responsibility to devise a safe work method statement and to implement proper controls that enable the personnel undertaking the remediation to work in a safe environment. This RAP does not relieve the Contractor or other contractors of their ultimate responsibility for work health and safety of their workforce and to prevent contamination of areas outside the 'remediation' workspace. This RAP sets out general procedures and the minimum standards and guidelines for remediation that will need to be used in preparing the safe work method statement.

All of the above documentation to be prepared by the Contractor must be provided as sets of work procedures that are to be provided to the Environmental Consultant and Site Auditor for their review. Site works should not commence until written approvals of these procedures have been provided by both of the above parties. The required documentation should also include a detailed staging plan for the earthworks to be developed by the remediation contractor to be submitted to the Environmental Consultant for review and approval prior to the commencement of remedial earthworks. A copy of plan should also be provided to the Site Auditor so that milestones can be identified and to enable the Site Auditor to programme and undertake site inspections.

All remedial works will comply with all legislative requirements including, but not limited to, those set out under the following Acts (and their subsequent amendments and regulations):

- Environmentally Hazardous Chemicals Act, 1985;
- Hazardous Chemicals Act, 1985;
- Environmental Offences and Penalties Act, 1989;
- Agricultural and Veterinary Chemicals Act, 1994;
- Protection of the Environment Operations Act, 1997 (POEO Act);
- Contaminated Land Management Act, 1997 (CLM Act);
- Pesticide Act, 1999;
- Work Health and Safety Act, 2011 (WHS Act);
- OHS Amendment (Dangerous Goods) Act, 2003 (including OHS Amendment (Dangerous Goods) Regulation 2005); and
- POEO Amendment Act, 2005 (including POEO Amendment (Scheduled Activities and Waste) Regulation 2008).

Prior to the commencement of site remediation (i.e. bulk earthworks) an inception meeting should be held with the Developer, Remediation Contractor, Builder, Environmental Consultant and Site Auditor. The inception meeting should cover, amongst other things, the requirements of this RAP and the roles and responsibilities of the relevant parties.

In summary the various parties are defined as follows along with their roles and responsibilities:

- The Principal, responsibility to ensure appropriate personnel are appointed to manage and conduct the remediation and validation works;
- Principal's Representative, who is responsible for overseeing the implementation of this RAP;
- Remediation Contractor, who will be responsible for conducting the remediation works and managing the site;
- Environmental Consultant, who will be responsible for providing advice as required for the remediation works and undertaking the validation works in accordance with this RAP;
- Geotechnical Consultant, who will be responsible for providing advice as required related to geotechnical aspects of the remediation works and undertaken validation works in accordance with this RAP; and if necessary; and
- Occupational Hygienist, who will be responsible for asbestos issues including air monitoring.

The Remediation Contractor will be responsible for preparing a list of contacts, including emergency contacts for the site operations and provision of signage at the site to allow the public to contact nominated site personnel out of hours.

Prior to the commencement of site remediation works, the following interim controls will be in place:

- The construction of permanent fences around the subject area meeting appropriate specifications to prevent unauthorised entry; and
- Any pits or unstable areas on site that may generate potential WHS or operational risk will be demarcated and taped off, with appropriate rectification action undertaken (e.g. backfilling of pits as soon as practicable to prevent undue injuries to workers etc.).

A hazardous building materials assessment of buildings / structures remaining at the site, such as the cottage at the north-eastern corner, should be undertaken. The assessment should be undertaken so that these materials can be removed and disposed prior to demolition and not represent a new contamination risk.

Following demolition of any remaining buildings by a licensed contractor and disposal off-site of all demolition waste in accordance with regulatory guidelines, the footprint of each former building area should also be investigated and validated prior to the commencement of major earthworks in the area, to show that no contamination associated with the building / demolition work remains on site prior to capping with VENM as per the FMP and geotechnical RAC. Validation will involve surface sampling of the building footprints and surrounding buffer areas (25 m width in all directions) using densities compliant with the NSW EPA (1995) (Table A).

All relevant tip dockets for off-site disposal of demolition wastes would be provided in the site validation report.

Buried services that are currently present that will need to be removed should also be identified and any hazardous materials disposed off-site.

The major site remediation activities will occur in three distinct stages being:

- Stage 1: Site Preparation Earthworks;
  - Stage 1a: Areas Requiring Deep Excavation;
  - Stage 1b: General Site Preparation Earthworks;
- Stage 2: VENM Capping; and
- Stage 3: Installation of Landfill Gas Mitigations.

16.1.2 Preliminary Work – Duty to Report

Section 60 of the CLM Act places obligation on owners of land and other people to notify the NSW EPA of contamination at a site. Based on the soil, groundwater and landfill gas contamination at this site and, in particular, the off-site migration of contaminated groundwater, there is a duty to report contamination present at the site to the NSW EPA.

DP understands from the client that the NSW EPA has been consulted under the SEARS process.

16.1.3 Regulatory Approvals and Licenses

All relevant regulatory approvals and licenses required to be obtained by the remediation and development work are to be obtained by the site owner prior to the commencement of site work. This includes that the proposed remediation strategy represents Category 1 work under the SEPP 55 guidelines.

Environmental Protection Licenses (EPLs) that currently apply to the site include, but may not be limited to:

- EPL 4612 for land-based extractive activity, crushing, grinding, or separating, water- based extractive activity; and
- EPL 10490 for the recovery of general waste, recovery of waste tyres, waste storage – other types of waste, waste storage – waste tyres.

DP understands from Benedict that these EPLs will be maintained for the duration of the cap construction, and other aspects of site remediation, and that they permit their importation of VENM. In this regard further EPLs are not considered likely to be required, as may otherwise be required under Schedule 3 in Part 1 of The Environmental Planning and Assessment Regulation 2000.

16.1.4 Remediation Excavation Trial Reporting

Current reports on the remediation trial excavations are included in Appendix H. Validation monitoring for landfill gas in the footprint of the trial excavations is proposed under the DP (2017b) SAQP.

16.1.5 Detailed Design of Landfill Gas Mitigation Measures

Landfill gas mitigation measures must be designed to meet the minimum requirements specified in NSW EPA (2012), BS 8485:2015, CIRIA (2014) C735 and relevant Australian Standards.

These minimum requirements include but not be limited to (as per Section 4, BS 8485:2015):

- The protection provided will:
  - prevent ground gas entering buildings;
  - avoid the build-up of hazardous gas beneath buildings or in subsurface infrastructure (e.g. inspection chambers and service runs);
  - avoid the build-up of hazardous ground gas within buildings;
  - demonstrate compliance by monitoring prior to occupation or use, implementing management measures, and by including site-wide measures designed to reduce the gas hazard beneath the building.
- The measures used will be:
  - effective: in that they do what they are intended to do;
  - robust: in that they are not easily compromised, particularly during construction;
  - durable: in that they will remain effective for the required design life of the development; and

  - buildable: in that they can be built given an appropriate standard of workmanship, supervision and verification.
- The effectiveness of the measures will be assessed in terms of the:
  - theoretical effectiveness assuming proper installation; and
  - practical effectiveness (i.e. what it is reasonable to expect to achieve under normal conditions); and
  - long-term effectiveness given the likely durability of materials, etc.
- Extreme events (e.g. exceptional changes in atmospheric pressure, rapid groundwater rise and/or flooding) will be taken into account when defining the Characteristic Gas Situation (CGS) and when selecting/constructing the protective measures.
- The protective measures will include the use of materials that have a defined design life or no known critical time deterioration properties, and will be placed where they might reasonably be expected to continue to perform for the life of a building, that might be in excess of 100 years.

The detailed design is yet to occur, however, the following points provide a guide for the detailed design:

- The private residential buildings to be constructed at the site correspond to Building Type A in Table 3 of BS 8485:2015;
- Only passive mitigation measures, as defined by NSW EPA endorsed guidelines will be used;
- The landfill gas mitigation measures will be designed to meet the standard required by Gas Protection Score 4.5, as derived by Table 4 in BS 8485:2015 for a CGS of 3 and a Building Type of A;
- The design of the measure(s) or system element(s) for the residential development (houses) should include the following general components (subject to actual detailed design) from top down:
  - Concrete Slab;
  - Protective Geotextile;
  - Gas proof membrane appropriately sealed around seams, detailing and penetrations;
  - Cushion geotextile;
  - 100 mm crushed gravel screenings (nominal >20 mm, no fines) with geo-vent collection strips; and
  - Anti-silting geotextile.
- Installation of the venting and gas proof membranes should be undertaken by an experienced Contractor with a track record of installation of gas barriers. The CQA testing should also be undertaken and documented by the installation Contractor or a third party. The documentation should be reviewed by the Environmental Consultant. The Environmental Consultant will validate each stage of the landfill gas mitigation work at each structure and this will comprise a hold point requiring the Site Auditor to inspect a statistically significant number of landfill gas mitigation measures during their installation before further installations are completed. In this regard batches of 2-3 may be validated and inspected initially with this number increasing say 10 per batch as the parties become more familiar with the construction and validation requirements.

Specific elements of the design should give consideration to the following:

- The concrete slab is the structural barrier in the landfill gas mitigation system and will correspond to the "Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab and will be well reinforced to control cracking and have minimal penetrations cast" as specified in Table 5 of BS 8485:2015. The structural barrier will be designed to have a gas protection score of 1.5. When practical, utilities should enter the building above floor level with any conduit or meter housing being properly vented outside of the building;
- The crushed gravel screening layer is the ventilation protection measure in the landfill gas mitigation system and will correspond to the "Passive sub floor dispersal layer with good performance consisting of a non-fines gravel layer with gas drains" as specified in Table 5 of BS 8485:2015. The ventilation protection measure will be designed to have a Gas Protection Score of 1.5;
- The ventilation protection measure would be a 100 mm thick gravel layer with geo-vent collection strips. This design needs to be improved to meet BS 8485:2015. Section B.10 of BS 8485:2015 requires, among other things, that the gravel layer should be at least 200 mm thick, the geocomposite strips should be 1 m wide and at least 12.5 mm thick, and the drains should be at a spacing of not more than 3 m. The drain network should be designed to cause external air to flow though all parts of blanket and not to short circuit between vent points on opposite sides of the building; this is achieved by having interleaved networks of pipes connected to opposite sides of the building, as illustrated in Figure B.12 of BS 8485:2015. The networks should be as symmetrical as possible. Side vents should normally be provided at no more than 10 000 mm centres and have an area equivalent to 1 500 mm2/m run of wall on at least two opposite sides;
- The gas proof membrane in the landfill gas mitigation system will meet the criteria specified in Table 7 of BS 8485:2015 and have a Gas Protection Score of 2.0;
- The risk assessment and all design decisions will be documented and recorded in a design phase report, which should be prepared by competent Environmental, Geotechnical and Structural Engineering Consultants. For the purpose of the RAP, the design phase report has been termed the Landfill Gas Mitigation System Design Report;
- The design phase report shall be prepared in accordance with the minimum requirements specified in Section 8 of BS 8485:2015 and relevant Australian Standards; and
- The design phase report shall be provided to the Site Auditor for review and a written approval provided by the Site Auditor, prior to the commencement of Stage 3 works.

The design can be modified as new landfill gas validation monitoring data becomes available.

The design report will specify the minimum requirements for the installation and verification of the landfill gas mitigation measures. The actual procedures to be used at the site shall be documented in an Installation and Verification Plan prepared by the Contractor and which needs to be reviewed and approved in writing by the Environmental Consultant and by the Site Auditor prior to the commencement of Stage 3 works.

One aspect of the landfill gas mitigation that requires consideration is the lateral (southwards) movement of gas to the proposed marina development. A measure currently proposed under the DA that could mitigate this is the retaining wall along the interface of proposed Lot 2 and Lot 3 (being the boundary of the gas generating land and the marina development). The wall is to be constructed of

stacked sandstone rock and will be designed to allow for any laterally moving gas to be vented vertically along the void spaces in the wall to atmosphere.

16.1.6 Clearance of Suspect Areas

The AST fuel storage facility, drum storage areas, the footprints of buildings that contained asbestos following their demolition, the weighbridge, and previously inaccessible areas (i.e. beneath existing stockpiles) are to be subject to soil validation testing in order to meet the EPA (1995) Sampling Design Guidelines recommended sampling density.

Any contamination found as a result of the validation sampling would be remediated as part of the Stage 1 work. A report documenting the results of these investigations should be prepared by the Environmental Consultant in accordance with NSW EPA endorsed guidelines. A copy of the report shall be provided to and approved by the Site Auditor, ideally, prior to the commencement of Stage 2 work.

16.1.7 Acid Sulfate Soil Investigation

Any areas of the site requiring further deep excavations that will disturb potential acid sulfate soil (PASS) will require an acid sulfate soil (ASS) investigation. We understand from Benedict that no further deep excavations are proposed.

16.1.8 Validation Landfill Gas and Surface Water Monitoring Programme

In order to arrive at a final site validation endpoint, the following key monitoring programmes are required to be undertaken throughout the duration of the site remediation programme:

- Landfill gas monitoring in order to:
  - Confirm the current CGS for the site and evaluate whether a reduction to a CGS of 2 may be applicable;
  - Evaluate whether the current remediation trial excavation (refer to Section 10.3) has resulted in a reduction in landfill gas in this area of the site which may potentially lessen the overall CGS for the site (currently CGS 3). Monitoring will need to account for the time required for the backfill to reach anaerobic (highest methane producing) conditions;
- Surface water (and contingency groundwater) monitoring in order to:
  - Establish concentration trends of key contaminants at the points of compliance (i.e. adjacent surface water bodies) (e.g. using Mann-Kendall trend analysis);
  - Confirm whether monitoring needs to be up-scaled to include groundwater monitoring;
  - Confirm whether site specific trigger levels need to be developed and/or an ecological risk assessment (considered unlikely) is required;
  - Confirm whether remediation of groundwater and/or surface water (considered highly unlikely) is required. Remediation options could involve the following:
    - Selective source removal;
    - A long term MNA programme to demonstrate a continued decrease in key contaminants emanating for the site;

- Installation of an impermeable barrier wall to prevent the flow of contaminant-impacted groundwater to the point(s) of compliance (i.e. adjacent surface water bodies); or
- Installation of a permeable reactive barrier wall to treat contaminant-impacted groundwater prior to its discharge to the point(s) of compliance (i.e. adjacent surface water bodies).

The landfill gas and groundwater / surface water monitoring programmes and associated reports will form part of the final site validation report. The primary constraint to the collection of data for these monitoring programmes at the current time is the activities on site which limit the ability to install and maintain monitoring points for the respective media.

16.1.9 Preliminary Long Term Environmental Management Plan

The proposed remediation strategy involves the long-term (post construction) management of contamination that will remain buried at the site. Protocols for the ongoing passive management of this residual contamination will be documented in a Long Term Environmental Management Plan (LTEMP). No ongoing monitoring or active management is envisaged as part of the LTEMP.

Notwithstanding the LTEMP is an important part of the remediation strategy because it will, among other things, advise future property owners:

- That contamination remains at the site and includes landfill gas and buried wastes;
- The long term ownership of the contamination;
- The restrictions that the contamination will place on the future use of the land;
- The level of responsibility that future residential and other types of property owners will have for adhering to the LTEMP;
- The tasks that will need to be undertaken as part of the long term management of residual contamination at the site;
- How the LTEMP will be made legally enforceable by Council including the implementation of the EMP through planning instruments;
- Reporting protocols and requirements;
- A mechanism for progressive improvement and monitoring of compliance with the EMP;
- Compliance auditing of LTEMP implementation;
- The end points that would need to be achieved before the LTEMP could be terminated;
- Contingency measures ; and
- Triggers for defining when contingency measures would need to be implemented.

It is envisaged that a single LTEMP will be prepared for the site as opposed to several EMPs covering different parts of the site.

A preliminary free standing version of the LTEMP will be prepared by the Environmental Consultant, reviewed by the Site Auditor and approved in writing by Liverpool City Council prior to the commencement of Stage 1 works or DA for the first group of houses. This will allow issues of concern to stakeholders to be flagged and addressed prior to the commencement of site work.

The preliminary version of the LTEMP (one document for the entire stie) shall be prepared in accordance with NSW EPA endorsed guidelines. The Environmental Consultant is to notify the Site Auditor during the remediation work of any significant changes that may need to be made to the preliminary version of the LTEMP. The Site Auditor would review any such proposed changes and advise Council of their acceptability.

A final version of the LTEMP will be prepared by the Environmental Consultant as part of the Stage 3 validation report (Section 19.3).

16.1.10 Supplementary Geotechnical Assessments

Geotechnical assessments, as described below, that need to be completed prior to the commencement of Stage 1 work include, but may not be limited to:

- Imported VENM geotechnical requirements (see FMP at Appendix J);
- HEIC specification (see J&K (2017)); and
- Up-dated settlement analysis (refer to Appendix I, J&K, 2017).

A geotechnical procedure needs to be in place for imported VENM to be used for construction of the upper 1.6 m layer of the Stage 2 cap. This is a requirement of Sections 1 and 4.2 of the "Fill Management Protocol for Imported VENM Cap Construction" given in Appendix J of the RAP.

A specification should be prepared for HEIC as per Section 7.2 of J&K (2017). The specification should include, among other things:

- A definition of deleterious subgrade conditions that would require the removal, replacement and/or treatment of soils;
- Requirements for ongoing levelling, survey and possible testing for the HEIC as per J&K (2017); and
- Acceptance criteria that need to be met by the compacted subgrade surface.

The specification should be submitted to and approved by the Environmental Consultant and the Site Auditor prior to the commencement of Stage 1 work.

Up-dated settlement analyses have been provided in J&K (2017), included in Appendix I.

The Supplementary Geotechnical Assessments should be prepared by the Geotechnical Engineer in accordance with relevant Australian Standards. The report should be provided to and approved by the Site Auditor prior to the commencement of Stage 1 work.

16.2 Stage 1: Site Preparation Earthworks

16.2.1 Removal and/or Replacement of Existing Buried Services

The Contractor is to obtain information from the site owner on all known and suspected buried services remaining at the site and to undertake a dial-before-you-dig (DBYD) buried service check. It is understood from Benedict that minimal (if any) buried services are present at the site.

Notwithstanding, where existing services are present, the following should occur in relation to their decommissioning or retention:

- All abandoned buried services at the site must be removed and all asbestos and other waste material disposed off-site to suitably licensed waste facilities;
- The location of all active services that remain at the site should be clearly identified and measures implemented to protect workers and the integrity of these services in accordance with regulatory requirements;
- Active services that are to remain on-site should be accurately located and shown on survey plans, which are to be included in the long term EMP; and
- Active services that are to be replaced as part of development work should be replaced as part of the Stage 1 work and be completed prior to the commencement of Stage 2 work.

The Environmental Consultant should inspect the work associated with the removal and/or replacement of existing buried services at the site and provide documentation in the Stages 1 & 2 validation work that will allow the Site Auditor to conclude that this work was completed in accordance with NSW EPA guidelines and regulatory requirements.

The Contractor shall backfill trenches used to remove buried services in accordance with the geotechnical requirements for constructing the 3m thick 'engineered fill' blanket.

All existing buried services shall be removed from an area, validated by the Environmental Consultant and backfilled in accordance with the geotechnical requirements prior to the commencement of construction of the 3 m thick 'engineered fill' blanket.

16.2.2 Winning On-site Material for Backfill and Cap Construction

16.2.2.1 Requirements for On-Site Materials

The following items need to be completed at the start of the Stage 1 works:

- Backfilling any excavated 'hotspots' (we note that the PCB 'hotspot' may not be able to be identified due to recent near surface earthworks associated with stockpile management);
- Levelling out the site to achieve design subgrade levels on which the 3 m thick 'engineered fill' blanket is to be constructed;
- Backfilling service trenches; and
- Constructing the 1.4 m thick lower layer of the 3 m thick 'engineered fill' blanket.

The on-site materials to be beneficially reused will require treatment in the form of inspection, selective excavation, hand picking, screening and/or validation testing. The level of treatment required will depend on the type of material excavated, the type and extent of contamination present, and how the treated material will be reused.

Material to be used as backfill below the base of the 3 m thick 'engineered fill' blanket will need to be validated to meet the 'Soil Below 3 m' criteria (Section 15.2) and the Geotechnical criteria (Section 15.5). The sampling frequency and protocols to be used for validating these materials are presented in Section 19.1.2 for hotspots and Section 19.1.3 for other areas.

Material to be used to construct the 1.4 m thick lower layer of the 3 m thick 'engineered fill' blanket will need to be validated to meet the Upper 3 m of Soil criteria (Section 15.1) and the geotechnical criteria (Section 15.5). The sampling frequency and protocols to be used for validating these materials are presented in Section 19.1.1.

The following are to be provided to the Environmental Consultant and the Site Auditor upon completion of filling the 'backfill excavations as per Section 7.6 and 7.2, respectively, of J&K (2017):

- The survey of the lateral extent and depth of 'backfill' excavations; and
- Level 1 density testing of 'backfill' and 'engineered fill'.

16.2.2.2 Testing Regime on Screening Operation

A testing regime was implemented to evaluate the ability of the screening operation to produce graded products meeting the soil RAC, in particular, with respect to the potential for the screening process to generate fibrous asbestos and asbestos fines (FA and AF) due to the presence of fragments of asbestos containing material (ACM) in the fill. In addition, the testing regime was used to formulate RAC for aesthetic parameters in relation to anthropogenic materials of ≤ 5% and for a 'significant reduction in organic matter' (refer to Section 15.1).

The testing regime involved a sampling programme conducted on the stockpiles of screened material that were generated as a result of the larger scale treatment trial remediation excavation. The testing regime comprised the following:

- An initial grid-based survey to determine if visible asbestos contamination is present at the stockpile surface;
- Sampling stockpiles at an initial approximate frequency of one sample per 1000 tonnes (equivalent to approximately one sample per 550 m^3 assuming 1.8 t/m^3). This frequency and the analytes to be tested were subject to review and refinement over time (if required), following an approval from the Site Auditor;
- Analysis of samples for the following contaminants:
    - metals, TRH, BTEX, PAH, OCP, OPP, PCB, phenols and asbestos (10 L sample for ACM and 500 ml sample for FA and AF) as per the RAC in Table 8, and Section 15.1;
- Analysis of samples for the following aesthetic analytes:
    - Anthropogenic material with reference to NSW Roads & Traffic Authority Test Method T276 Foreign Materials Content of Recycled Crushed Concrete; and
    - Organic matter.

A hold point was applied between the results of the initial testing regime and the application of the screening process at other areas of the site discussed below, as determined by the Environmental Consultant, such that:

- Suitable RAC can be derived for anthropogenic materials and organic matter; and
- The testing regime confirms that the screening process is not generating unacceptable levels of FA and AF.

Whilst the initial testing regime was focused on the on the existing stockpiles of screened material that were generated as a result of the larger scale treatment trial remediation excavation (now backfilled), future validation testing will focus only on the screened fill for re-use in the lower 1.4 m of the 3 m thick 'engineered fill' blanket. In this regard, the testing regime comprised an overall 'validation' of the general screening 'processes'.

The results of the testing regime on the screening operations are provided in Appendix H.

16.2.2.3 Additional Areas Requiring Deep Excavation

Based on the results of the larger scale treatment trial remediation excavation (refer to Section 10.3) and which are to be fine-tuned with additional landfill gas investigations, and with due consideration to the overall project earthworks / construction timetable, further areas of the central 'deep fill' portion of the site may be excavated and backfilled in a similar manner to that occurring at the current trial remediation excavation, however, the proponent is unlikely to undertake further excavation due to timing constraints on the future management of contaminated / landfill gas generating fill in-situ (see Figure 6).

The procedure for the Contractor for any areas requiring deep fill excavation should be as follows:

- Excavation of those fill materials that presently comprise a significant contribution to landfill gas, followed by their separation into various product / waste streams;
- Oversize concrete and brick (>120mm) shall be crushed and reused on-site as a coarse fill;
- Screen soils using a mobile mechanical screen and then hand-pick to remove unsuitable materials. The screen fractions should be as per the current trial remediation excavation viz. <16 mm, 16 – 40 mm and 40 – 120 mm;
- Remove timber waste by mechanical means or by hand (depending on size) from the fill as far as is practicable and recycle recovered timber at a Benedict facility that is licenced to take the type of timber that is recovered;
- Remove metal waste from the fill and recycle recovered metal at a metal waste recycler;
- Remove visible ACM from the screen by hand picking and segregate for bagging and disposal. The procedures adopted should comply with the measures specified in 'Managing Asbestos in or on soil' (NSW EPA, 2014) and 'How to safely remove asbestos code of practice, (Safe Work Australia, 2011). For non-friable asbestos (ACM) involving greater than 10 m^2 of fibro sheets or fragments only a Class A or Class B asbestos removal license hold may conduct the asbestos removal work (if uncertain then a licensed removalist should be engaged). All workers involved where greater than 10 m^2 of asbestos is involved must hold current certification. If friable asbestos (FA/AF asbestos) is encountered then only currently licensed Class A asbestos removalists are permitted to conduct asbestos removal or related works. If friable asbestos is present then it is a legal requirement that only a WorkCover Licensed Asbestos Assessor may undertake air monitoring, risk assessments and issue clearance certificates for removal work. The management of asbestos waste will require to meet the requirements of Clause 42 of the POEO (Waste) Regulation (2005), including: (i) storing asbestos waste at the premises in an environmentally safe manner, (ii) keeping non-friable asbestos securely packaged at all times, (ii) keeping friable asbestos in a sealed container, (iii) wetting down asbestos contaminated soil in this case by the use of spray mists during excavation, screening/processing, transport and backfilling], (iv) transporting asbestos in a covered leak proof vehicle, (v) disposing asbestos off-

site to a landfill which can legally accept the waste, (vi) not disposing asbestos in domestic garbage bins, and (vii) preventing the illegal re-use, recycling or dumping of asbestos waste. Further information in this regard is outlined in our correspondence dated 13 October 2016 (Appendix H);

- Remove other deleterious materials extracted from the excavated material (e.g. rubber, plastics, vegetation, asbestos, bitumen, drums/containers) and dispose to landfill;
- Create stockpiles of coarse fill and soils which are to be treated and validated to criteria specified in this RAP and validated by the Environmental Consultant. The criteria to be applied to site won material will vary depending on whether the site won material is placed above or below the blanket subgrade level;
- Undertake validation testing on the stockpiled material with reference to Section 19.1.1 prior to re-use. Material which meets the RAC (Section 15.1) will be deemed suitable (from a contamination standpoint) for re-use in the lower 1.4 m of the 3 m thick 'engineered fill' blanket. Stockpiled materials which fail the RAC will be classified as waste and removed to a licensed landfill. Where stockpiles fail the RAC but show no preponderance for leaching, do not contain VOC that could cause a vapour intrusion issue or contain asbestos above the RAC then such material may be used as deep replacement filling in the existing excavation and as it will ultimately be well in excess of 3 m below finished levels;
- The materials are then to be backfilled and compacted in accordance with directions from the project Geotechnical Engineer (J&K) (refer to Section 11); and
- Surveys of levels must be prepared at each stage of the excavations and backfilling process as well as the final application of capping.

Deep excavations should be inspected, documented and approved by the Environmental Consultant prior to the commencement of backfilling (and compaction). The Environmental Consultant should also validate, document and approve the materials to be used to backfill the deep excavations. In each of the above the inspection and documentation of these processes would constitute hold points before further related works are contemplated.

Accordingly the nature and quality of the products derived from the recently completed and any future screening operations should be continuously validated through the remediation works programme and the results included in the site validation report.

16.2.3 Removal of Hotspots

Areas which show elevated concentrations of methane based on prior monitoring results will be excavated and the source of methane (mainly timber) removed. Similarly other hotspots will be excavated and the materials classified as wastes and removed to landfill. Potential other types of hotspot present at the site include hotspots contaminated by large quantities of:

- Biodegradable material that form gas hotspots and/or generate leachate,
- Drummed waste or areas where fuel leaks occurred that pose soil vapour and/or groundwater contamination risks; and
- Unexpected finds.

Protocols that define a hotspot that needs to be remediated are as follows:

- Areas where peak methane concentrations exceed 25% v/v (average of 10% v/v across the site);
- Buried drums or other types of bulk waste containers; and
- Grossly contaminated material based on high odorous or physical appearance.

The sampling frequency and protocols to be used for validating these materials are presented in Section 19.1.2 for hotspots and Section 19.1.3 for other areas. Validation will be suitably documented prior to any further work being undertaken at the hotspot concerned. Once areas have been validated then all such areas should be embargoed for the storage or stockpiling of materials other than imported VENM verified under the FMP.

16.2.4 General Site Preparation Earthworks

The site preparation cut and fill earthworks are to be undertaken by the Contractor in accordance with the procedures outlined in J&K (2017). It is understood from Benedict that no staging of the site preparation is proposed. Should this change, a construction staging plan for the 'Stage 1b General Site Preparation Earthworks' should be prepared by the Contractor and reviewed and approved by the Environmental Consultant and the Site Auditor prior to the commencement of the Stage 1b work. The plan should specify, among other things, how the site area will be subdivided to allow construction of the 3m thick 'engineered fill' blanket to occur in stages across the site together with the start and completion dates for the various works that need to occur in each area.

For the purpose of this RAP, the site preparation earthworks are considered to include the lower 1.4 m of the 3 m thick 'engineered fill' blanket. The procedure for the Contractor for site preparation earthworks should be as follows:

- Backfill the existing site excavations to the Specifications in J&K (2017);
- Undertake cut and fill earthworks to a level of -1.6 m of the subgrade level on which the 3 m thick 'engineered fill' blanket is to be placed;
- Excavate and stockpile site material to a level of the subgrade level on which the 3 m thick 'engineered fill' blanket is to be placed (i.e. excavate to a depth of approximately 1.4 m). This will need to be done in stages to allow for the HEIC in the dot point below. The Environmental Consultant should undertake regular inspections during the excavation and stockpiling exercise;
- Undertake the HEIC works on the exposed subgrade in accordance with the Specification to be prepared as recommended in J&K (2017). The purpose of HEIC is to improve the density of the upper fill materials, particularly those areas of inferior compaction, and to provide a relatively uniform platform onto which to place the 3 m thick 'engineered fill' blanket;
- An accurate survey of the compacted subgrade level should be made as part of the validation program for the construction of the 'engineered fill' blanket. The survey should be undertaken by a licensed surveyor at a grid spacing not exceeded 10m in size and a survey drawing produced that is to be included in the Stages 1 & 2 validation report;
- Undertake validation testing on the stockpiled material with reference to Section 19.1.1 prior to re-use. Material which meets the RAC (Section 15.1) will be deemed suitable (from a contamination / aesthetic standpoint) for re-use in the lower 1.4 m of the 3 m thick 'engineered fill' blanket;
- Subject to approval and at the direction of the Geotechnical Engineer, commence the placement of the lower 1.4 m of the 3 m thick 'engineered fill' blanket in accordance with the Specification in J&K (2017). We note that, as a minimum, the stockpiled material is likely to require screening to

remove oversized material in order to be geotechnically suitable for part of the 'engineered fill' blanket and this will be done at the direction of the Geotechnical Engineer; and

- Complete a survey of the finished level to confirm the thickness of VENM required in order to reach the final design levels.

If unexpected conditions are encountered during the remediation (such as buried tanks, significantly stained soils or unexpected contaminated soil or contaminants) reference should be made to the procedures outlined in Section 16.5.

J&K (2017) includes a specification for HEIC of the subgrade which must be undertaken prior to commencing construction of the 3 m capping system. The specification has been prepared by the Geotechnical Consultant and must be approved by Site Auditor prior to the commencement of HEIC works. All related documentation will be presented in the site validation report.

The removal of asbestos, management of failures of the RAC in stockpile and screened material, removal of leachable materials, procedures to be adopted in the event of excavation of ASS, documentary requirements including surveys in Stage 1b will follow the same procedures as described in Stage 1a.

Tracking of excavated materials will be via numbered stockpiles which will subdivided based on the presence of contaminants and be sequentially numbered. The volume and classification of any waste materials designated for off-site disposal will be determined to enable correlation with weighbridge returns of final disposal from the licensed landfill. The volume of remaining stockpiles and their placement destination i.e. back into the excavations will be recorded in a similar fashion. Surveys will verify the area and thickness of each lift following compaction of each 200 mm layer. This system should provide a record of materials movement from origin to repository.

The distinct difference between HEIC surface and the site-won re-compacted material, as opposed to a marker layer (geotextile) is to define the boundary between the existing fill and 3 m thick cap (i.e. the cap being 1.4 m site-won validated material overlain by 1.6 m imported VENM) in the event that any future excavations (post development) extend to this depth. Prior to the placement of the site-won material, any required validation of the site surface, for example in prior hotspot areas or areas of backfill, should be subject to validation assessment. This exercise would represent a hold point in site works enabling Site Auditor inspection of the subgrade (prior to 3 m cap placement) if deemed necessary. The Environmental Consultant must inspect the ground surface, describe the exposed soils, check that the compacted subgrade level agrees with the design level within the specified tolerance and issue a certification letter to the Site Auditor stating that the compacted subgrade surface has been formed in accordance with the RAP and is suitable for construction of the proposed 3 m thick 'engineered fill' blanket. Construction of the 'engineered fill' blanket should only commence after the Site Auditor has received the certification letter from the Environmental Consultant and approved the commencement of the work.

The types of on-site fill to be used for the lower 1.4 m thick layer of the 'engineered fill' blanket will ultimately depend on how much existing fill is used for Benedict's recycling and processing operations. Only on-site soils that have been validated in accordance with the RAP requirements (Section 19.1) and shown to meet the Residential A SAC (Section 15.1) are to be used to construct the lower 1.4 m of the 3m thick 'engineered fill' blanket.

The in-situ volume of on-site fill required to construct the 1.4 m thick lower blanket layer will be subject to confirmation from Benedict. Any deviation from the specified thickness will involve a reduced thickness of site-won material and a corresponding increased thickness of imported VENM.

The protocol to manage site-won stockpiled soils that fail the RAC for the upper 3 m of soil and contaminated soil excavated as part of deeply buried services construction work is as follows:

- Designation of an on-site burial area for the placement of the soils and the location of the burial area must be recorded on a drawing in the validation report;
- Alternatively, this material could be classified and disposed at a suitably licensed off-site waste facility in accordance with Section 17.5 of the RAP.

The Environmental Consultant should ideally inspect the general site preparation earthworks at a frequency not less than once per week and record the inspection findings in the site inspection field record prepared in the field at the time of the site inspection. A photo record of site conditions must also be taken.

The Site Auditor should inspect the 1.4 m thick layer when it has been completed in an area and before the commencement of other work in the area.

16.2.5 Installation of Deeply Buried Services

All services that will be located below the 3 m thick 'engineered fill' blanket are to be constructed prior to the placement of the 3 m thick 'engineered fill' blanket. Based on the current design, this is understood to comprise the deep trunk sewer main (refer to the drawing of this sewer main in Appendix B). The relevant protocols in Section 21 of this RAP are to be followed during the construction of this service line. Specific geotechnical protocols for the installation of any such services are to be prepared by the Geotechnical Consultant as these services will be below the 3 m thick 'engineered fill' blanket.

Protocols for the maintenance of these deeply buried services will be included in the long term EMP.

All deeply buried services shall be constructed in an area prior to the commencement of construction of the 3 m thick 'engineered fill' blanket.

16.2.6 Accurate Surveys

Accurate surveys of the following items are to be completed:

- The final subgrade level across the site onto which the 3 m thick 'engineered fill' blanket is to be constructed; and
- The top surface of the 1.4 m thick site-won fill layer, which forms the lower layer of the 3 m thick 'engineered fill' blanket.

The surveys will be used to determine whether the 3 m thick 'engineered fill' blanket has been constructed to the required thickness and top surface elevation. A licensed surveyor should undertake the surveys. The surveys should consist of the measurement of spot heights across the site at grid spacing not larger than 20 x 20 m and to an accuracy of <10 mm. The results of each survey are to be plotted on a scaled surveyor's drawing, with topographic elevations contoured at intervals of 0.2 m.

Copies of the survey plans are to be provided by the Environmental Consultant in their Stages 1 & 2 and Stage 3 validation reports.

16.3 Stage 2: VENM Capping

16.3.1 Hold Point Requirements

The hold points that need to be met prior to the commencement of Stage 2 VENM capping in an area. These conditions should include, but not be limited to:

- The Geotechnical Engineer has certified in writing that the subgrade and the lower 1.4m layer in the area have been constructed in accordance with and meets all geotechnical requirements, as specified in the geotechnical design reports and this RAP;
- The Environmental Consultant has certified in writing that all existing buried services have been removed from the area, validated by the Environmental Consultant and backfilled in accordance with the geotechnical requirements;
- The Environmental Consultant has certified in writing that all deeply buried services have been constructed in an area;
- The Environmental Consultant has certified in writing that the 1.4 m lower layer of the capping blanket have been validated in accordance with the RAP and the soils meet the Residential A criteria; and
- The Site Auditor has inspected the completed 1.4 m thick layer and issued an approval for the commencement of construction of the 1.6 m VENM layer.

16.3.2 Work Procedures

In summary the procedure for the Contractor for importation and placement of the 1.6 m VENM cap that will form the upper portion of the 3 m thick 'engineered fill' blanket:

- Seek approval from the Geotechnical Engineer on the geotechnical suitability of proposed imported VENM which is required to comprise well graded granular material (J&K, 2016a);
- Evaluate VENM source material, from a site contamination standpoint, in accordance with the site Fill Management Protocol for Imported VENM Cap Construction (FMP) (refer to Section 18 and Appendix J);
- Seek approval from the Environmental Consultant that the VENM source material complies with the requirements of the FMP;
- Commence importing VENM;
- Place VENM in accordance with the Specification in J&K (2016a);
- Maintain records of fill importation and placement in accordance with the FMP to provide to the Environmental Consultant to include in the final site validation report;
- The Environmental Consultant should inspect construction of the 1.6m thick VENM layer at an initial frequency not less than once per week and record the inspection findings in the site inspection field record prepared in the field at the time of the site inspection. Inspection frequency can be reduced to coincide with the completion of specified completed areas once the suitability

of any particular VENM source is established. A photo record of site conditions should also be taken; and

- The Site Auditor should inspect the 1.6 m thick layer when it has been completed in an area and before the commencement of other work in the area.

VENM importation will be managed under the FMP (Appendix J). Imported VENM will be progressively validated as set out in the FMP. Notwithstanding validation of the final surface of the 3 m thick capping materials will be undertaken by the Environmental Consultant via grid based sampling, initially on a 30 x 30 m grid, however the sampling grid may be progressively reduced towards a wider grid of 100mx100m, once the provenance of imported VENM is established. The analytical suite will be the same as set out in the FMP. Provision of validation document for this component will comprise a hold point to enable an auditor inspection (it is envisaged that this would combined with the inspection of VENM placement).

16.3.3 Geotechnical Validation

The geotechnical properties of the 3 m thick 'engineered fill' blanket are to be progressively validated as the capping layer is completed. The results of the geotechnical validation are to be documented in a report prepared by the Geotechnical Engineer in accordance with Australian Standards. Further details of the Geotechnical Validation program are provided in Section 19.3.

16.3.4 Stages 1 and 2 Validation Report

The Environmental Consultant shall prepare a validation report at the end of the Stages 1 and 2 works. The purpose of the report will be to document all remediation and validation work undertaken for the Stages 1 and 2 work and provide copies of all collected data in accordance with NSW EPA endorsed guidelines. The report(s) is to include a copy of the geotechnical validation report for the Stages 1 and 2 earthworks including the 3 m thick 'engineered fill blanket'.
The Site Auditor will review the validation report and will assess whether the Stage 1 and 2 work was completed in accordance with the RAP and regulatory requirements. The Site Auditor will document the results of the audit in a Section B site audit statement (SAS) and site audit report (SAR). The Section B SAS would be used by the developer to support the granting of a construction certificate/occupation certificate for the housing, and associated infrastructure work. Follow-up validation reports would then be submitted to the auditor for the Stage 3 work as it is progressively completed across the site, as described in Section 19.

No Stage 3 work is to commence until a Section B SAS has been issued by the Site Auditor that concludes that the Stage 1 and 2 work has been completed and the site is in a condition suitable for the commencement of the Stage 3 work.

16.4 Stage 3: Installation and Verification of Landfill Gas Mitigation Measures

Landfill gas mitigation measures must meet the minimum design, installation and verification (CQA) requirements set out in:

- NSW EPA (2012) *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases* and related (referenced) publications, including:

- BSI 8485 (2015) *Code of Practice for Design of Protective Measures for Ground Gases*.

In summary the Stage 3 landfill gas mitigation measures can be divided into two sub-stages as follows:

- Stage 3a: Design the measure(s) or system element(s) to achieve a score consistent with what is required based on the CGS of 3 (i.e. 4.5 points); and
- Stage 3b: Installation of the measure(s) or system element(s) and compliance with the relevant CQA.

16.4.1 Minimum Requirements

The landfill gas mitigation measures shall be designed, installed and verified in accordance with the minimum requirements specified in the NSW EPA (2012) guideline, the BS 8485:2015 Code of Practice, CIRIA (2014) C735 Good Practice on the Testing and Verification of Protection Systems for Buildings against Hazardous Ground Gases and relevant Australian Standards.

16.4.2 Installation and Verification Plan

The Contractor shall prepare an Installation and Verification Plan for the Stage 3 work that meets the minimum requirements specified in Section 16.4.1 and the landfill gas Mitigation System Design Report prepared by the Environmental Consultant and approved by the Site Auditor in Stage 1.

The verification plan for the Stage 3 work shall be presented as a Construction Quality Assurance (CQA) Plan. The Installation and Verification Plan shall be reviewed and approved in writing by the Environmental Consultant and the Site Auditor prior to the commencement of Stage 3 work.

16.4.3 Hold Point Requirements

The hold points that need to be met prior to the commencement of Stage 3 landfill gas mitigation measures in an area include, but not be limited to:

- The Site Auditor has completed a Section B SAS that certifies that the Stage 1 and 2 remediation and validation work has been completed in the area in accordance with the RAP and that the area is in a condition suitable for the commencement of the Stage 3 work;
- The Planning Authority was issued a Development Consent allowing the Stage 3 work to commence in the area; and
- The Site Auditor has approved in writing the Installation and Verification Plan for the Stage 3 landfill gas mitigation measures.

16.4.4 Installation of Landfill Gas Mitigation Measures

The Stage 3 work shall be undertaken in accordance with the approved Installation and Verification Plan. The Environmental Consultant shall regularly inspect the Stage 3 work sufficient to allow the Environmental Consultant to determine whether the landfill gas mitigation measures are being installed and verified in accordance with the approved Installation and Verification Plan. The frequency of the Environmental Consultant's site inspections should not be less than once per week.

The Environmental Consultant shall document the findings of each site inspection in a site inspection field record prepared in the field at the time of the site inspection. A photo record of site conditions should also be taken. During the inspection the Environmental Consultant should determine whether the Contractor's work was being undertaken in accordance with the approved Installation and Verification Plan, the required data and documentation was being generated by the Contractor, and non-conformances are identified and their significance assessed.

Copies of the Environmental Consultant's site inspection field records and site photos are to be included in the Stage 3 validation report. The Environmental Consultant shall notify the Site Auditor without unreasonable delay of any significant defects in the installation and verification work being undertaken by the Contractor.

16.4.5 Verification of Landfill Gas Mitigation Measures

Landfill gas mitigation measures shall be verified and documented by the Contractor in accordance with the minimum requirements specified in Section 8 of BS 8485:2015 and the design phase report. These include, but may not be limited to:

- A description of any measures installed – this could be presented in textual form, as photographic records or by as-built construction drawings (any variations to the pre- construction design should be fully detailed and justification(s) presented);
- Details of who installed the measures;
- Details of who inspected or verified the installation/s and a description of how this took place, together with any constraints (i.e. areas that could not be inspected or tested) or other issues of uncertainty;
- Verification test results, outcome of inspections and compliance data should be provided, either within the main text or as an Annex to the report;
- Any defects identified, together with corrective actions and subsequent verification checks;
- Copies of regulatory correspondence/sign-off;
- Manufacturers' specifications, warranties and/or guarantees;
- Personnel details (such as relevant qualifications);
- Maintenance requirements and/or limitations of the system; and
- A concluding comment about the suitability (or otherwise) of installed gas measures and include the name of the author, company details and date of issue.

The installation and verification documentation for each structure at the site shall be provided in an installation and verification report prepared in accordance with Section 19.2. The Environmental Consultant shall undertake all necessary additional verification work that may be required to meet the minimum requirements.

16.4.6 Stage 3 Validation Report

The Environmental Consultant shall prepare a validation report at the end of the Stage 3 work. The purpose of the report will be to document all remediation and validation work undertaken for the Stage 3 work and provide copies of all collected data in accordance with NSW EPA endorsed guidelines.

A copy of the geotechnical validation report for the Stage 3 work shall be included in Environmental Consultant's validation report.

The validation report would be reviewed by the Site Auditor, who will assess whether the Stage 3 work was completed in accordance with the RAP and regulatory requirements. The Site Auditor will document the results of the audit in a Section A site SAS and SAR only if passive landfill gas mitigation measures have been used and the area is suitable for the intended land uses. The Section A SAS would be used by the developer to support the Planning Authority issuing an Occupation Certificate for housing and associated infrastructure work constructed in the area.

16.5 Contingencies for Unexpected Finds

Given the presence of anthropogenic material in the fill (i.e. building rubble), it is possible that significant quantities of asbestos may also be present. Unexpected conditions also include biodegradable material, odorous waste, leachable material, voids, soft compressible material, and any other material not previously documented as having being present at the site.

If unexpected conditions are encountered during the remediation (such as significant quantities of asbestos, buried tanks, significantly stained soils or unexpected contaminated soil or contaminants), the following general approach will be adopted:

- Stop work in the area of impact and barricade area to prevent access;
- The Site Manager is to contact the Principal's representative and the Environmental Consultant;
- The Environmental Consultant will make an assessment of the severity of the occurrence in terms of the potential impact to human health and the environment;
- The Environmental Consultant will liaise with the Principal's representative as required;
- Provision of advice from the Environmental Consultant to the Principal's representative regarding the recommended course of action;
- Obtaining necessary approvals from Council and the Auditor; and
- Implementation of the agreed management/remediation strategy.

Any areas of fill exhibiting indications of contamination (e.g. buried tanks) or that significantly differ from the materials previously assessed must be characterised as part of the remediation works. If significant quantities of bonded ACM or FA and AF are encountered, a site specific asbestos management plan should be prepared by an occupational hygienist / Environmental Consultant and that work must be undertaken by an appropriately licenced contractor.

Where unexpected finds are reported the Environmental Consultant should independently assess the nature of the find and determine whether the RAP already makes suitable provisions to deal with the situation. It is envisaged that regular (at least weekly) site inspections by the Environmental Consultant will presage earthworks in all areas prior to their scheduled commencement. A detailed daily record of all site works should be maintained by the Remediation Contractor and Environmental Consultant (inspections) and the documents provided in the site validation report. The occurrence and management of all Unexpected Finds is to be documented in the relevant validation report.

16.6 Ground Gas Contingency Measures

Should site conditions warrant the expansion of the landfill gas measures, as noted above, into areas which would otherwise have only been subject to a 3 m engineered capping layer, then the reason for additional measures must be reported and provided to the Site Auditor along with the proposed mitigation design. If required it is anticipated that the design will depend on the severity of the gas concentrations and other factors affecting the CGS and the specific land use (exposure risk) proposed in the affected area.

Conceptually for areas other than residential footprints where the risk (consequence) of gas build up is lower the mitigation system will be correspondingly less protective. For example, in landscaped areas normally the 3m cap will suffice, however if gas emissions are observed then the mitigation system may comprise some or all of the components listed below:

- Earthen cover/bituminous concrete;
- Protective Geotextile;
- Gas proof membrane;
- Geotextile;
- 100 mm crushed gravel screenings (nominal >20 mm, no fines) with geo-vent collection strips; and
- Anti-silting geotextile.

Each modification to the system will require specific design which will depend on circumstances and will require to be agreed by the Site Auditor. Installation, construction validation and reporting will follow the same steps as outlined above.

This RAP is based on the design assumption that only passive landfill gas mitigation measures are required for the long term management of landfill gas at the site following the completion of the Stage 3 work, since it is not feasible for active measures to be used for long term management of residential areas of this nature.

The triggers that will apply for decisions to be made on the need for additional / revised landfill gas mitigation measures will be based on the outcome of proposed validation monitoring (refer to the SAQP – DP, 2017b).

The additional remediation measures that would be undertaken if a CGS of greater than 3 was calculated during validation monitoring may involve further evaluation of risk and/or targeted excavation and off-site disposal and/or on-site screening of gas generating fill.

16.7 Roles and Responsibilities

In summary the various parties are defined as follows along with their roles and responsibilities:

- The Principal, responsibility to ensure appropriate personnel are appointed to manage and conduct the remediation and validation works;
- Principal's Representative, who is responsible for overseeing the implementation of this RAP;
- Remediation Contractor, who will be responsible for conducting the remediation works and managing the site;
- Environmental Consultant, who will be responsible for providing advice as required for the remediation works and undertaking the validation works in accordance with this RAP;
- Geotechnical Consultant, who will be responsible for providing advice as required related to geotechnical aspects of the remediation works and undertaken validation works in accordance with this RAP; and if necessary
- Occupational Hygienist, who will be responsible for asbestos issues including air monitoring.

The Remediation Contractor will be responsible for preparing a list of contacts, including emergency contacts for the site operations and provision of signage at the site to allow the public to contact nominated site personnel out of hours.

The Environmental Consultant is also responsible for inspecting the site and collecting all necessary validation data that will allow the Environmental Consultant to conclude that:

- The remediation and validation work has been undertaken in accordance with the RAP and regulatory requirements; and
- The remediated site at the end of the Stage 3 work is suitable for Residential A land use provided it is managed in accordance with a long-term EMP approved by Council.

The Geotechnical Consultant is also responsible for inspecting the site and collecting all necessary geotechnical validation data that will allow the Geotechnical Consultant to conclude that:

- The earthworks conducted at the site were undertaken in accordance with the RAP and regulatory requirements; and
- The site at the end of the Stage 3 work is geotechnical suitable for residential land use.

16.8 Site Supervision

Supervision of the works will require varying degrees of input from the various parties nominated above. Likely supervision requirements are set out below in Table 10.

Table 10: Supervision Requirements during Remediation

Party	Supervision	Competency
The Principal, responsibility to ensure appropriate personnel are appointed to manage and conduct the remediation and validation works.	As required	Ability to delegate responsibility
Principal's Representative, who is responsible for overseeing the implementation of this RAP.	Daily	Suitably qualified and experienced consultant or contractor
Remediation Contractor, who will be responsible for conducting the remediation works and managing the site;	Daily	Suitably qualified and experienced contractor holding necessary licenses and approvals to do the works
Environmental Consultant, who will be responsible for providing advice as required for the remediation works and undertaking the validation works in accordance with this RAP.	Weekly or as required	Qualified and suitably experienced consultant meeting the definition of competent person as defined in NEPM (2013)
Geotechnical Consultant, who will be responsible for providing advice as required related to geotechnical aspects of the remediation works and undertaken validation works in accordance with this RAP.	Weekly or as required	Qualified professional civil or geotechnical engineering consultant with lead consultant holding EA NER
Occupational Hygienist, who will be responsible for asbestos issues including air monitoring.	As required	WorkCover NSW licensed asbestos assessor and certified full member of the AIOH

Note: the Geotechnical Consultant should inspect the backfill material not only for geotechnical characteristics, but also for physical evidence of contamination that should include, *inter alia*, asbestos fragments, industrial waste (e.g. slag, ash), stained / odorous material, types and proportions of anthropogenic material present, the proportion of timber and degradable material present in the material.

The Geotechnical Consultant must prepare a detailed record of each inspection and provide a copy to the Environmental Consultant for review and inclusion in the site validation report.

16.9 Environmental Monitoring Programme

The environmental monitoring programme to be undertaken during remediation is set out in Table 11 below.

Table 11: Environmental Monitoring Programme during Remediation

Item	Method	Locations	Frequency	Reporting	Party
Dust (air quality)	Approved methods for sampling and analysis of air pollutants in NSW (NSW EPA, 2007) NSW EPA references Australian Standard (AS) 3580.10.1-1991 as the method for measuring deposited particulate matter.	4 locations on site boundary	Monthly	Monthly	EC
Asbestos fibres (air quality)	Membrane filter method	4 locations on site boundary	As required for asbestos-related works		OH
Methane	Surface monitoring as per Environmental Guidelines Solid Waste Landfills (2nd Ed) 2016	10 m transects on final capped areas	Monthly and as required as each fill area is completed	Monthly	EC
Landfill gas (geoprobe)	Landfill gas concentration with triggers to install monitoring wells to allow flow measurements.	20 monitoring points.	Monthly	Monthly	EC
Groundwater (contingency only)	Bore (monitoring well) samples	As established by monitoring programme (refer to Section 16.1.8)	Monthly	Monthly	EC
Surface Water	Grab samples	Two (2) locations in Georges River and two (2) in the dredge pond (proposed marina basin) (4 locations in total)	Monthly	Monthly	EC

Notes: EC Environmental Consultant and OH Occupational Hygienist

The above monitoring requirements for landfill gas (subsurface) and surface water quality are provided in the DP (2017b) SAQP.

Changes to the Environmental Monitoring Programme can only occur after the Site Auditor has issued a written approval of the proposed changes.

17. Management and Waste Classification of Excavated Material

17.1 Stockpiling of Contaminated Material

If required, contaminated material shall be stockpiled at a suitable designated location. Suitable locations include any areas not previously remediated and/or covered with final capping materials (VENM). Stockpiles should not exceed 5 m in height and <100 m^2 footprint and should be suitably positioned and managed to minimise dust and odours (see below). In the absence of a suitable NSW guideline stockpile management should follow the 'Guideline for stockpile management: Waste and waste derived products for recycling and reuse', (SA EPA, 2010).

Dust control is recommended for all stockpiled materials and should include light conditioning with water for exposed materials or covering with an anchored geotextile or similar.

All stockpiles of potentially contaminated material to remain on the site overnight shall be surrounded by star pickets and marking tape or other suitable material to clearly delineate their boundaries and be adequately secured in order to reduce the risk of sediment runoff. Should the stockpile remain for over 48 hours they should be appropriately managed to prevent fugitive dust leaving the site (e.g. light wetting or covering with an anchored geotextile depending on weather conditions) and geotextile silt fences or hay bales should be erected around each stockpile to prevent losses by surface erosion.

17.2 Waste Classification

The need for waste classification testing may arise, for example, under the following circumstances:

- Unexpected finds are encountered during the Stage 1: Site Preparation Earthworks;
- Geotechnically unsuitable material requires off-site disposal; and
- Detailed excavations (i.e. footings and buried services) generate excess spoil that requires off-site disposal.

Materials requiring waste classification for off-site disposal purposes should be excavated and stockpiled and classified with reference to NSW EPA (2014a) *Waste Classification Guidelines, Part 1: Classifying Waste*. The adopted sampling frequency for stockpile waste classification sampling will be based on NEPC (2013). NEPC (2013) suggests adopting the Vic EPA (2010) *Soil Sampling* guideline to characterise large stockpiles in excess of 200 m^3. The Vic EPA guideline would be adopted only for stockpiles in excess of 200 m^3. Proposed stockpile sampling frequencies are shown in Table 12, below, however, the sampling frequency could be reviewed (reduced) based on the consistency of the results.

Table 12: Minimum Number of Samples Recommended for Stockpiles

Stockpile Volume (m^3)	No. Samples
<75	3
75 - <100	4
100 - <125	5
125 - <150	6
150 - <175	7
175 - <200	8

Samples shall be screened using a photo-ionisation detector (PID) and analysed as outlined below:

- Analysis of metals, TRH, BTEX, PAH and asbestos (all samples);
- Analysis of PCB, OCP and PCB (one in three samples);
- Analysis of specific samples for any identified additional contaminants of concern. Potential for concern will be based on visual and olfactory observations and PID results; and
- Analysis of selected samples for TCLP for metals and PAH based on total concentration results as appropriate to complete the waste classification.

17.3 Spoil Contingency Plan

Any materials which fail to meet the NSW EPA (2014a) criteria for direct landfill disposal (i.e. Hazardous Waste materials) following initial waste classification assessment will require segregation and separate stockpiling pending further testing and treatment. The contingency plan to cater for the storage, treatment and disposal of these materials is as follows:

- On the basis of on-site observations and the contaminant exceedances recorded, materials will be carefully excavated, segregated and placed in well delineated locations;
- Stockpiles of excavated materials will be appropriately bunded with hay bales / sandbags and if required conditioned with water, covered and/ or lined with anchored impermeable plastic sheeting to prevent dust generation;
- If considered appropriate, further sampling and analysis will be conducted to more fully characterise the subject material, and confirm its contamination status. If the further characterisation works show that the material can be classified as General Solid Waste or Restricted Solid Waste, dispose of the material directly to an appropriately licensed landfill;
- Review potential options for the treatment, re-use or recycling of the material, and adopt options identified to be suitable for the subject material; and
- Review NSW EPA's General Immobilisation Approvals on the NSW EPA website. If an applicable General Immobilisation Approval exists, further assess/dispose of the waste in accordance with the approval and other approvals or licences as required by the NSW EPA.

If no General Immobilisation Approval is applicable to the material, NSW EPA (2014b) *Waste Classification Guidelines Part 2: Immobilisation of Waste* will apply, and the following will be conducted:

- Conduct additional sampling and analysis as required based on the available results to provide information for immobilisation options. In general immobilisation options include natural immobilisation, chemical fixation, micro-encapsulation and macro-encapsulation;
- Investigate, including trials as appropriate, immobilisation treatment options for the material;
- Apply to the NSW EPA for a Specific Immobilisation Approval; and
- Implement the requirements imposed on management/disposal of the material by the NSW EPA including (if applicable) Chemical Control Orders issued under the *Environmentally Hazardous Chemicals Act* 1985 (EHC Act).

17.4 Loading and Transport of Spoil

All transport of waste and disposal of materials must be conducted in accordance with the requirements of the *Protection of the Environment Operations Act* (1997) (POEO Act). All required licences and approvals required for disposal of the material will be obtained prior to removal of the materials from the site.

Transport of spoil shall be *via* a clearly delineated, pre-defined haul route.

Removal of waste materials from the site shall only be carried out by a licensed contractor holding the appropriate licence, consent or approvals to dispose of the waste materials according to the classification outlined in the waste classification guidelines and with the appropriate approvals obtained from the NSW EPA, if required.

The truck dispatch shall be logged and recorded by the Contractor for each load leaving the site and comply with appropriate waste tracking requirements. A record of the truck dispatch will be provided to the Principal's representative. All tip dockets related to off-site disposal of waste materials must be supplied to the Environmental Consultant for inclusion in the site validation report.

17.5 Disposal of Material

When site work associated with this RAP commences at the site, all materials excavated and removed shall be disposed in accordance with the POEO Act and to a facility/site legally able to accept the material. Copies of all necessary approvals from the receiving site shall be given to the Principal's representative prior to any contaminated material being removed from the site. A record of the disposal of materials will be maintained.

All relevant analysis results shall be made available to the Remediation Contractor and proposed receiving site / waste facility to enable selection of a suitable disposal location. Holding arrangements, treatment and disposal requirements for excavated materials which fail to meet the landfill disposal guideline levels are discussed in Section 17.3.

Details of all contaminated and spoil materials removed from the site (including VENM) shall be documented by the contractor with copies of weighbridge slips, trip tickets and consignment disposal confirmation provided to the Environmental Consultant and the Principal's representative. A site log will be maintained by the Principal's representative to track disposed loads against on-site origin.

Accordingly all excavated material be tracked from source to repository, whether refilled on site or disposed off-site and appropriately documented including volumes so that the data can be checked by the Environmental Consultant and independently verified by the Site Auditor. All excavated materials removed from the site shall be tracked from cradle to grave and documented by the Environmental Consultant in validation reports sufficient to allow the Site Auditor to validate that this requirement was met.

18. Imported VENM for Cap

18.1 Imported VENM for Cap

An FMP for the site has been prepared as a stand-alone document (see Appendix J). All imported VENM fill for the upper 1.6 m cap must comply with the FMP. The FMP details the requirements for assessing the VENM prior to importation to the site, with respect to contamination and (if required) salinity, and the procedures to be implemented during the course of VENM importation. Application of the FMP to all soil and rock to be imported to the site will provide a consistent approach to the management of materials with respect to their suitability for use as the proposed cap.

The following should be considered with respect to the implementation of the FMP:

- The FMP applies only to the materials imported for the bulk earthworks and does not apply to other materials imported to the site for the purpose of road construction or drainage works etc.;
- It is the responsibility of Benedict Industries Pty Ltd and its nominated qualified Geotechnical and Environmental Consultants to maintain compliance with the FMP; and
- The suppliers of the materials are required to provide the supporting documentation to verify that the subject material complies with the FMP. It is the suppliers' responsibility to ensure that the supporting documentation is complete and correct. In this regard, the suppliers of materials must be issued with a copy of the FMP.

18.2 Other Materials Required by the Remediation / Redevelopment Work

Other non-VENM materials that are not associated with the VENM cap (the cap is to comprise only VENM) may be imported to the site after works associated with this RAP commence. These materials may include:

- Gravel or recycled aggregate associated with gas drainage layers;
- Materials for road construction and drainage work; and
- Landscaping topsoil for vegetated areas.

These materials are to be managed, tracked and stockpiled separately from the imported VENM and must comply with all regulatory requirements.

19. Site Validation

19.1 Validation Sample Collection and Analysis

19.1.1 Existing Fill to be Incorporated into the 3 m Thick Engineered Fill Blanket

Following the Stage 1a excavation of deep fill areas, screening and stockpiling of this fill and Stage 1b progressive excavation and stockpiling of site material to a level of -3.0 m of final design level (i.e. excavate to a depth of approximately 1.4 m equating to approximately 126 000 m^3), the stockpiled fill will be validated for chemical contaminants and asbestos as follows:

- Collection of validation samples at a frequency of one sample per 500 m^3 with scope to adjust the frequency to one sample per 1000 m^3 depending on the consistency of the results. The sampling frequency is considered appropriate because (i) there is a considerable amount of existing data characterising these materials as set out in the DSI (DP, 2016) and accordingly this sampling regime represents a supplementary data set, and (ii) imported VENM will be placed about the existing fill to a minimum depth of 1.6 m thus preventing normal access and exposure;
- The stockpile soil sampling frequency of one sample per 500 m^3 for all contaminants of concern shall not be adjusted without prior written approval of the Site Auditor. A lower stockpile frequency for some analytes may be justified after the collection and testing of not less than 50 validation stockpile samples;
- Analysis of validation samples for metals, TRH, BTEX, PAH, OCP, OPP, PCB, Phenols and asbestos (10 L sample for ACM and 500 mL sample for FA and AF) as per the RAC in Table 8, and Section 15.1. Neutral leachate tests for heavy metals and PAHs should be undertaken at a frequency of not less than 10% of stockpile validation samples;
- The Environmental Consultant should inspect each stockpile during or following completion of the stockpile formation and again during its removal and placement and will record the inspection findings in the site inspection field record prepared in the field at the time of the site inspection. A photo record of site conditions should also be taken. Auditor inspection should take place as required by the auditor;
- Collection and analysis of QA/QC samples as per Section 20.2; and
- Statistical evaluation of the data set to provide the 95% UCL of the mean concentrations, identification of hotspots (≥ 2.5 x RAC), SD < 50% of the RAC and identification of statistical outliers.

Validation samples should be collected at a minimum rate of eight per batch to allow for a statistical analysis to be undertaken on the batch (if required). In this regard, the Contractor should aim to generate stockpiles of approximately 4000 m^3.

If the validation samples exceed the RAC (Section 15.1) further assessment of the relevant 500 m^3 component should be undertaken to evaluate which portion(s) of the stockpile are suitable for retention on site and which may require off-site disposal.

Following the Stage 1a excavation of deep fill areas, screening and stockpiling of this fill and Stage 1b progressive excavation and stockpiling of site material to a level of -3.0 m of final design level (i.e. excavate to a depth of approximately 1.4 m equating to approximately 126 000 m^3), the stockpiled fill will be validated for aesthetic parameters as defined by the outcome of the development of the RAC for these parameters (refer to Section 15.1).

The validation of the RAC for anthropogenic materials of ≤ 5% may be with reference to either or a combination of:

- NSW Roads & Traffic Authority Test Method T276 Foreign Materials Content of Recycled Crushed Concrete; and
- Qualitative methods (i.e. visual inspection of screened material).

The validation of the RAC for significant reduction in organic matter (approximately ≥ 70%) may be with reference to either or a combination of:

- Organic matter content (macro scale soil test);
- NSW Roads & Traffic Authority Test Method T276 Foreign Materials Content of Recycled Crushed Concrete; and
- Qualitative methods (i.e. visual inspection of screened material).

The physical condition (description, odour, staining, anthropogenic content) of each soil validation should also be recorded and included in the validation report, since these properties correspond to remediation acceptance criteria given in Section 15.1;

Soil samples should be representative of the materials being validated and also target any suspect materials based on physical appearance.

Soil samples from stockpiles should be collected using the procedures specified in Section 7.5 of the NEPM (2013) Schedule B2 guidelines. For example:

- Stockpiles should be managed so they only contain one type of relatively uniform material;
- A uniform sample point distribution should be used across each stockpile, with the sample locations used for each stockpile documented on a plan that is provided in the validation report;
- Samples for inorganic and non-volatile components should be taken at various depths towards the centre of the stockpile from 300 mm below the stockpile surface;
- Samples for volatile and semi-volatile compounds should be taken without delay from a freshly excavated surface 500 mm or greater depth below the stockpile surface;
- Composting of samples will not occur; and
- Systematic sampling directly from excavator buckets during the stockpile formation process or for appraisal of larger stockpiles using appropriate QA/QC processes is an acceptable strategy.

The Environmental Consultant will undertake the validation sampling.

19.1.2 Contingency Excavation of 'Hotspots' Encountered During Earthworks

Should fill 'hotspots' be identified during excavation or stockpile sampling, the 'hotspot' should be removed and the walls and the base and walls of the excavation will be validated as follows:

- Inspection of the excavated surface and collection of validation samples from excavation to characterise the excavation boundary conditions and validate the removal of the 'hotspot' as follows:
  - BASE OF EXCAVATION – approximately one sample over nominal 30 m x 30 m grid (minimum one sample per base);
  - SIDE OF EXCAVATION – one sample per 10 linear metre and 2 m to 3 m depth intervals (minimum one sample per wall);
- Analysis of validation samples for the contaminants of concern (e.g. metals, TRH, BTEX, PAH, OCP, OPP, PCB, phenols or asbestos); and
- Collection and analysis of QA/QC samples as per Section 20.2.

If the validation samples exceed the RAC (Section 15.1) further excavation of the contaminated materials will be required with further validation samples taken until the results are within the RAC.

The Environmental Consultant will undertake the validation sampling.

19.1.3 Backfill Placed below Subgrade Level

The validation protocols for fill used to backfill excavation below the subgrade level of the 3 m thick 'engineered fill' blanket are as follows:

- Undertake a visual inspection of the material and physically remove (or screen out) any gas or leachate generating material;
- Adopt the sampling methodology outlined in Section 19.1.1;
- Analysis of validation samples for TRH, BTEXN as per the RAC in Table 8, and Section 15.2;
- If, after the first 50 samples tested, all results indicate the general absence of VOC contamination (i.e. TRH and/or BTEXN), review and reduce the sample frequency;
- The Environmental Consultant should inspect each stockpile during or following completion of the stockpile formation and again during its removal and placement and record the inspection findings in the site inspection field record prepared in the field at the time of the site inspection. A photo record of site conditions should also be taken;
- Collection and analysis of QA/QC samples as per Section 20.2; and
- Statistical evaluation of the data set to provide the 95% UCL of the mean concentrations, identification of hotspots (≥ 2.5 x RAC), SD < 50% of the RAC and identification of statistical outliers.

19.1.4 Geotechnical Validation

Geotechnical RAC are set out in Section 15.5 as specified by J&K (2017) and in their response to auditor comments dated 22 August 2016 (J&K, 2017). The monitoring, testing and validation of the

geotechnical site improvement against the relevant RAC stipulated by J&K will be undertaken the Geotechnical Engineer (J&K). The results of the geotechnical validation will be incorporated as an appendix into the site validation report.

The various geotechnical requirements of the earthworks must be validated and documented by the Geotechnical Consultant. These requirements include, but may not be limited to:

- The proof-rolling the base of proposed 'backfill' areas;
- The HEIC work;
- The type of fill and compaction of the fill used to construct the 3m thick 'engineered fill' blanket; and
- The results of further geotechnical investigations once the 3m thick 'engineered fill' blanket has been completed, as recommended in J&K (2017).

The geotechnical validation report should be confirm the predicted future settlement of building foundations, the site classification and pavement design CBR value.

The geotechnical validation report should include a letter from the design structural engineer confirming that all structures to be built at the site have been designed to tolerate settlements predicted by the Geotechnical Consultant. The geotechnical validation report should be prepared in accordance with relevant Australian Standards and a copy included in the Stages 1 and 2 validation report prepared by the Environmental Consultant.

19.2 Stage 3 – Validation of the Landfill Gas Mitigation Measures

The validation of the measure(s) or system element(s) of the landfill gas mitigation system shall involve a review of the CQA documentation (to be developed on the basis of the proposed structures – refer to Section 16.4) by the Environmental Consultant. The landfill gas mitigation measure(s) or system element(s) installed for every structure constructed at the site shall be verified and documented in a Stage 3 validation report prepared by the Environmental Consultant in accordance with NSW EPA endorsed guidelines.

Validation CQA criteria will include:

- Checking the specification of the supplied anti-silting, cushioning and protective geotextile layers, specification to be determined following receipt of detailed design of the development;
- Confirming the suitability of the gravel blanket materials by undertaking random sampling and PSD analysis of the supplied materials (AS 1289.3.6.1—2009). One sample per building lot will be tested;
- Confirming the suitability of geovent gas collection strips including open area;
- Undertaking visual inspection of gas proof membrane particularly around seals and penetrations and using smoke testing where feasible; and
- Visual inspection of the slab for defects, cracks, unsealed joints etc.

In addition methane validation within built structures and voids e.g. foundations of each building will be undertaken using a GA5000 or similar. A methane trigger level of 10% LEL will be adopted. If the trigger value is exceeded then an assessment of risk and any additional mitigation measures will be made.

The Environmental Consultant shall prepare a Stage 3 validation report for each part of the site, with the number of validation reports needing to be prepared depending on the staging of the residential development and the requirements of the developer. Each Stage 3 validation report shall include a copy of an implementation and verification report prepared by the Contractor who installed the landfill gas mitigation measures together with additional data collected by the Environmental Consultant during the Stage 3 installation and verification work.

The implementation and verification reports shall be prepared by the Contractor in accordance with the minimum requirements specified in the NSW EPA (2012), BS 8485:2015 Code of Practice, CIRIA (2014) C735, and relevant Australian Standards. These minimum requirements should include those already described in this section of the RAP together with, but not be limited to [Section 8, BS 8485:2015]:

- A description of any measures installed – this could be presented in textual form, as photographic records or by as-built construction drawings (any variations to the pre- construction design should be fully detailed and justification(s) presented);
- Details of who installed the measures;
- Details of who inspected or verified the installation/s and a description of how this took place, together with any constraints (i.e. areas that could not be inspected or tested) or other issues of uncertainty;
- Verification test results, outcome of inspections and compliance data should be provided, either within the main text or as an Annex to the report;
- Any defects identified, together with corrective actions and subsequent verification checks;
- Copies of regulatory correspondence/sign off;
- Manufacturers' specifications, warranties and/or guarantees;
- Personnel details (such as relevant qualifications);
- Maintenance requirements and/or limitations of the system; and
- A concluding comment about the suitability (or otherwise) of installed gas measures and include the name of the author, company details and date of issue.

With each Stage 3 validation report, the Environmental Consultant shall include a final version of the long-term Environmental Management Plan (EMP), based on the preliminary version approved by Council prior to the commencement of remediation work.

For each Stage 3 validation report, the Environmental Consultant is to provide a copy to the Site Auditor. The Site Auditor will then review the Stage 3 validation report and determine whether the documentation demonstrates that the part of the site covered by the report meets NSW EPA requirements for the intended land use. The results of the audit will be documented by the Site Auditor in a SAS/SAR. Copies of the SAS/SAR will be provided to the site owner, developer, the NSW EPA and Council. An Occupation Certificate for the part of the site covered by the SAS/SAR should only be

issued after a Section A SAS has been issued stating that the area is suitable for the intended residential land use.

20. Quality Assurance Plan

20.1 Sample Collection and Handling

The general sampling procedures comprise:

- The use of stainless steel or disposable (e.g. nitrile glove) sampling equipment;
- Washing of all re-usable sampling equipment, in contact with the sample, in a 3% solution of phosphate free detergent (Decon 90) then rinsing with distilled water prior to each sample being collected; transfer of the sample into an appropriate sampling container, sealing of containers to minimise cross contamination during transportation to the laboratory;
- Use of laboratory prepared sampling containers for samples for analysis of chemical contaminants (generally comprising new glass jars sealed with Teflon lined lids);
- Labelling of the sample containers with individual and unique identification including Project No. and Sample No.;
- Placement of the containers into a chilled (where necessary), enclosed and secure container for transport to the laboratory; and
- Use of chain-of-custody documentation so that sample tracking and custody can be cross-checked at any point in the transfer of samples from the field to hand-over to the laboratory.

20.2 Field QA/QC

Quality assurance (QA) and quality control (QC) procedures will be adopted throughout the field sampling programme to assess sampling precision and accuracy.

The following QA/QC samples will be collected/prepared and analysed:

- 5% intra-laboratory replicate samples;
- 5% inter-laboratory replicate samples;
- Trip blank samples – one per sampling day (when volatiles are included in the analytical suite); and
- Trip spike samples – one per sampling day (when volatiles are included in the analytical suite).

Appropriate sampling procedures will be undertaken to minimise cross contamination. These include:

- Standard operating procedures are followed;
- Replicate field samples are collected and analysed;
- Samples are stored under secure, temperature controlled conditions;

- Chain-of-custody documentation is employed for the handling, transport and delivery of samples to the selected laboratory; and
- Proper disposal of contaminated soil, fill or surface water originating from the site is completed.

20.3 Laboratory Quality Assurance and Quality Control

A NATA accredited laboratory will be used to conduct analysis. The laboratory will need to undertake analysis in accordance with its accreditation, including in-house QA/QC procedures involving the routine testing of:

- Reagent blanks;
- Spike recovery analysis;
- Laboratory duplicate analysis;
- Analysis of control standards;
- Calibration standards and blanks; and
- Statistical analysis of QC data including control standards and recovery plots.

20.4 Data Quality Objectives and Indicators

The validation assessment is to be conducted in accordance with Data Quality Objectives (DQOs) and QA/QC procedures to assess the repeatability and reliability of the results.

The validation assessment will be planned in accordance with the following DQOs:

- State the Problem;
- Identify the Decision;
- Identify Inputs to the Decision;
- Define the Boundary of the Assessment;
- Develop a Decision Rule;
- Specify Acceptable Limits on Decision Errors; and
- Optimise the Design for Obtaining Data.

A checklist of Data Quality Indicators (DQI) in accordance with NEPC (2013) Schedule B2 will be completed as part of the validation assessment. The DQIs are:

- Documentation completeness;
- Data completeness;
- Data comparability and representativeness; and
- Data precision and accuracy.

Based on a fulfilment of the DQOs and DQIs an assessment of the overall data quality will be presented in the validation assessment report.

21. General Environmental Management Plan

21.1 General

The Contractors will undertake the work with due regard to the minimisation of environmental effects and to meet regulatory and statutory requirements.

The Contractors should have in place an over-arching environmental management plan that incorporates this RAP so that work on the site complies with, but not limited to, the following:

- *Protection of the Environment Operations Act* 1997;
- *Contaminated Land Management Act* 1997;
- *Work Health and Safety Act* 2011; and
- *Work Health and Safety Regulation* 2011.

The following general measures outlined below should be implemented during the remediation phase. All personnel should be made familiar with the following section prior to the commencement of site works as required.

In addition all contractors must meet all requirements of the Liverpool Council LEP. Specifically contractors must note the provisions of Part 6 and Part 7 of the LEP related to site contamination (Section 6.6) and environmentally sensitive land use - acid sulphate soils (Section 7.7)

21.2 Vibration Control

The use of any plant and/or machinery should not cause unacceptable vibrations to nearby properties and should meet Council requirements.

21.3 Dust Control

Dust emissions should be confined within the site boundary. The following dust control procedures will be employed to comply with this requirement as necessary:

- Erection of dust screens around the perimeter of the site;
- Securely covering all loads entering or exiting the site;
- Use of water sprays across the site to suppress dust;
- Covering of all stockpiles of contaminated soil remaining onsite more than 48 hours;
- Dust monitoring as may be required by the Council DA consent; and
- Keeping excavation and stockpile surfaces moist.

21.4 Odour Control

No odours should be detected at any boundary of the site during remediation works by an authorised Council Officer relying solely on sense of smell. The following procedures should be employed to comply with this requirement as required:

- Use of appropriate covering techniques such as plastic sheeting, polythene or geotextile membranes to cover excavation faces or stockpiles;
- Fine spray of water and/or hydrocarbon mitigating agent on the impacted areas/materials;
- The use of water spray, as and when appropriate, to eliminate wind-blown dust;
- Use of sprays or sprinklers on stockpiles or loads to lightly condition the material;
- Restriction of stockpile heights to 5 m above surrounding site level. If required, restrict uncovered stockpiles to appropriate sizes to minimise odour generation;
- Ceasing works during periods of inclement weather such as high winds or heavy rain;
- Regular checking of the fugitive dust and odour issues to ensure compliance. Undertake immediate remediation measures to rectify any cases of excessive dust or odour (e.g. use of misting sprays or odour masking agent); and
- Adequate maintenance of equipment and machinery to minimise exhaust emissions.

21.5 Stormwater Management and Control

As necessary, the remediation contractor shall take appropriate measures to ensure that potentially contaminated water does not leave the site. In particular, stormwater management for the duration of the remediation works shall be utilised and monitored to minimise stormwater flow into adjacent waterways.

21.6 Occupational Health and Safety

The Contractors shall develop a site emergency response plan (ERP) and occupational health and safety plan (OHSP). This will ensure the safety of the personnel working on site, given any likely emergency situation which may occur. The OHSP and ERP should include emergency phone numbers and details of local emergency facilities.

Appropriate fencing and signage should be installed around and within the site to prevent unauthorised access to the site, restricted access remediation areas and/or deep excavations.

All personnel on site should be required to wear the following personnel protective equipment (PPE) at all times:

- Steel-capped boots;
- High visibility clothing; and
- Hard hat meeting AS1801-1981 requirements.

The following additional PPE will be worn as required:

- Hearing protection meeting AS1270-1988 requirements when working around machinery or plant equipment if noise levels exceed exposure standards;
- Safety glasses or safety goggles with side shields meeting AS1337-1992 requirements (as necessary, particularly during demolition);
- Disposable coveralls (if necessary) to prevent contact with splashed contaminated soil, materials or water;
- Nitrile work gloves meeting AS2161-1978 requirements or heavy duty gauntlet gloves; and
- Any additional protection identified by the Environmental Consultant.

In the event that personnel are required to work in areas of potential contact with asbestos, the following PPE in addition to standard construction PPE, should be worn during works involving the handling and/or removal of soils impacted by asbestos:

- Disposable coveralls (rated type 5, cat 3 or equivalent);
- Half-face P1/P2 respirator or equivalent;
- Gloves; and
- Safety footwear which should be laceless.

Excavation, handling, stockpiling, transport etc. of materials containing asbestos should be undertaken by a licensed contractor in accordance with relevant regulatory requirements.

21.6.1 Management of Landfill Gas During Earthworks and Construction

The presence of HGG (landfill gas) has been confirmed at the site. Methane has been detected in landfill gas wells at concentrations which exceed 100% of the lower explosive limit (LEL). In this regard, care should be taken during construction to minimise the likelihood of creating areas in which landfill gas can accumulate such as deep trenches. Standard confined space protocols should apply and the Contractors must be made aware of the additional hazards posed by the presence of landfill gas at the site. Reference should be made to Safe Work Australia (2011) *Confined Spaces, Code of Practice*.

Standard multi-gas LEL meters should be used by site personnel where appropriate. Advice should be sought by the Contractor's from the Environmental Consultant. Safe Work Australia (2011) states that "a safe atmosphere must be ensured, so far as is reasonably practicable, during work in a confined space. A safe atmosphere in a confined space is one that:

- Has a safe oxygen level;
- Is free of airborne contaminants or any airborne contaminants are in concentrations below their allowable exposure standard (if any); and
- Any flammable gas or vapour in the atmosphere is at concentrations below 5% of its LEL.

21.7 Hours of Operation

All remediation work should be conducted within the hours specified by Council.

21.8 Contingency Plans to Respond to Site Incidents

The key to effective management of incidents is the timely action taken before any situation reaches a reportable or critical level. Therefore, surveillance activities are extremely important, and should be conducted for the measures prescribed herein and any other measures as seen appropriate by the Principal's representative. During work activities on the site, the following inspection or preventative actions must be performed by the main Contractor and carefully documented:

- Regular inspection of works;
- Completion of routine environmental checklists and follow-up of non-compliance situations;
- Maintenance of supervision on-site; and
- An induction process for site personnel involved in the remediation works that includes relevant information on environmental requirements, and ensures that all site personnel are familiar with the site emergency procedures.

The Contractor's site foreman should be responsible for initiating an immediate emergency response using the resources available on the site. Where external assistance is required, the relevant emergency services should be contacted. A list containing contact details for key personnel who may be involved in an environmental emergency response should be completed and be readily available to personnel at all times.

21.9 Identify Regulatory Compliance

The work should be undertaken with all due regard to the minimisation of environmental effects and to meet all statutory requirements, including, inter alia, provisions specified in:

- *Protection of the Environment Operations Act* 1997;
- *Contaminated Land Management Act* 1997;
- *Dangerous Goods Act* 2008;
- *Work Health and Safety Act* 2011;
- *Work Health and Safety Regulation* 2011;
- DUAP NSW EPA (1998) *State Environmental Planning Policy No. 55* (SEPP 55).

21.10 Community Engagement

The developer, Mirvac Homes (NSW) Pty Ltd (Mirvac), or their delegated representative will manage all community and stakeholder engagement. The remediation is part of a Development Application (DA) that requires approval by the consent authority (being Liverpool City Council) and as such also

requires certain public consultation. The following consultation (community / stakeholder engagement) has been completed to date:

- Mirvac has met with Council on a number of occasions regarding this development including a formal pre-DA meeting;
- As part of the Environmental Impact Statement (EIS) for the project, Mirvac has actively engaged with the surrounding residents via a letterbox drop of a fact sheet (Appendix K). To date Mirvac has not received any responses;
- Mirvac has also met with the owners of Flower Power (being the adjoining owners to the east) to discuss the development, and have attempted to meet with the owners of Moorebank Recyclers (being the adjoining owners to the south);
- The EIS also requires engagement with the relevant Government authorities and letters have been forwarded to them seeking comment;
- Once lodged at Council, the DA will most likely be exhibited by Council including a mail-out to the affected owners allowing them a month to provide comment; and
- Mirvac is scheduled to meet with the Moorebank Residents' Action Group on 20 December 2016.

In relation to community engagement and the site remediation component of the project, site signage in relation to project contact persons will be limited to that required by DA consent conditions and/or regulatory requirements, with additional signage indicating that public enquires shall be directed to the Mirvac or their delegated representative. A log of any communications between stakeholders (community) and Mirvac (or their delegated representative) shall be recorded.

The Environmental Consultant and Geotechnical Engineer will be available via Mirvac to provide specific feedback on any questions or complaints relevant to the remediation / earthworks component of the project. The log of communications between stakeholders (community) and Mirvac (or their delegated representative) shall be provided to the Environmental Consultant for inclusion in the site validation report.

21.11 Contact Details

The following table provides a list of personnel and contact details relevant to the remediation. The list should be filled in as relevant personnel are appointed to the remediation project.

Table 13: Contact Details

Role	Personnel / Contact	Contact Details (phone)
Principal	Ernest Dupere (Benedict)	0407 282 444
Principal's Representative	Brett Jarvis (Benedict)	0425 282 209
Site Manager	Marko Zrillic (Benedict)	0412 777 358
Environmental Consultant	John Russell (DP)	9809 0666
Gas Barrier Installation Contractor	TBA	TBA
Regulator	NSW EPA (pollution line)	131 555

Role	Personnel / Contact	Contact Details (phone)
Regulator	NSW EPA (general enquiries)	131 555
Consent Authority	Liverpool City Council	1300 36 2170
Utility Provider	Sydney Water	13 20 92
Utility Provider	Power	TBA
Utility Provider	Gas	TBA

Notes to table:

Table to be completed when the contact details are known.

22. Provisional Project Timeframe

The following provides a provisional project timeframe for bulk earthworks and associated remediation earthworks and subsequent construction phases. The project timeframe provided below is only indicative and will be subject to amendment as the project proceeds. The project timeframe should be regularly updated and the Environmental Consultant should provide a revised copy to the Site Auditor every 3-month period.

Table 14: Provisional Project Timeframe

Item	Year 1			Year 2			Year 3			Year 4		
Stage 1a: Deep Fill Earthworks												
Stage 1b: General Site Preparation Earthworks												
Stage 2: VENM Capping				IV1								
Retaining Wall Construction					IV2							
Construction of Dwellings												
Stage 3: Installation of Landfill Gas Mitigations						IV3/ EMP	IV3	IV3	IV3	IV3	IV3	FV

Notes to table:

IV1: Interim Validation Report covering Stages 1 and 2 Earthworks

IV2: Interim Validation Report covering Construction of Retaining Wall

IV3: Interim Validation Reports covering installation of landfill gas mitigation measures for various stages of the development

EMP: Environmental Management Plan (generic document for all dwellings with landfill gas mitigation systems)

FV: Final Validation Report to close out any remaining site validation issues such as long term landfill gas and groundwater / surface water monitoring

At this stage DP understand that a single Section B SAS is required for the entire site. It is not known whether a single Section A SAS will be required for the whole site, or whether more than one Section A SAS will ultimately be necessary to support a staged development.

23. Validation Report

Validation assessment reports will be prepared by the Environmental Consultant for the various stages of the project with reference to OEH (2011) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*. The reports will be submitted to Council at the completion of the various stages of the remediation works programme. The objective is for the validation reports to confirm that the site has been remediated to a suitable standard for the proposed redevelopment and occupation and that no related adverse human health and environmental effects have occurred as a result of the works. The validation reports will also include a summary of the information from previous investigations.

The major components of the validation reporting are summarised in where the Stages 1 and 2 validation report is discussed in Section 19.1 and the Stage 3 validation reports in Section 19.2.

In summary, the validation report(s) will include:

- Landfill gas and surface water monitoring reports (validation monitoring programme);
- Geotechnical report(s);
- Details of the earthworks;
- Analytical test results (e.g. initial testing regime on screened material from the current trial remediation excavation and subsequent validation of filling to form part of the upper 3 m);
- Waste classification results;
- The final disposal destination of the materials removed from site and disposal dockets, where appropriate including all necessary waste tracking information, waste disposal (weighbridge dockets) and waste reconciliation information verifying that the volumes taken off site match the disposed amounts;
- Photographic record during the works including gas ventilation and membrane installation;
- Gas mitigation CQA documentation, including the results of membrane integrity testing;
- All environmental monitoring results and sampling locations, including air quality, surface water, groundwater, landfill gas, geotechnical validation results, filling and construction records (for the landfill gas mitigation measures), including CQA data;
- Records of imported VENM including all relevant material tracking information as set out in the FMP including movement of material within the site (stockpiling and final repository);
- Details of any unexpected finds or environmental incidents; and
- Survey information confirming the thickness of final site capping.

24. Long Term Environmental Management Plan

A Long Term Environmental Management Plan (LTEMP) will be required for the ongoing management of contamination remaining on site and landfill gas mitigation systems. The (post construction) LTEMP should include:

- Procedures for the management and maintenance of the cap and landfill gas mitigation systems; and
- Procedures for scenarios where the capping or landfill gas mitigation systems need to be penetrated and reinstated.

The LTEMP will require establishment of appropriate public notification under Section 149(2) of the EP&A Act or a covenant registered on the title to land under Section 88B of the Conveyancing Act 1919. The formal LTEMP would be prepared prior to or during remediation and finalised following validation of the remedial activities.

At present it is not feasible to provide exact details of the contents of the LTEMP as this will depend on the outcome of site validation. Notwithstanding, the overall purpose and objectives of the LTEMP will be to set out the measures necessary for the maintenance of environmental mitigation measures for soil, soil gas and groundwater throughout the tenure of proposed land use and will provide a means of managing the remaining contamination on the site within the context of the proposed residential land use. No ongoing monitoring is envisaged in the post construction environment, although the LTEMP will contain contingencies in this regard.

The LTEMP will summarise the nature and extent of remaining contamination on the site and must be imposed on the land under one of the above mechanisms. In addition the LTEMP must be:

(i) agreed with the local council,

(ii) be reasonably legally enforceable as set out in Section 3.4.6 of the Guidelines for the DEC (2006) (or subsequent amendments),

(iii) provide measures to ensure that future on-site and off-site environmental and human health risks are minimised and are maintained at acceptable levels,

(iv) provides a mechanism for updating, revising and reviewing the LTEMP in light of any new environmental information resulting from events, incidents or monitoring,

(v) provide a mechanism to ensure that the LTEMP and any subsequent revisions are provided to all relevant land holders/owner/occupiers within the site,

(vi) provides a mechanism for landholder feedback through an ongoing community consultation mechanism,

(vii) provides a mechanism restricting future groundwater abstraction,

(viii) provides a mechanism to prevent and/or regulate future excavations/penetrations through the capping system beyond the specified depths of 1.6 m (into VENM) and 3 m (engineered cap) for example excavations for service installation or maintenance of buried services,

(ix) requires than development consent is required for any future excavations deeper than 2.5 m bgl from Liverpool City Council,

(x) provides procedures for the filling of planned or inadvertent filling and sealing of breaches in the capping system, and

(xi) requires periodic checking by an environmental / geotechnical consultant to confirm that the overall integrity of the cap has not been compromised and that the capping system remains functional and complies with the requirements of the LTEMP.

Further details are also provided in Section 16.1.9. A preliminary LTEMP will be prepared for auditor agreement and will be provided for approval by Council prior to the finalisation of the Stage 1 works, or will accompany the DA for the first group of houses.

The site will be remediated to the extent that only passive landfill gas mitigation measures will be required, and in order that the final version of the LTEMP will support the preparation of a Section A SAS. The final version of the LTEMP will be prepared by the Environmental Consultant and provided to the Site Auditor for review and approval. The Site Auditor will then send a final version of the LTEMP to Council for their written approval prior to the issuing of a Section A SAS.

The LTEMP will remain in force until such time as the Environmental Consultant, the Site Auditor and NSW EPA agree that it is no longer necessary.

25. Conclusion

It is considered that remediation of the site in accordance with the procedures and validation methods outlined in this RAP will render the site suitable for the proposed residential development.

The proposed validation monitoring of landfill gas and surface water may also allow modifications (e.g. a lowering of the CGS for the site) to the proposed scope and general methodology of remediation that has been recommended in this RAP. Any modifications would be subject to approval by the Site Auditor and agreement with the Geotechnical Consultant.

The detailed design of buildings incorporating the required gas mitigation measure(s) or system element(s) will necessarily be undertaken at the appropriate point in time of the project and under a separate DA associated with Stage 3 of the remediation.

DP considers that this RAP has met the objectives of a RAP specified in NSW EPA guidelines, SEPP55 guidelines and Council's contaminated land policy. These objectives are to:

- Set remediation goals that are likely to meet the conditions of a Development Consent so that the redevelopment area will be suitable for the proposed residential land uses and will pose no unacceptable risk to human health or the environment;
- Evaluate the range of remediation options available to address the existing site contamination issues, and thereby reduce risks to acceptable levels;
- Document the preferred remediation techniques and procedures;
- Establish the various safeguards required to complete the remediation work in a safe and environmentally acceptable manner;

- Identify the necessary approvals and licences required by regulatory authorities in order to enable the remediation works to proceed;
- Document a remediation strategy that will address on-site issues affecting future migration of contamination from the site; and
- Document a remediation strategy that will complement other regulatory requirements relevant to the remediation of contamination.

The proposed remediation strategy has included tasks that will address uncertainties that currently exist in relation to groundwater quality, composition of the 3 m 'engineered fill blanket' and the finalised GSV and CGS, as required by the NSW OEH (2011) guidelines.

DP considers that the site can be made suitable for its intended residential land use if the site is remediated in accordance with the RAP and managed in accordance with a LTEMP, as required by NSW OEH (2011) guidelines.

26. References

ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality

BSI 8485 (2015) Code of Practice for Design of Protective Measures for Ground Gases

CIRIA (2007) C665 Assessing Risks Posed by Hazardous Ground Gases to Buildings

CIRIA (2014) C735 Good Practice on the Testing and Verification of Protection Systems for Buildings against Hazardous Ground Gases

DoH (2009) Guidelines for the Assessment and Remediation and Management of Asbestos-Contaminated Sites in Western Australia

DUAP NSW EPA (1998) State Environmental Planning Policy No. 55 (SEPP 55)

Dames & Moore (1994) Report on Groundwater Sampling

Dames & Moore (2000) Landfill Groundwater and Surface Water Monitoring and Assessment Program

DEC (2006) Guidelines for the NSW Site Auditor Scheme (2nd Edition)

DEC (2007) Guideline for the Assessment and Management of Groundwater Contamination

DP (1999) Proposed Environmental Monitoring Program, Sorting, Recovery and Transfer (SRT) Facility, 146 Newbridge Road, Moorebank

DP (2002a) Preliminary Geotechnical Assessment, 146 Newbridge Road, Moorebank

DP (2002b) Report on Preliminary Contamination Assessment, Proposed Residential Development, 146 Newbridge Road, Moorebank

DP (2002c) Geotechnical Assessment, 146 Newbridge Road, Moorebank

DP (2005) Proposed Mixed Commercial / Residential Development, 146 Newbridge Road, Moorebank

DP (2008) Preliminary Desktop Review, Benedict Sand and Gravel, Moorebank

DP (2009a) Desktop Review, Benedict Sand and Gravel, Moorebank

DP (2009b) Environmental and Geotechnical Advice, Benedict Sand and Gravel, 146 Newbridge Road, Moorebank

DP (2009c) Review of Foundation Options, Proposed Residential Development, 146 Newbridge Road, Moorebank

DP (2009d) Compaction and Grading, 146 Newbridge Road, Moorebank

DP (2014a) Initial Comments on the Design of Landfill Gas Mitigation Measures 146 Newbridge Road, Moorebank Stage 1

DP (2014b) Draft Concept Design for Landfill Gas Mitigation Measures, 146 Newbridge Road, Moorebank Stage 1

DP (2015a) Construction Environmental Management Plan, Proposed Retaining Wall, 146 Newbridge Road, Moorebank, NSW

DP (2015b) Sampling and Analysis Quality Plan, Proposed Residential Subdivision, 146 Newbridge Road, Moorebank, NSW

DP (2015c) Report on Geotechnical Investigation, Proposed Residential Subdivision, 146 Newbridge Road, Moorebank

DP (2015d) Report on Geotechnical Investigation, Retaining Wall, 146 Newbridge Road, Moorebank

DP (2016) Detailed Site Investigation, Proposed Residential Development, 146 Newbridge Road, Moorebank

EIS (2013) Stage 1 Environmental Site Assessment for Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014a) Preliminary Hazardous Ground Gas Screening for the Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014b) Hazardous Ground Gas (HGG) Screening Results (Round 2), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014c) Hazardous Ground Gas (HGG) Screening Results (Round 3), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014d) Hazardous Ground Gas (HGG) Screening Results (Round 4), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014e) Hazardous Ground Gas (HGG) Screening Results (Round 5), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EMM (2015) Preliminary Investigation of Contamination, Proposed Georges Cove Marina

EMM (2016a) Supplementary Preliminary Investigation, Proposed Georges Cove Marina

EMM (2016b) Remediation Action Plan, Proposed Georges Cove Marina

J&K (2013) Geotechnical Investigation for Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

J&K (2016a) Geotechnical Evaluation for Proposed Residential Subdivision at 146 Newbridge Road, Moorebank, NSW

J&K (2017) Geotechnical Evaluation for Proposed Residential Subdivision at 146 Newbridge Road, Moorebank, NSW

J&K (2016b) Response to RAP Comments (ref: 26903Zemail3)

NEPC (2013) National Environment Protection (Assessment of Site Contamination) Measure 1999 amended 2013

NHMRC (2016) Australian Drinking Water Guidelines

NSW EPA (2016) Environmental Guidelines: Solid Waste Landfills [Second Edition 2016]

NSW EPA (2012) Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases

NSW EPA (1995) Sampling Design Guidelines

NSW EPA (2014a) Waste Classification Guidelines, Part 1: Classifying Waste

NSW EPA (2014b) Waste Classification Guidelines Part 2: Immobilisation of Waste

OEH (2011) Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites

SA EPA (2010) Guideline for stockpile management: Waste and waste derived products for recycling and reuse

Safe Work Australia (2011) Confined Spaces, Code of Practice

Vic EPA (2010) Soil Sampling

27. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 146 Newbridge Road, Moorebank in accordance with DP's proposal dated 26 April 2016 and acceptance received from Mr Ernest Dupere dated 26 April 2016. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Benedict Industries Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations

or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Asbestos has previously been detected by observation or by laboratory analysis at the site, either on the surface of the site, or in filling materials at the test locations sampled and analysed. Building demolition materials, such as concrete, brick, tile, timber, plastic, are ubiquitous throughout the fill at the site, and these are considered as indicative of the possible presence of hazardous building materials (HBM), including asbestos. It is therefore considered possible that HBM, including asbestos, may be during bulk earthworks associated with the proposed development, and hence no warranty can be given that asbestos is not present.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards associated with future design aspects relevant to our input to the project, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the environmental components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

Site Drawings



Douglas Partners Geotechnics / Environment / Groundwater	TITLE: Site Locality Remediation Action Plan 146 Newbridge Road, Moorebank, NSW		N MGA	OFFICE: Sydney DRAWN BY: MJC DATE: 29.04.2016
CLIENT: Benedict Industries Pty Ltd	PROJECT No: 71459.06	DRAWING No: 1	REVISION: A	SCALE: As shown



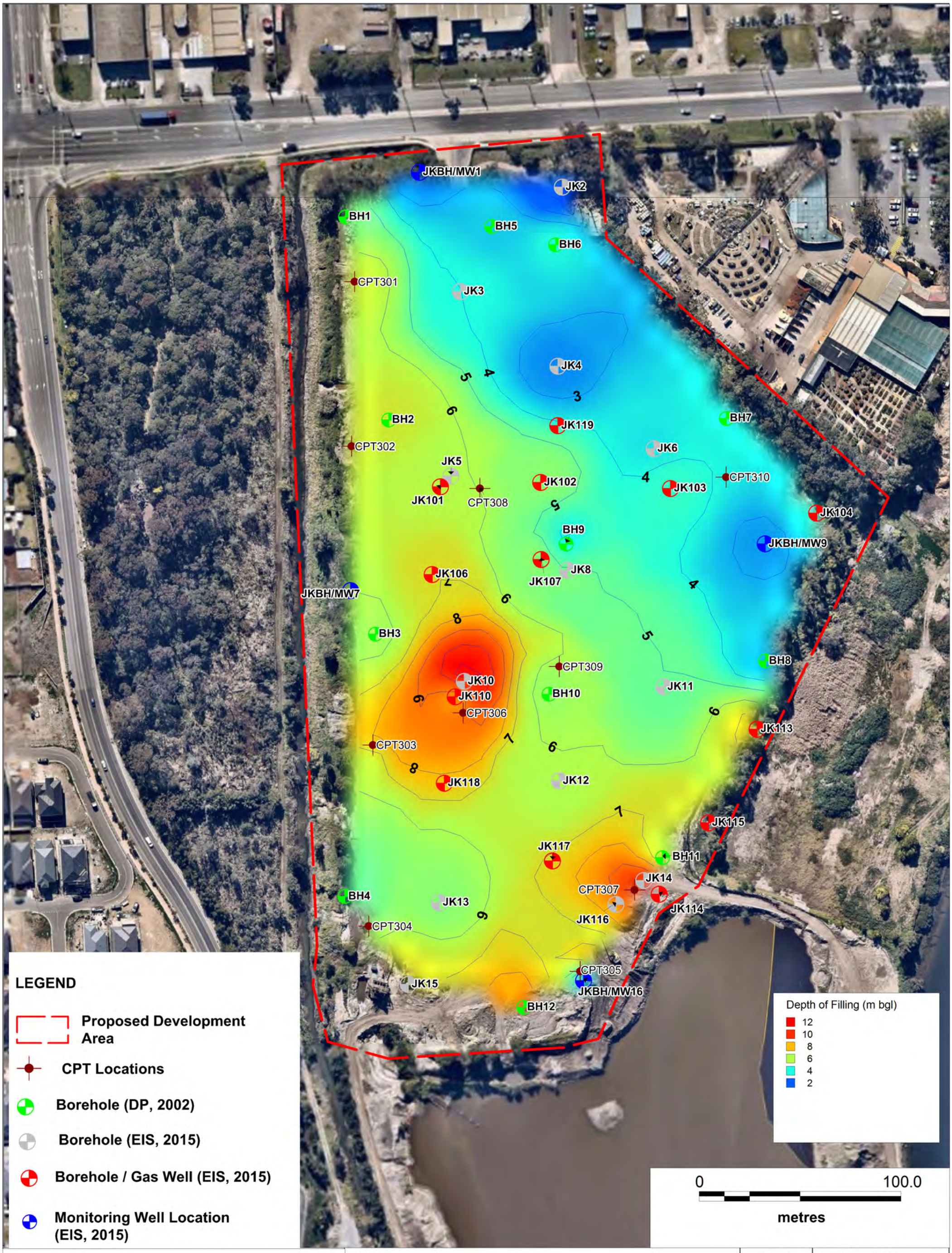
Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Previous Test Locations
Remediation Action Plan
146 Newbridge Road, Moorebank, NSW

MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 29.04.2016

CLIENT:	PROJECT No:	DRAWING No:	REVISION:	SCALE:
Benedict Industries Pty Ltd	71459.06	2	A	As shown



Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Depth of Filling Contours

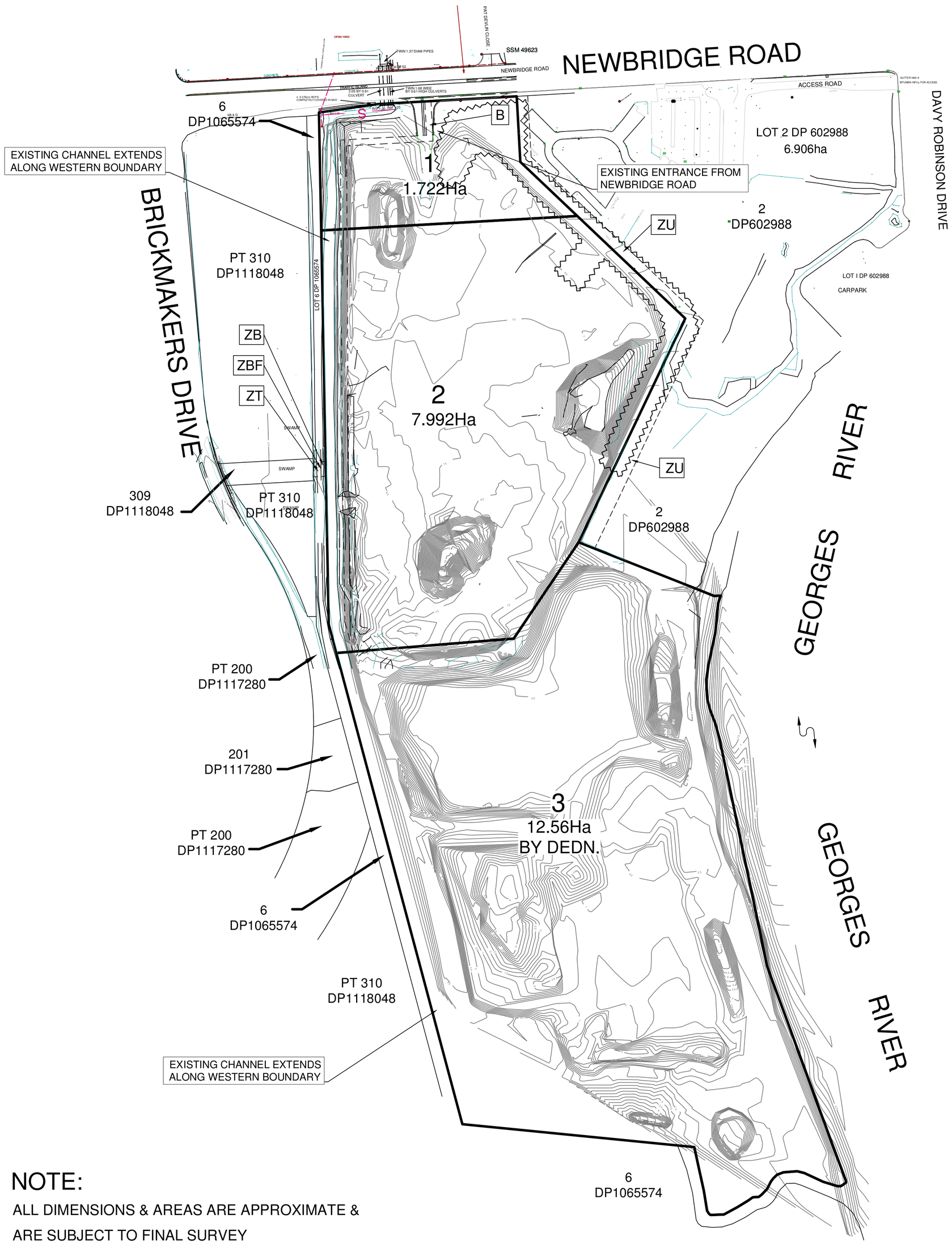
146 Newbridge Road, Moorebank, NSW

CLIENT: Benedict Industries Pty Ltd	PROJECT No: 71459.04	DRAWING No: 2	REVISION: A	SCALE: As shown

OFFICE: Sydney
DRAWN BY: MJC
DATE: 13.11.2015

Appendix B

Drawings of the Proposed Development



N

AN EXISTING SURFACE MODEL WAS CREATED USING A COMPILATION OF VARIOUS TOPOGRAPHIC SURVEYS OF THE SUBJECT SITE BY JMD INCLUDING MATERIAL STOCKPILES WHICH WERE COMPLETED FOR BENEDICT IN 2014, 2015 AND 2016 AS WELL AS A DETAIL SURVEY BY FREEBURN SURVEYORS 23-10-2013.

SMALLER TEMPORARY STOCKPILES HAVE NOT BEEN SHOWN HOWEVER THE AREA BENEATH A NUMBER OF THE TEMPORARY STOCKPILES WAS ASSUMED TO GRADE CONSISTENTLY BETWEEN THE BOTTOM OF THE STOCKPILES. THE THREE LARGER STOCKPILES HAVE BEEN SHOWN.

NOTES:

1. THESE NOTES AND LEGEND (IF SHOWN) FORM PART OF THE PLAN AND SURVEY AND MUST REMAIN WITH THE PLAN IN ANY REPRODUCTION IN WHOLE OR PART.
2. THE SURVEY INFORMATION SHOWN HERE WAS PREPARED FOR A SPECIFIC PURPOSE FOR THE CLIENT SHOWN. THE INFORMATION IS NOT TO BE USED FOR ANY OTHER PURPOSE OR BY ANYONE NOT AUTHORISED BY THIS CLIENT.
3. IF THIS PLAN HAS BEEN PROVIDED IN ELECTRONIC FORMAT, BE ADVISED THAT THE POSITION OF SOME DETAIL IS SHOWN DIAGRAMMATICALLY ONLY, IN ORDER TO PROVIDE CLARITY ON THE HARD COPY PLAN. SOME TEXT AND LINESTYLES MAY BE SHOWN IN INCORRECT POSITIONS OR DIFFERENTLY TO THAT INTENDED, AS YOU MAY BE VIEWING THE DRAWING IN AN INCOMPATIBLE PROGRAM OR VERSION. THE HARD COPY PLAN IS TO BE USED TO CHECK TEXT AND LINESTYLES.
4. THIS PLAN HAS BEEN PREPARED FOR HARD COPY (OR PDF) FORMAT ONLY AND IF PROVIDED IN CAD FORMAT ALL DIMENSIONS HEREON TAKE PRECEDENCE OVER ANY INTERROGATION OF LINEWORKS IN THE CAD FILE.
5. THE PROPOSED BOUNDARY DIMENSIONS SHOWN ARE APPROXIMATE ONLY. THEY HAVE BEEN COMPILED FROM TITLE DIAGRAMS AND ADJOINING DEPOSITED PLANS AND ARE SUBJECT TO SURVEY

6. B DENOTES PROPOSED RIGHT OF CARRIAGEWAY (5 WIDE)
   ZB DENOTES EXISTING RIGHT OF CARRIAGEWAY (12 WIDE - LIMITED IN HEIGHT TO RL7.2)
   ZBF DENOTES EXISTING RIGHT OF FOOTWAY (12 WIDE - LIMITED IN HEIGHT TO RL7.2)
   ZT DENOTES EXISTING EASEMENT FOR CONSTRUCTION, MAINTENANCE & REPAIR OF A ROAD BRIDGE (12 WIDE)
   ZU DENOTES EXISTING EASEMENT FOR BATTER (9 & 14 WIDE)

0 10 20 40 60 80 100 200
SCALE :- 1 : 2000 Metres (A1)

NOTE:

ALL DIMENSIONS & AREAS ARE APPROXIMATE &
ARE SUBJECT TO FINAL SURVEY

Issue	App	Date	Description
A	S.G.	24-01-2017	ISSUED FOR DA

Client: MIRVAC HOMES (NSW) PTY LTD.
Designed by : S.G.
Date of Drawing : 24-01-2017
Ratio (A1) : 1:2000

Datum : AHD
Origin of Levels :
Date of Survey : N/A

JMD Development Consultants

John M. Daly & Associates PTY LTD
Surveying Engineering Project Management Licensed Water Service Co ordinators
A.B.N. 88051977989
32 Iolanthe Street
P.O. BOX 25
CAMPBELLTOWN N.S.W. 2560
PH. (02) 4625 5055
FAX (02) 4628 2013
email: admin@jmd.com.au

Project : MOOREBANK COVE - STAGE 2
NEWBRIDGE ROAD, MOOREBANK

Sheet 1 of 4 sheets

PLAN OF EXISTING FEATURES OVER STAGE 1

Ref: 14005-DS1

Locality : MOOREBANK
L.G.A. : LIVERPOOL
CAD Ref: S:\DATA\14\14005\14005 EMW\ENG\CAD\E6-RESI DA PLANS\14005E6-ADD1

The ratio shown on this plan relates to the original plan, produced by JMD only. Any photocopying or printing from digital files provided (particularly PDF files) may significantly alter the ratio of the plan.

AS DIRECTED BY BENEDICT, AN EXISTING SURFACE MODEL WAS CREATED USING A COMPILATION OF VARIOUS TOPOGRAPHIC SURVEYS OF THE STOCKPILES COMPLETED FOR BENEDICT IN 2014, 2015 & 2016.

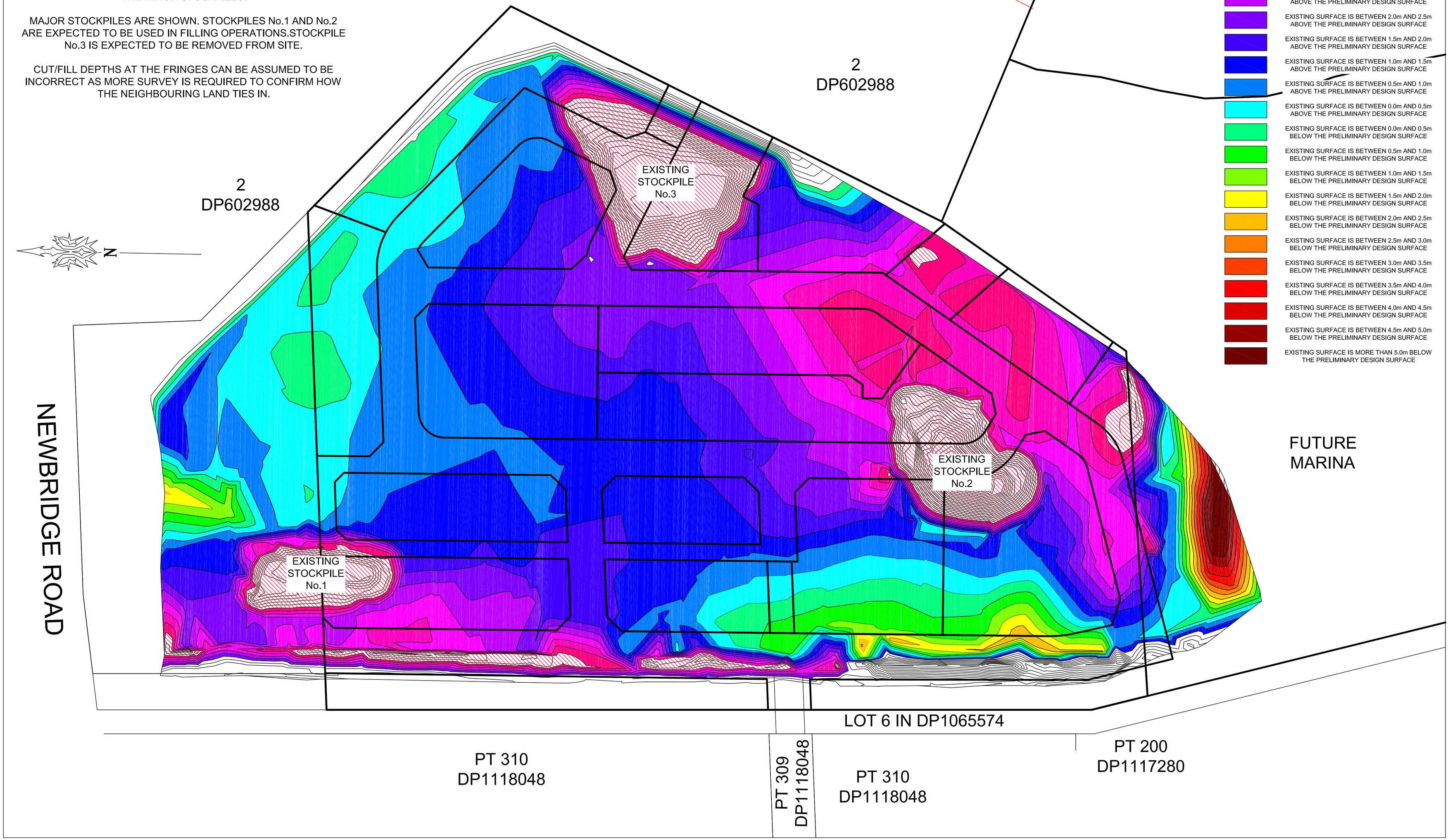
THE AREA BENEATH A NUMBER OF THE MINOR STOCKPILES WAS ASSUMED TO GRADE CONSISTENTLY BETWEEN THE BOTTOM OF THE MINOR STOCKPILES.

MAJOR STOCKPILES ARE SHOWN. STOCKPILES No.1 AND No.2 ARE EXPECTED TO BE USED IN FILLING OPERATIONS.STOCKPILE No.3 IS EXPECTED TO BE REMOVED FROM SITE.

CUT/FILL DEPTHS AT THE FRINGES CAN BE ASSUMED TO BE INCORRECT AS MORE SURVEY IS REQUIRED TO CONFIRM HOW THE NEIGHBOURING LAND TIES IN.

PRELIMINARY FILL PLAN BASED ON A FINISHED SURFACE THAT IS 3m BELOW THE FINISHED SURFACE LEVEL MODEL (i.e. BOTTOM OF THE CAPPING LAYER) PREPARED BY JMD FOR THE RESIDENTIAL DEVELOPMENT APPLICATION.

THE FINISHED SURFACE LEVEL USED IN THIS MODEL INCLUDES PRELIMINARY BULK EARTHWORKS LEVELS ALONG THE WESTERN RETAINING WALL.



Issue	App	Date	Description
A	T.H.	01-09-2016	PRELIMINARY FOR REVIEW

Client: MIRVAC HOMES (NSW) PTY LTD.

Designed by : S.G.

Date of Drawing : 01-09-2016

Ratio (A1) : 1:750

Datum : AHD

Origin of Levels :

Date of Survey : VARIOUS

JMD Development Consultants

John M. Daly & Associates PTY LTD
A.B.N. 88051977989
Surveying
Engineering
Project Management
Licensed Water Service Co ordinators

32 Iolanthe Street
P.O. BOX 25
CAMPBELLTOWN N.S.W. 2560

PH. (02) 4625 5055
FAX (02) 4628 2013
email: admin@jmd.com.au

Project : MOOREBANK COVE DEVELOPMENT
NEWBRIDGE ROAD, MOOREBANK

Sheet 1 of 1 sheets

PRELIMINARY FILL PLAN OF THE RESIDENTIAL PORTION OF LOT 7 DP1065574
ABOVE THE BOTTOM OF THE CAPPING LAYER (i.e. 3m BELOW PROPOSED FSL)

Ref: 14005-FILL2

Locality : MOOREBANK

L.G.A. : LIVERPOOL

CAD Ref: C:\USERS\SGRAY\DESKTOP\14005\14005FILL2

This ratio shown on this plan relates to the original plan, produced by JMD only. Any photocopying or printing from digital files provided (particularly PDF files) may significantly alter the ratio of the plan.

RAINGARDEN No.1 (NORTHERN RAINGARDEN)

NEWBRIDGE ROAD

LOT 1 CREATED UNDER STAGE 1 IS TO BE DEVELOPED AS COMMERCIAL DEVELOPMENT

SUPERLOTS 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 & 16 ARE TO BE FURTHER DEVELOPED INTO RESIDENTIAL LOTS.

LOT 17 MAY BE USED AS A FUTURE ROAD CONNECTION OR BE DEVELOPED INTO RESIDENTIAL LOTS.

LOT 18 IS TO BE A DEDICATED AS A DRAINAGE RESERVE

LOT 19 IS TO BE DEDICATED AS A DRAINAGE RESERVE

LOT 20 IS TO BE DEDICATED AS A PUBLIC RESERVE

12m (RADIUS) TEMPORARY CUL-DE-SAC TO BE CONSTRUCTED UNTIL WHICH TIME THE FUTURE COLLECTOR ROAD IS CONSTRUCTED

NORTHERN CATCHMENT AREA OF THE RESIDENTIAL DEVELOPMENT DRAINING TO RAINGARDEN No.2

CATCHMENT BOUNDARY

BRIDGE TO BE CONSTRUCTED UNDER DA1552/2006B

BRICKMAKERS DRIVE

SOUTHERN CATCHMENT AREA OF THE RESIDENTIAL DEVELOPMENT DRAINING TO RAINGARDEN No.2

PROPOSED DRAINAGE EASEMENT TO DRAIN MAJOR FLOWS TO RIVER

RAINGARDEN No.2 (SOUTHERN RAINGARDEN)

GEORGES RIVER

PROPOSED DRAINAGE EASEMENT TO DRAIN LOW FLOWS FROM RAINGARDEN TO RIVER

LOT 3 CREATED UNDER STAGE 1 IS TO BE SUBDIVIDED TO ALLOW THE CREATION OF ROAD No.2. RESIDUE LOT (LOT 21) IS TO BE DEVELOPED INTO A MARINA

1 DP (UNREG)

ROAD NO. 1, ROAD NO. 2, ROAD NO. 3, ROAD NO. 4, ROAD NO. 5, ROAD NO. 7, ROAD NO. 9, ROAD NO. 11, ROAD NO. 12

PROPOSED STAGE 2 WORKS

RATIO 1:1000

N

NEWBRIDGE ROAD

FUTURE B6 (COMMERCIAL) DEVELOPMENT TO BE COMPLETED BY OTHERS INCL. COLLECTOR RD CONNECTING TO LOT 2 DP602988

1 DP (UNREG)

2 DP602988

BRICKMAKERS DRIVE

PT 310 DP1118048

PT 309 DP1118048

PT 310 DP1118048

PT 200 DP1117280

201 DP1117280

PT 200 DP1117280

PT 310 DP1118048

6 DP1065574

POTENTIAL FUTURE RESIDENTIAL LOT LAYOUT SUBJECT TO CHANGE BASED ON FUTURE HOUSE & DA'S SITING

2 DP602988

GEORGES RIVER

PROPOSED FUTURE MARINA TO BE CONSTRUCTED UNDER DA 846/2012 TO BE DESIGNED & CONSTRUCTED BY OTHERS

GEORGES RIVER

FUTURE FORESHORE DEDICATION

6 DP1065574

SCALE :- 1 : 2000

SCALE :- 1 : 1000

OVERALL DEVELOPMENT PLAN

RATIO 1:2000

Issue	App	Date	Description
A	T.H.	20-11-2016	ISSUED FOR DA

Client: MIRVAC HOMES (NSW) PTY LTD.

Designed by : S.G.

Date of Drawing : 20-11-2016

Ratio (A1) : 1:1000/1:2000

Datum : AHD

Origin of Levels :

Date of Survey : N/A

JMD Development Consultants

John M. Daly & Associates PTY LTD
A.B.N. 88051977989
Surveying
Engineering
Project Management
Licensed Water Service Co ordinators
32 Iolanthe Street
P.O. BOX 25
CAMPBELLTOWN N.S.W. 2560
PH. (02) 4625 5055
FAX (02) 4628 2013
email: admin@jmd.com.au

Project : MOOREBANK COVE - STAGE 2
NEWBRIDGE ROAD, MOOREBANK

Sheet 1 of 3 sheets

OVERALL PLAN SHOWING CATCHMENTS

Ref: 14005E10

Locality : MOOREBANK

L.G.A. : LIVERPOOL

CAD Ref: S:\DATA\14\14005\14005 EMW\ENG\CAD\E10 RAINGARDEN SUPPORT\14005E10-PLAN

The ratio shown on this plan relates to the original plan, produced by JMD only. Any photocopying or printing from digital files provided (particularly PDF files) may significantly alter the ratio of the plan.

DP602988

208.6

310

'1118048

311

FUTURE RESIDEN

POCKET PARK
334.40 m²

POCKET PARK
1357.97 m²

AREA OF LOT 31
TO BE REZONED R3:
4190 SQM

TOTAL 179 LOTS

rev:	date:	amendment:
A	21.11.16	ISSUE FOR INFORMATION

project:
GEORGES COVE MARINA
Newbridge Road
Moorebank NSW 2170

Copyright of the design and other information shown here is owned by Mirvac Design pty. ltd. Reproduction or use of the design by any party for any purpose is expressly forbidden without the written permission of Mirvac Design pty. ltd.

architect:
MIRVAC DESIGN
architects
planners
interior designers

Level 26, 60 Margaret St.
Sydney, NSW, 2000
tel. 02 9080 8000
fax. 02 9080 8181
Mirvac Design Pty. Ltd.
ABN 78 003 359 153

mirvac

title:
CONCEPT PLAN
Reduced Site Area
Option 20y

drawn:
approved:

job no: .....

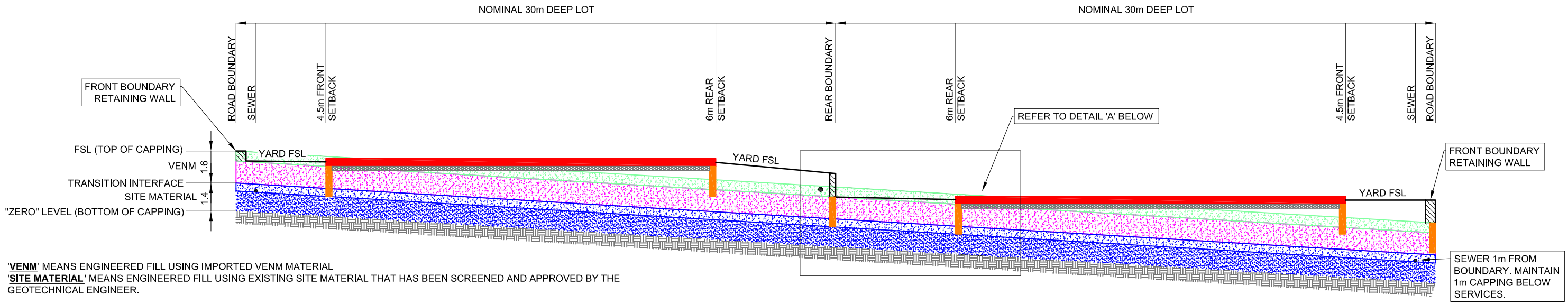
lot no: 0

date: 21-11-2016

drawing no: MP01-20y

scale @ A0:1:500

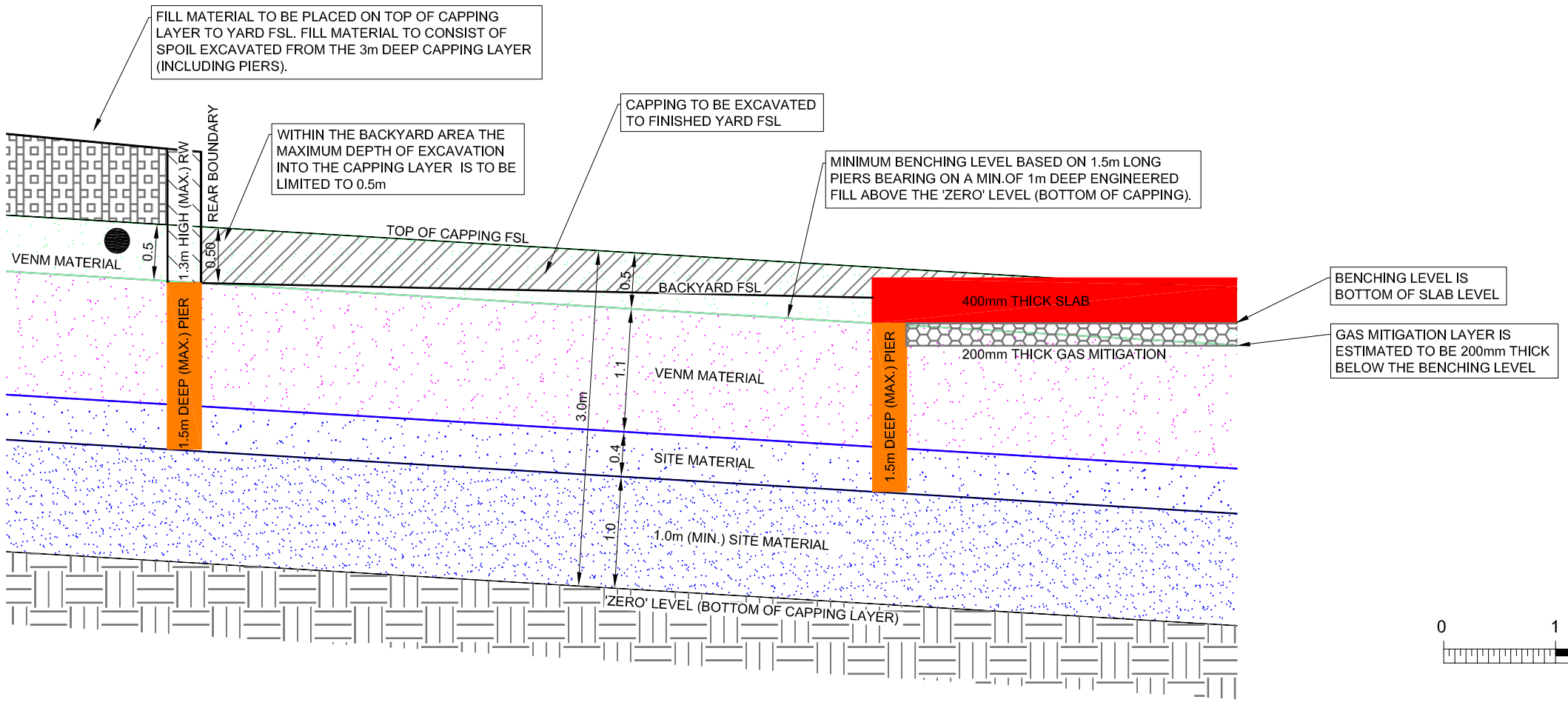
rev: B



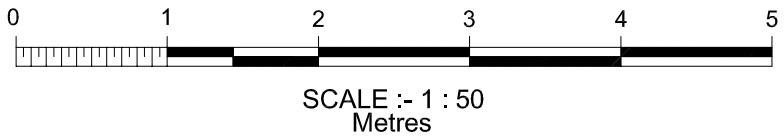
'**VENM**' MEANS ENGINEERED FILL USING IMPORTED VENM MATERIAL
'**SITE MATERIAL**' MEANS ENGINEERED FILL USING EXISTING SITE MATERIAL THAT HAS BEEN SCREENED AND APPROVED BY THE GEOTECHNICAL ENGINEER.

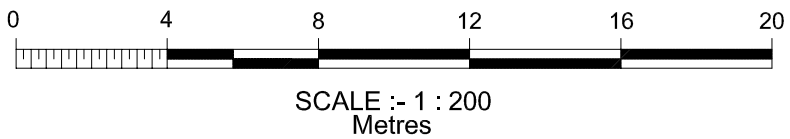
ALL ENGINEERED FILL TO BE PLACED UNDER LEVEL 1 GEOTECHNICAL SUPERVISION

TYPICAL HOUSE BENCHING SECTION
SHOWING CUT AND FILL WITHIN THE CAPPING LAYER
RATIO 1:200



DETAIL A - PIER, CUT AND FILL DETAILS
RATIO 1:50





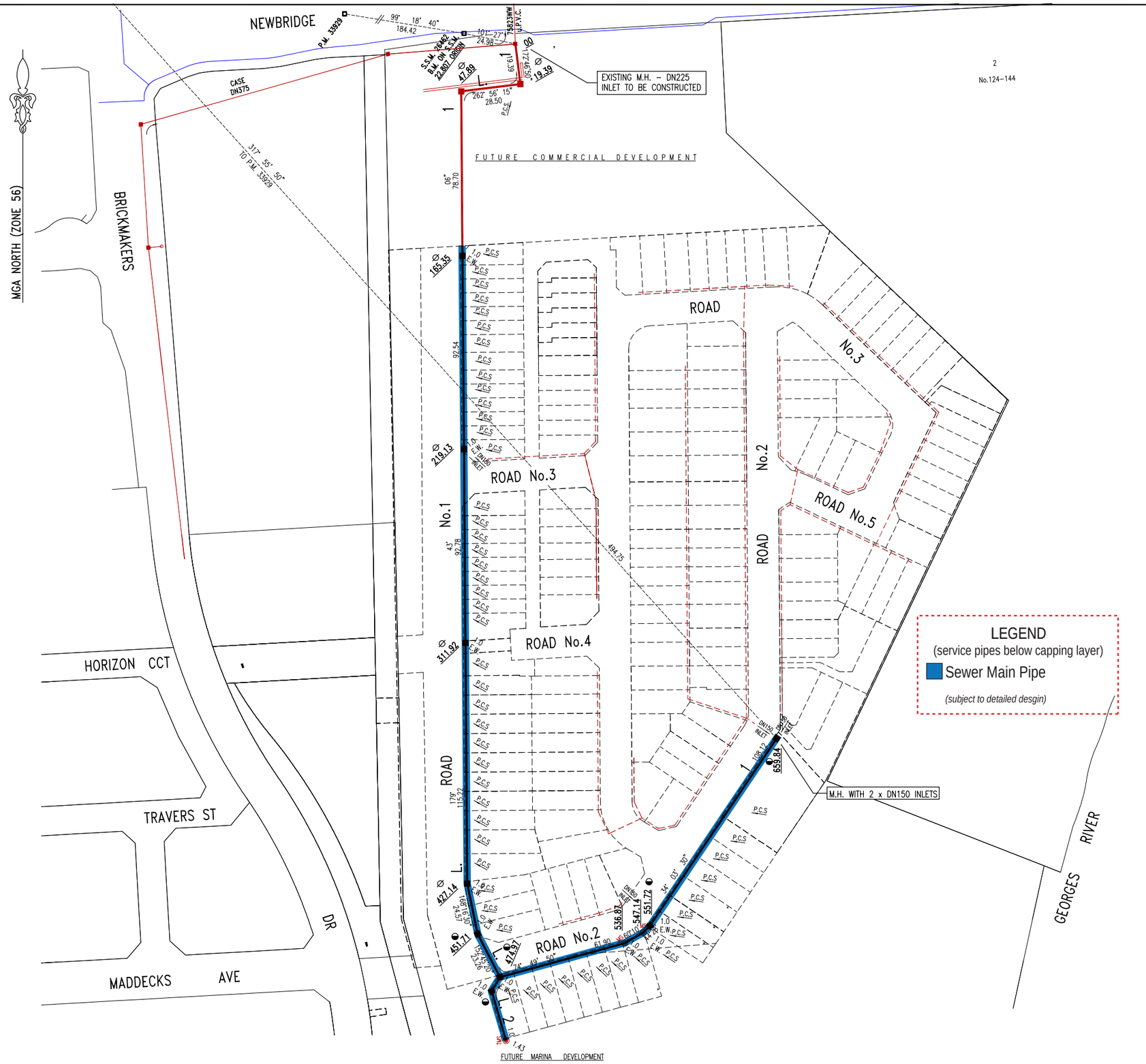
B 13-03-2017 MINOR AMENDMENTS TO NOTES, SERVICES ADDED
A 09-03-2017 ORIGINAL ISSUE FOR COMMENT

Client: MIRVAC HOMES (NSW) PTY LTD.	Ratio (A3) : 1:200 & 1:50	JMD Development Consultants	John M. Daly & Associates PTY LTD A.B.N. 88051977989 Surveying Engineering Project Management Licensed Water Service Co ordinators 32 Iolanthe Street P.O. BOX 25 CAMPBELLTOWN N.S.W. 2560 PH. (02) 4625 5055 FAX (02) 4628 2013 email: admin@jmd.com.au	Project : MOOREBANK COVE - NEWBRIDGE ROAD, MOOREBANK	Sheet 1 of 1 sheets
Origin of Levels : N/A	Date of Survey :			TYPICAL HOUSE BENCHING SECTION SHOWING CUT AND FILL WITHIN THE CAPPING LAYER	Ref: 14005E15
Datum : AHD	Designed By : S.G. Approved : T.H.			Locality : MOOREBANK / L.G.A. : LIVERPOOL / CAD Ref: c:\users\sgray\desktop\14005\14005e15.dwg	

The ratio shown on this plan relates to the original plan, produced by JMD only. Any photocopying or printing from digital files provided (particularly PDF files) may significantly alter the ratio of the plan.

A1

DEVELOPER CONTRACT PLAN
LEAK TIGHT SEWER SPECIFICATION



0 5 10 20 30 40 50 100 METRES

DATUM LINE OF AZIMUTH
P.M. 33929–SSM 26462 99°18'40" MGA
(ALL DISTANCES SHOWN ARE GROUND DISTANCES)

NOTES :

1. WATER SERVICING COORDINATOR & DESIGNER:
   CALIBRE CONSULTING (NSW) PTY LTD
   P.O. BOX 8300 BAULKHAM HILLS BC NSW 2153
   Ph: (02) 8808 5000
   FOR:
   MIRVAC HOMES (NSW) PTY LTD
   LEVEL 28 200 GEORGE ST, SYDNEY NSW 2000
   Ph: (02) 9080 8848

2. THE WORKS AND MATERIAL ARE IN ACCORDANCE WITH THE SEWER RETICULATION CODE OF AUSTRALIA (WSA 02–2002–2.2 VERSION 3) INCLUDING THE SYDNEY WATER SUPPLEMENT AND APPENDICES AND THE TECHNICAL SPECIFICATION FOR LEAK TIGHT SEWER SYSTEMS (VERSION 8) 17/12/14.

3. ALL LOTS WERE VACANT AT TIME OF SURVEY.

4. ALL STRUCTURES TO BE CONSTRUCTED TO PROPOSED FINISHED SURFACE LEVELS. AS THE PFSL'S SHOWN ON THIS PLAN MAY BE SUBJECT TO CHANGE, THE CONSTRUCTOR IS TO LIAISE WITH THE SITE SUPERINTENDENT TO VERIFY ALL FINAL LEVELS AT TIME OF CONSTRUCTION. DEPTH TO INVERT SHOWN ON SECTIONS SHEETS 3 & 4 IS FROM EXISTING GROUND LEVEL.

5. PIPES CONCRETE ENCASED SHOWN ACCORDINGLY: SUPPORT TYPE 12U

6. ALL LEVELS ELECTRONICALLY GENERATED. NO LEVEL BOOK AVAILABLE.

7. ALL ROAD CROSSINGS TO BE BACKFILLED WITH 14:1 CEMENT STABILISED SAND.

8. CONCRETE BULKHEADS TO BE CONSTRUCTED AT REAR OF KERB FOR ALL ROAD CROSSINGS. REFER SEW–1206 & SEW–1207–V.

9. EXISTING & PROPOSED SERVICES ARE INDICATIVE ONLY. CURRENT SERVICES SEARCH & SITE CHECK OF ALL EXISTING SERVICES WILL BE NECESSARY PRIOR TO THE COMMENCEMENT OF WORK & APPROPRIATE PROCEDURES, PRECAUTIONS AND CARE NEED TO BE TAKEN BY THE CONSTRUCTOR WHEN WORKING IN CLOSE PROXIMITY TO SERVICES DURING CONSTRUCTION AND ANY DAMAGE TO EXISTING SERVICES IS TO BE RECTIFIED AT THE CONSTRUCTORS EXPENSE.

10. THE MINIMUM NUMBER OF FIELD COMPACTION TESTS REQUIRED TO SATISFY THE SEWERAGE CODE OF AUSTRALIA (CLAUSE 22.3.4.4) ARE:

    PIPE EMBEDMENT ZONE: NIL (SEE NOTE 13)
    TRENCH FILL ZONE – TRAFFICABLE: NIL (SEE NOTE 7)
    TRENCH FILL ZONE – NON–TRAFFICABLE: 10
    M.H. & M.S. ZONE: 18

11. PRECAUTIONS ARE NECESSARY IN THE VICINITY OF SUB–STATION & OTHER ELECTRICAL EARTHING.

12. CONSTRUCTOR TO PROVIDE WSC WITH CERTIFIED RED MARKED UP WAC DRAWINGS SHOWING ACCURATE DISTANCES OF PCS'S TO CENTRE OF DOWNSTREAM STRUCTURES & CHAINAGES OF CONCRETE ENCASED SECTIONS.

13. EMBEDMENT COMPACTION TESTING SUBJECT TO CLAUSE 22.3.3.1 OF SEWERAGE CODE OF AUSTRALIA. SELF COMPACTING METAL GRANULAR EMBEDMENT MAY BE USED

14. SUBSURFACE CONDITIONS, INCLUDING GROUNDWATER, INADEQUATE FOUNDATION CONDITIONS, CONTAMINATION, UNRECORDED BURIED MATERIAL OR OBJECTS, AND ARCHAEOLOGICALLY SIGNIFICANT ITEMS, MAY BE ENCOUNTERED DURING CONSTRUCTION, REQUIRING FURTHER ENVIRONMENTAL, GEOTECHNICAL OR ARCHAEOLOGICAL ASSESSMENT AND APPLICATION OF APPROPRIATE CONSTRUCTION METHODS AND STANDARDS.

15. MINIMUM ALLOWABLE BEARING PRESSURE FOR MAINTENANCE HOLES SHALL BE 100kPA. FOUNDATION MATERIAL TO BE INSPECTED BY A SUITABLY EXPERIENCED GEOTECHNICAL ENGINEER PRIOR TO PLACING BLINDING CONCRETE. CERTIFICATION TO BE PROVIDED TO WSC. ALSO REFER STD DWG SEW–1200

16. INVERT LEVEL OF EXISTING SEWER LINE 1–CH00 TO BE CONFIRMED PRIOR TO CONSTRUCTION. WSC TO BE ADVISED

◒ – DN1050 M.H. TO BE CONSTRUCTED IN ACCORDANCE WITH DTC–2203

Ø – DN1200 M.H. TO BE CONSTRUCTED IN ACCORDANCE WITH DTC–2200

PLAN DRAWN DATE: 29/11/16 VERSION: 01 SHEET 1 OF 1 SHEETS

PLAN TO BE READ IN CONJUNCTION WITH CURRENT SYDNEY WATER STANDARDS
SYDNEY WATER CORPORATION

PRIOR TO COMMENCEMENT OF EXCAVATION FOR PROPOSED AND EXISTING SERVICES CONTACT :-
DIAL BEFORE YOU DIG ..... Ph. 1100
ELECTRICITY ..... Ph. .....
GAS ..... Ph. .....
TELECOMMUNICATIONS ..... Ph. .....
GIVING AT LEAST 48 HOURS NOTICE.

UTILITIES

TYPE	DATE	REF.	TYPE	DATE	REF.

WORK AS CONSTRUCTED CERTIFICATION

DEVELOPER .....
WATER SERVICE CO-ORDINATOR .....
CONSTRUCTOR .....
COMPLETED ..... W.A.C. PREPARED .....

DESIGNER .....

I CERTIFY THAT THE WORKS HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE WORK AS CONSTRUCTED DRAWINGS.

PIPE SCHEDULE

SIZE DN	TYPE	CLASS	LENGTH	PIPE JOINING METHOD / NOTES
150	U.P.V.C.	SN8	184.87	
225	u.P.V.C.	SN8	507.36	

DESIGN HEAD ..... m
NO BOUNDARY TRAPS REQUIRED.

20m BELOW AUSTRALIAN HEIGHT DATUM

SCALES
PLAN 1:1000 SECTION { HOR. 1:1000 VERT. 1:250
CROSS SECTIONS ..... NATURAL
LENGTHS, DEPTHS & LEVELS ARE IN METRES.

NO AMENDMENTS ARE TO BE MADE TO THIS PLAN WITHOUT REFERENCE TO SYDNEY WATER. THIS PLAN IS NOT NECESSARILY UP TO DATE OR CORRECT AND SYDNEY WATER ACCEPTS NO RESPONSIBILITY.

U.B. DIRECTORY ..... MAP 270 E8 (41st Ed.)

SHEET 1 OF 3 File No. N/A

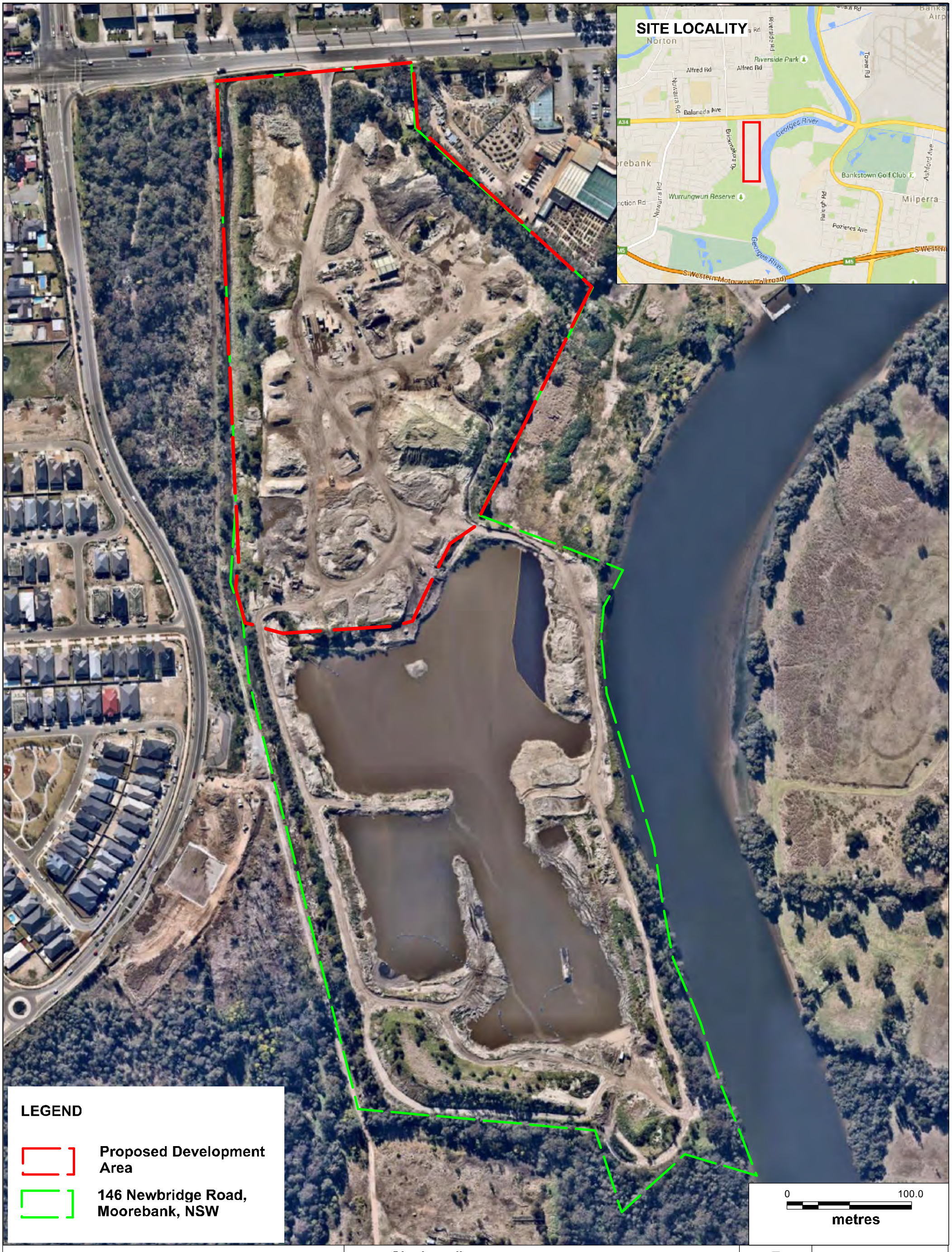
Sydney WATER SYDNEY WATER CORPORATION

Case No. 158048WW

LIVERPOOL SEWERAGE
DRAINS TO
MALABAR SEWAGE TREATMENT
SPO327

Appendix C

Drawings DP (2016)



Douglas Partners Geotechnics / Environment / Groundwater	TITLE: Site Locality Detailed Site Investigation 146 Newbridge Road, Moorebank, NSW	N MGA	OFFICE: Sydney DRAWN BY: MJC DATE: 14.10.2015
CLIENT: Benedict Industries Pty Ltd	PROJECT No: 71459.03	DRAWING No: 1	REVISION: A / SCALE: As shown



Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Test Locations
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 17.2.2016

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.03
DRAWING No: 2
REVISION: A
SCALE: As shown

Peak Methane Concentration %

60

40

20

0

Where a shallow and deep well are present at the one location, the well with the highest methane peak has been used to generate the contours.

Well ID	Well ID	Well ID
BH1	JK103	JK115
JKBH/MW16	JK104	JK119
JKBH/MW17	JK106	
JKBH/MW9	JK110	
JK101	JK113	
JK102	JK114	

LEGEND

- Proposed Development Area
- Surface Sample
- a Replacement Well
- b Shallow Gas Well
- Borehole / Gas Well
- Monitoring Well
- Borehole
- Borehole (DP, 2002)
- Borehole (EIS, 2015)
- Borehole / Gas Well (EIS, 2015)
- Monitoring Well Location (EIS, 2015)

JKBH/MW1, JK2, BH1, BH5, BH6, BH201, JK3, BH207, BH206, BH202, BH204, BH205, JK4, BH203, BH208, BH2, JK119, BH7, JK6, JK104, BH209, JK5, JK101, JK102, BH211, BH211b, BH210, JK103a, JK103b, BH9, BH212, JKBH/MW107a, JK107b, JK106, JK8, BH213, JKBH/MW9, BH214, JKBH/MW7, BH/MW216, BH215, BH3, BH8, JK10, JK110, BH10, JK11, JK113, SS217, BH/MW218, JK118a, JK118b, JK12, SS219, JK115, BH220, JK117, BH11, JK14, JK114, JK114b, BH4, JK13, JK116, BH221, BH224, JK15, JKBH/MW16, BH225, BH222, BH12, BH223

0 100.0 metres

Douglas Partners Geotechnics / Environment / Groundwater	TITLE: Peak Methane Concentration Contours 19/8/15 Detailed Site Investigation 146 Newbridge Road, Moorebank, NSW	N MGA	OFFICE: Sydney DRAWN BY: MJC DATE: 17.02.2016
CLIENT: Benedict Industries Pty Ltd	PROJECT No: 71459.03	DRAWING No: 3	REVISION: A / SCALE: As shown

Peak Methane Concentration %

60

40

20

0

Where a shallow and deep well are present at the one location, the well with the highest methane peak has been used to generate the contours.

Wells used to generate the contours

Well ID	Well ID	Well ID	Well ID
BH/MW216	JK101	JK110	JK119
BH/MW218	JK102	JK113	JKBH/MW7
BH202	JK103b	JK114	JKBH/MW9
BH211	JK104	JK115	
BH223	JK106	JKBH/MW16	
JKBH/MW1	JK107b	JK118a	

LEGEND

- Proposed Development Area
- Surface Sample
- a Replacement Well
- b Shallow Gas Well
- Borehole / Gas Well
- Monitoring Well
- Borehole
- Borehole (DP, 2002)
- Borehole (EIS, 2015)
- Borehole / Gas Well (EIS, 2015)
- Monitoring Well Location (EIS, 2015)

JKBH/MW1, JK2, BH1, BH5, BH6, BH201, JK3, BH207, BH206, BH202, BH204, BH205, JK4, BH203, BH208, BH2, JK119, BH7, JK104, JK6, BH209, JK5, JK101, JK102, BH211, BH211b, BH210, JK103a, JK103b, BH9, BH212, JKBH/MW107a, JK107b, BH213, JKBH/MW9, BH214, JK106, JK8, JKBH/MW7, BH/MW216, BH215, BH3, BH8, JK10, JK11, BH10, JK110, JK113, SS217, BH/MW218, JK118a, JK118b, JK12, SS219, JK115, BH220, BH11, JK117, JK14, JK114, JK114b, BH4, JK13, JK116, BH221, BH224, JK15, JKBH/MW16, BH225, BH222, BH12, BH223

0 100.0 metres

Douglas Partners Geotechnics / Environment / Groundwater	TITLE: Peak Methane Concentration Contours 1/10/15 Detailed Site Investigation 146 Newbridge Road, Moorebank, NSW	N MGA	OFFICE: Sydney DRAWN BY: MJC DATE: 17.02.2016
CLIENT: Benedict Industries Pty Ltd	PROJECT No: 71459.03	DRAWING No: 4	REVISION: A / SCALE: As shown

Peak Methane Concentration %

60
40
20
0

Where a shallow and deep well are present at the one location, the well with the highest methane peak has been used to generate the contours.

Wells used to generate the contours

Well ID	Well ID	Well ID	Well ID
BH/MW216	BH225	JK106	JK118a
BH/MW218	JKBH/MW1	KBH/MW107	JK119
BH202	JK101	JK110	JKBH/MW16
BH211	JK102	JK113	JKBH/MW7
BH223	JK103b	JK114	JKBH/MW9
BH224	JK104	JK115	

LEGEND

- Proposed Development Area
- Surface Sample
- a Replacement Well
- b Shallow Gas Well
- Borehole / Gas Well
- Monitoring Well
- Borehole
- Borehole (DP, 2002)
- Borehole (EIS, 2015)
- Borehole / Gas Well (EIS, 2015)
- Monitoring Well Location (EIS, 2015)

0 100.0
metres

Douglas Partners
Geotechnics / Environment / Groundwater

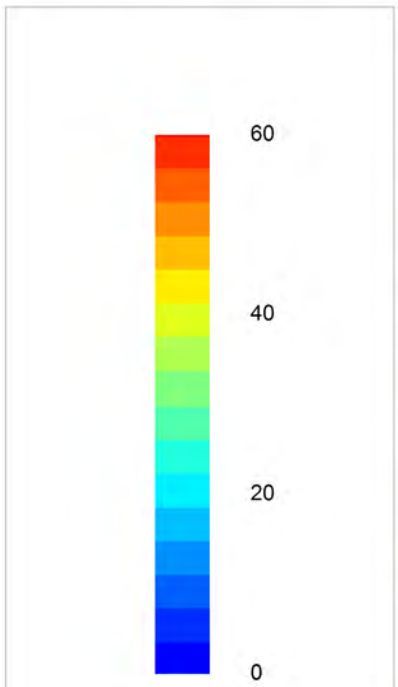
TITLE: Peak Methane Concentration Contours 27/10/15
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 17.02.2016

CLIENT: Benedict Industries Pty Ltd | PROJECT No: 71459.03 | DRAWING No: 5 | REVISION: A | SCALE: As shown

Peak Methane Concentration %



Where a shallow and deep well are present at the one location, the well with the highest methane peak has been used to generate the contours.

Wells used to generate the contours

Well ID	Well ID	Well ID	Well ID
BH/MW216	JKBH/MW1	JK117	JK119
BH202	JK101	JK113	JKBH/MW7
BH211a	JK103b	JK114	JKBH/MW9
BH223	JK106	JK114b	
BH224	JK107b	JK115	
BH225	JK104	JKBH/MW16	

LEGEND

- Proposed Development Area
- Surface Sample
- a Replacement Well
- b Shallow Gas Well
- Borehole / Gas Well
- Monitoring Well
- Borehole
- Borehole (DP, 2002)
- Borehole (EIS, 2015)
- Borehole / Gas Well (EIS, 2015)
- Monitoring Well Location (EIS, 2015)

0 100.0 metres

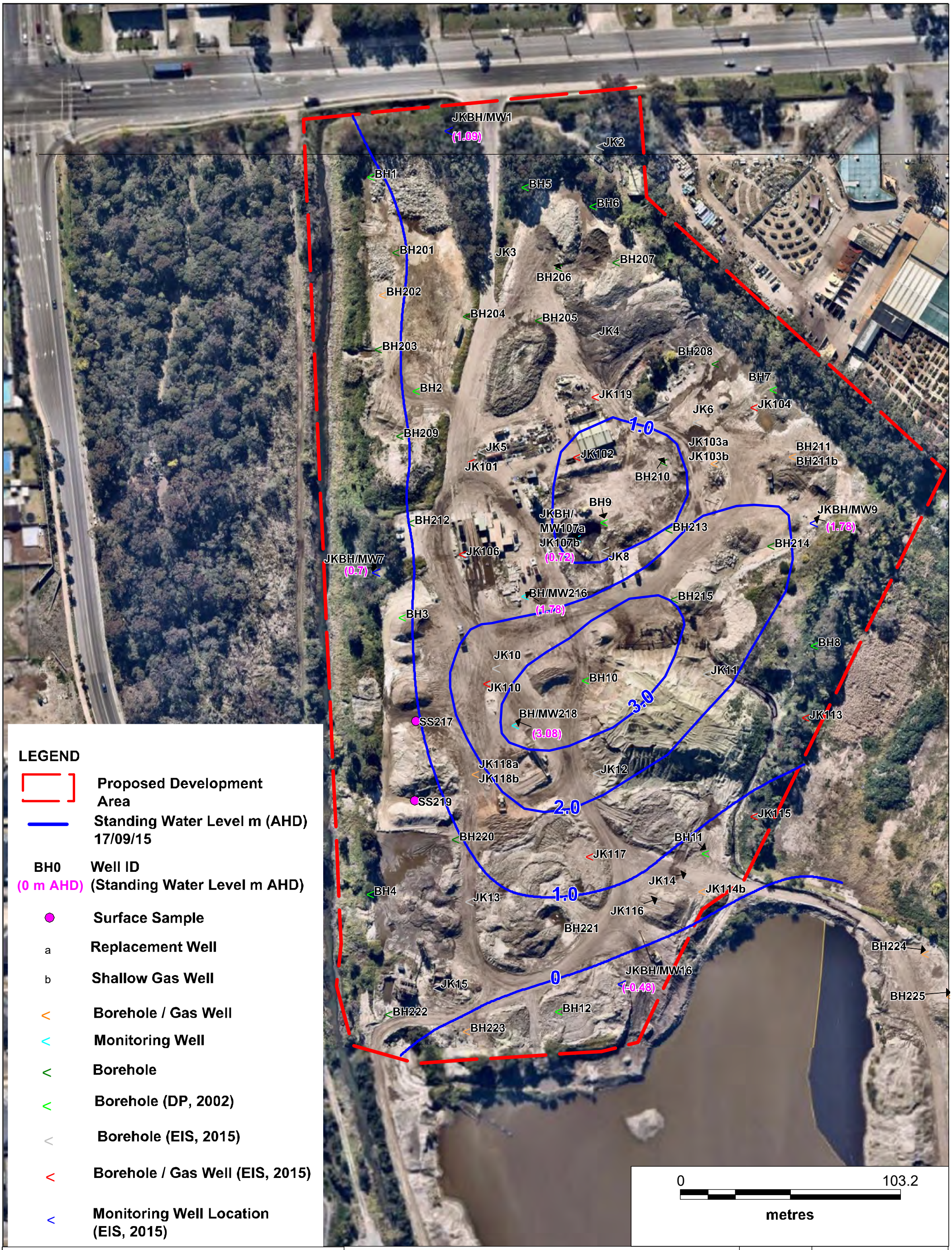
N MGA

Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Peak Methane Concentration Contours 10/2/16
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

OFFICE: Sydney
DRAWN BY: MJC
DATE: 17.02.2016

CLIENT: Benedict Industries Pty Ltd | PROJECT No: 71459.03 | DRAWING No: 6 | REVISION: A | SCALE: As shown

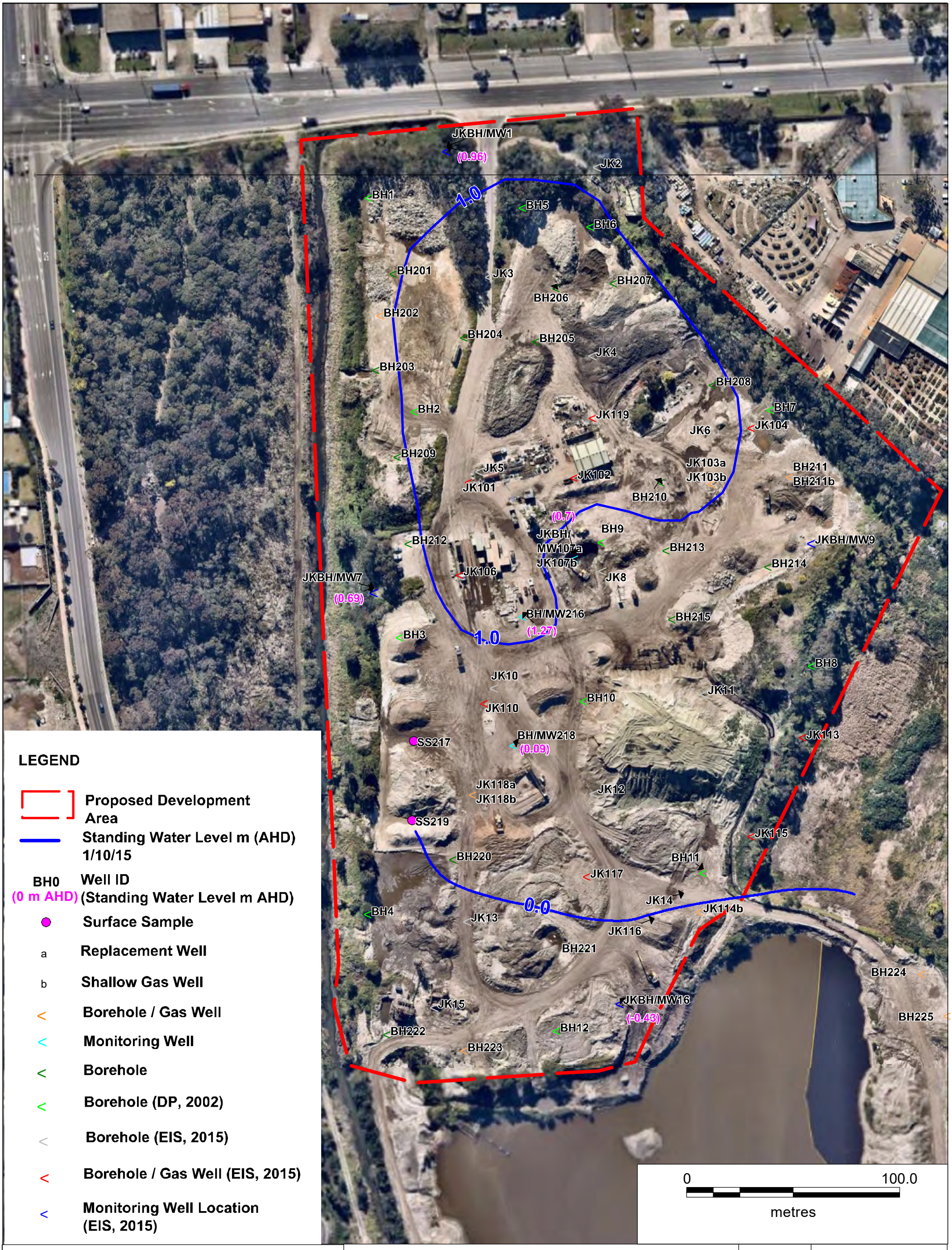


Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Standing Water Level (17.09.15)
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

OFFICE: Sydney
DRAWN BY: BAH
DATE: 19.02.16

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.03
DRAWING No: 7
REVISION: A
SCALE: As shown



Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Standing Water Level (1.10.15)
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

OFFICE: Sydney
DRAWN BY: BAH
DATE: 18.02.2016

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.03
DRAWING No: 8
REVISION: A
SCALE: As shown



Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Surface Water Sample Locations
Detailed Site Investigation
146 Newbridge Road, Moorebank, NSW

N
MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 19.02.2016

CLIENT: Benedict Industries Pty Ltd
PROJECT No: 71459.03
DRAWING No: 9
REVISION: A
SCALE: As shown

Appendix D

Summary of Soil Results (DP, 2016)

Douglas Partners
Geotechnics | Environment | Groundwater

Table 1: Summary Results for Metals

Test Location ID	Depth (m)	As [3]	Cd	Cr	Cu	Pb [4]	Hg [5,6]	Ni	Zn	Mn
BH/MW216	0.1-0.2	<4	0.8	13	28	54	<0.1	9	130	200
BH/MW216	3.9-4.35	7	<0.4	21	26	66	0.1	11	83	230
BH/MW216	5.9-6.35	17	<0.4	21	23	51	<0.1	9	170	130
BH/MW218	0.9-1.35	<4	<0.4	4	2	4	<0.1	3	13	68
BH/MW218	2.9-2.35	5	<0.4	14	46	37	<0.1	13	64	110
BH/MW218	5.9-6.35	5	<0.4	15	7	11	<0.1	2	3	5
BH201	0.1-0.2	<4	0.4	7	32	56	<0.1	5	110	61
BH201	0.9-1.35	4	1	15	79	110	0.1	9	170	160
BH202	0.9-1.35	<4	<0.4	45	47	13	<0.1	11	32	1500
BH202	1.9-2.35	6	0.5	26	50	170	0.1	15	140	180
BH203	0.1-0.2	<4	<0.4	7	46	44	<0.1	5	100	87
BH203	0.9-1.35	7	<0.4	14	19	36	<0.1	6	70	40
BH203	2.9-3.35	7	0.5	15	160	860	0.2	14	380	150
BH204	0.1-0.2	<4	<0.4	5	24	47	<0.1	3	83	44
BH204	1.9-2.35	5	<0.4	15	56	72	<0.1	5	140	130
BH204	3.9-4.35	7	<0.4	11	64	150	0.1	16	210	80
BH205	0.9-1.35	<4	<0.4	46	15	12	<0.1	19	25	92
BH205	2.9-3.35	6	<0.4	9	7	13	<0.1	2	5	8
BH205	3.9-4.35	8	<0.4	15	15	15	<0.1	2	15	9
BH206	0.1-0.2	5	<0.4	17	30	140	0.2	15	140	160
BH206	0.9-1.35	8	<0.4	15	22	16	<0.1	11	30	450
BH206	2.35-2.9	<4	<0.4	16	8	25	<0.1	3	9	37
BH206	4.35-4.9	17	<0.4	19	10	32	<0.1	11	30	120
BH207	0.1-0.2	<4	<0.4	25	53	16	<0.1	26	40	490
BH207	0.9-1.35	5	<0.4	15	18	21	<0.1	6	55	73
BH208	1.9-2.35	<4	<0.4	18	21	55	<0.1	13	470	190
BH208	0.9-1.35	<4	<0.4	10	19	32	<0.1	5	44	42
BH208	3.9-4.35	7	<0.4	30	13	26	<0.1	5	16	6
BH209	0.1-0.2	6	<0.4	18	82	98	0.1	13	210	270
BH209	0.9-1.35	<4	<0.4	21	37	35	<0.1	10	75	450
BH209	1.9-2.35	5	<0.4	17	55	35	<0.1	9	66	150
BH209	3.9-4.35	7	0.4	19	25	150	<0.1	10	140	190
BH210	0.1-0.2	<4	<0.4	10	63	11	<0.1	14	33	280
BH210	2.0-2.45	5	<0.4	12	4	10	<0.1	2	5	15
BH211	0.1-0.2	<4	<0.4	12	19	21	<0.1	9	54	200
BH211	0.9-1.35	<4	<0.4	10	5	10	<0.1	2	4	18
BH211	2.9-2.35	4	<0.4	17	3	24	<0.1	4	6	42
BH212	0.1-0.2	<4	<0.4	28	67	16	<0.1	11	39	800
BH212	2.9-3.35	6	0.6	16	41	130	0.1	9	240	120
BH213	0.1-0.2	8	<0.4	19	21	19	<0.1	14	43	200
BH213	2.9-3.35	5	<0.4	13	4	18	<0.1	3	27	27
BH214	0.1-0.2	<4	<0.4	18	46	17	<0.1	11	48	240
BH214	2.2-2.65	<4	<0.4	6	14	54	<0.1	8	33	67
BH215	0.9-1.35	<4	<0.4	9	10	28	<0.1	4	50	61
BH215	1.9-2.35	<4	<0.4	4	17	19	<0.1	2	11	13
BH220	0.1-0.2	4	0.8	16	47	190	0.2	11	290	610
BH221	0.1-0.2	<4	<0.4	11	14	30	0.1	4	69	110
BH221	1.9-2.35	4	<0.4	14	16	92	<0.1	6	78	120
BH221	2.9-3.35	7	0.6	15	45	620	0.2	9	290	180
BH221	3.9-4.35	17	0.7	25	24	86	<0.1	8	150	130
BH222	0.1-0.2	<4	<0.4	16	32	22	<0.1	26	52	560
BH222	0.9-1.35	<4	<0.4	12	85	22	<0.1	12	77	220
BH223	2.0-2.45	5	<0.4	17	540	79	0.2	10	110	190
JK103a	0.1-0.2	<4	<0.4	73	78	6	<0.1	11	26	2300
JK103a	1.9-2.35	<4	<0.4	4	18	31	<0.1	1	14	51
JK103a	2.9-3.35	<4	<0.4	12	22	49	<0.1	9	66	170
JK103a	5.9-6.35	<4	<0.4	3	3	3	<0.1	<1	1	1
JK107a	0.1-0.2	<4	<0.4	9	19	38	<0.1	5	79	87
JK107a	1.9-2.35	10	<0.4	17	29	98	<0.1	10	110	89
JK107a	7.9-8.35	<4	<0.4	5	5	6	<0.1	1	2	2
JK107a	8.9-9.35	<4	<0.4	3	3	6	<0.1	<1	4	3
JK118a	0.1-0.2	<4	<0.4	4	17	15	<0.1	5	25	110
JK118a	1.9-2.35	<4	<0.4	9	12	63	<0.1	6	87	120
JK118a	4.9-5.35	<4	<0.4	15	15	10	<0.1	2	9	9
SS217	0.0-0.1	5	<0.4	9	18	25	<0.1	6	55	120
SS219	0.0-0.1	<4	<0.4	9	24	45	<0.1	7	80	120
BD1/070815	-	8	0.6	13	49	35	<0.1	43	160	340
BD2/080915	-	5	<0.4	9	42	90	0.1	6	75	79
BD3/090915	-	4	0.5	12	27	140	0.1	8	170	100
BD5/100915	-	6	<0.4	16	56	93	<0.1	10	250	85
BD4/100915	-	9	<1	18	23	25	<0.1	6	35	254
BD6/100915	-	6	<1	8	15	14	<0.1	7	15	152
BD7/100915	-	10	<1	30	13	27	<0.1	2	11	<5
BH222(T)	0.9-1.35	<4	<0.4	23	250	42	<0.1	16	160	270
BH204 (T)	3.9-4.35	6	<0.4	13	31	180	<0.1	8	150	110
BH206 (T)	2.35-2.9	<4	<0.4	16	10	35	<0.1	2	10	49
BH/MW216 (T)	5.9-6.35	14	<0.4	18	18	43	<0.1	7	210	74
Laboratory PQL		4	0.4	1	1	1	0.1	1	1	1
NEPM HIL A [1, 2]		100	20	100 [7]	6000	300	40	400	7400	3800
EILs [8] - Urban residential/Public open space		100	NC	450	230	1100	NC	300	850	NC

Notes to Table:

All results in mg/kg on a dry weight basis

NA - Not Applicable

NC - No Criteria

NT - Not Tested

PQL - Practical Quantitation Limits

1 - Health Based Criteria for Residential with Accessible Soils Land Use

2- HIL generally applies to the top 3m of soil

3- HIL assumes 70% oral bioavailability. Site-specific bioavailability may be important and should be considered where appropriate (refer Schedule B7)

4- HIL is based on blood lead models (adult lead model where 50% bioavailability has been considered) Site-specific bioavailability may be important and should be considered where appropriate (refer Schedule B7)

5- Assessment of methyl mercury should only be considered if there is evidence of its potential source

6- HIL does not address elemental mercury

7 - Chromium (VI)

8- EILs refer to contamination present in soil for at least two years

BD1/070815 is the replicate sample of JK107a/1.9-2.35 m (Envirolab)

BD2/080915 is the replicate sample of BH213/2.9-3.35 m (Envirolab)

BD3/090915 is the replicate sample of BH212/2.9-3.35 m (Envirolab)

BD5/100915 is the replicate sample of BH207/0.9-1.35 m (Envirolab)

BD4/100915 is the replicate sample of BH201/0.9-1.35 m (ALS)

BD6/100915 is the replicate sample of BH206/0.9-1.35 m (ALS)

BD7/100915 is the replicate sample of BH208/3.9-4.35 m (ALS)

exceeds NEPM Health-Based Criteria for Residential with accessible soil Landuse

Underlined results exceed NPEM Ecological Investigation Levels for Urban residential/Public open space

Douglas Partners
Geotechnics | Environment | Groundwater

Table 2: Summary Results for Hydrocarbons

Test Location ID	Depth (m)	TRH				TRH (NEPC, 2013)						BTEX				PAHs
		C_6 - C_9	C_{10} - C_{14}	C_{15} - C_{28}	C_{29} - C_{36}	F1 (C_6-C_{10}-BTEX)	F2 (>C_{10}-C_{16} - Napthalene)	C_6-C_{10}	>C_{10}-C_{16}	>C_{16}-C_{34}	>C_{34}-C_{40}	Benzene	Toluene	Ethyl Benzene	Xylenes	Naphthalene
BH/MW216	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH/MW216	3.9-4.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH/MW216	5.9-6.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH/MW218	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH/MW218	2.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH/MW218	5.9-6.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH202	0.9-1.35	<25	<50	<100	240	<25	<50	<25	<50	200	330	<0.5	<1	<2	<1	<1
BH201	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH201	0.9-1.35	<25	<50	<100	110	<25	<50	<25	<50	110	130	<0.5	<1	<2	<1	<1
BH202	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH203	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	110	<100	<0.5	<1	<2	<1	<1
BH203	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH203	2.9-3.35	<25	<50	<100	200	<25	<50	<25	<50	210	170	<0.5	<1	<2	<1	<1
BH204	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	110	<100	<0.5	<1	<2	<1	<1
BH204	1.9-2.35	<25	<50	<100	120	<25	<50	<25	<50	170	<100	<0.5	<1	<2	<1	<1
BH204	3.9-4.35	<25	<50	<100	140	<25	<50	<25	<50	150	130	<0.5	<1	<2	<1	<1
BH205	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH205	2.9-3.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH205	3.9-4.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH206	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	120	<100	<0.5	<1	<2	<1	<1
BH206	0.9-1.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH206	2.35-2.9	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH206	4.35-4.9	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH207	0.1-0.2	<25	<50	850	1200	<25	<50	<25	<50	1700	1300	<0.5	<1	<2	<1	<1
BH207	0.9-1.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH208	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH208	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH208	3.9-4.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH209	0.1-0.2	<25	<50	160	250	<25	<50	<25	<50	330	170	<0.5	<1	<2	<1	<1
BH209	0.9-1.35	<25	<50	370	910	<25	<50	<25	<50	990	1100	<0.5	<1	<2	<1	<1
BH209	1.9-2.35	<25	<50	<100	140	<25	<50	<25	<50	140	150	<0.5	<1	<2	<1	<1
BH209	3.9-4.35	<25	<50	<100	150	<25	<50	<25	<50	120	130	<0.5	<1	<2	<1	<1
BH210	0.1-0.2	<25	<50	260	570	<25	<50	<25	<50	680	580	<0.5	<1	<2	<1	<1
BH210	2.0-2.45	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH211	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH211	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH211	2.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH212	0.1-0.2	<25	<50	230	640	<25	<50	<25	<50	640	840	<0.5	<1	<2	<1	<1
BH212	2.9-3.35	<25	<50	100	250	<25	<50	<25	<50	280	160	<0.5	<1	<2	<1	<1
BH213	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH213	2.9-3.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH214	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH214	2.2-2.65	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH215	0.9-1.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH215	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH220	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	130	<100	<0.5	<1	<2	<1	<1
BH221	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH221	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BH221	2.9-3.35	<25	<50	<100	<100	<25	<50	<25	<50	110	<100	<0.5	<1	<2	<1	<1
BH221	3.9-4.35	<25	<50	220	<100	<25	<50	<25	<50	270	<100	<0.5	<1	<2	<1	<1
BH222	0.1-0.2	<25	<50	400	590	<25	<50	<25	<50	890	340	<0.5	<1	<2	<1	<1
BH222	0.9-1.35	<25	<50	450	790	<25	<50	<25	<50	990	890	<0.5	<1	<2	<1	<1
BH223	2.0-2.45	<25	<50	<100	110	<25	<50	<25	<50	100	130	<0.5	<1	<2	<1	<1
JK103a	0.1-0.2	<25	<50	110	550	<25	<50	<25	<50	460	860	<0.5	<1	<2	<1	<1
JK103a	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK103a	2.9-3.35	<25	<50	460	360	<25	<50	<25	<50	720	240	<0.5	<1	<2	<1	<1
JK103a	5.9-6.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK107a	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK107a	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK107a	7.9-8.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK107a	8.9-9.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK118a	0.1-0.2	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK118a	1.9-2.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
JK118a	4.9-5.35	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
SS217	0.0-0.1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
SS219	0.0-0.1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BD1/070815	-	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BD2/080915	-	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.5	<1	<2	<1	<1
BD3/090915	-	<25	<50	<100	<100	<25	<50	<25	<50	110	<100	<0.5	<1	<2	<1	<1
BD5/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD4/100915	-	<25	<50	<100	<100	<25	<50	<25	<50	110	<100	<0.5	<1	<2	<1	<1
BD6/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD7/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Laboratory PQL		25	50	100	100	25	50	25	50	100	100	0.2	0.5	1	1	1
NEPM HSL A [6] SAND		NC	NC			45/70/110/200 [1]	110/240/440/NL [1]	NC	NC	NC	NC	0.5/0.5/0.5/0.5 [1]	160/220/310/540 [1]	55/NL/NL/NL [1]	40/60/95/170 [1]	3/NL/NL/NL [1]
NEPM HSL A [6] SILT		NC	NC			40/65/100/190 [2]	230/NL/NL/NL [2]	NC	NC	NC	NC	0.6/0.7/1/2 [2]	390/NL/NL/NL [2]	NL/NL/NL/NL [2]	95/210/NL/NL [2]	4/NL/NL/NL [2]
NEPM HSL A [6] CLAY		NC	NC			50/90/150/290 [3]	280/NL/NL/NL [3]	NC	NC	NC	NC	0.7/1/2/3 [3]	480/NL/NL/NL [3]	NL/NL/NL/NL [3]	110/310/NL/NL [3]	5/NL/NL/NL [3]
CRC HSL for Intrusive Worker by Vapour Intrusion		NC	NC			NC	NC	NL	NL	NL	NL	77	NL	NL	NL	NL
CRC HSL A for Direct Contact - Resident		NC	NC			NC	NC	4400	3300	4500	6300	100	14000	4500	12000	1400
CRC HSL for Intrusive Worker by Direct Contact		NC	NC			NC	NC	82000	62000	85000	120000	1100	120000	85000	130000	29000
NEPM ESL Residential A,B,C [4, 7] - Coarse Soils		NC	NC			180 *	NC	NC	120 *	300	2800	50	85	70	105	170 [8]
NEPM ESL Residential A,B,C [4, 7] - Fine Soils		NC	NC			180 *	NC	NC	120 *	1300	5600	65	105	125	45	170 [8]
Management limits for TPH fractions in coarse soils - Residential A, B, C [5]		NC	NC			NC	NC	700	1000	2500	10000	NC	NC	NC	NC	NC
Management limits for TPH fractions in fine soils - Residential A, B, C [5]		NC	NC			NC	NC	800	1000	3500	10000	NC	NC	NC	NC	NC

Notes to Table:

All results in mg/kg on a dry weight basis

NC - No Criteria

PID - Photoionisation Detector

PQL - Practical Quantitation Limits

NL - Not Limiting

1- Soil HSLs for vapour intrusion (mg/kg) for SAND samples recovered from 0 m to <1 m / 1 m to <2 m / 2 m to <4 m / >=4 m

2- Soil HSLs for vapour intrusion (mg/kg) for SILT samples recovered from 0 m to <1 m / 1 m to <2 m / 2 m to <4 m / >=4 m

3- Soil HSLs for vapour intrusion (mg/kg) for CLAY samples recovered from 0 m to <1 m / 1 m to <2 m / 2 m to <4 m / >=4 m

4- ESLs are of low reliability except where indicated by * which indicates that the ESLs are of moderate reliability

5- Management limits are applied after consideration of relevant ESLs and HSLs

6- Multiplication factor may be applied (for depths >2m) subject to favourable biodegradation conditions - refer to 2.4.10 NEPC (2013)

7- ESLs apply from the surface to 2 m depth below finished surface/ground level

8- Ecological Investigation Level (EIL) - this value relates to fresh contamination.

exceeds NEPM HSL Health-Based Criteria for Residential with accessible soils Landuse

exceeds NEPM management limits for TRH fractions in coarse/fine soils - Residential Landuse

Underlined results exceed the NEPM ESL guideline values for Residential with accessible Soils Landuse

Bold results exceed the CRC CARE guideline values for HSL

BD1/070815 is the replicate sample of JK107a/1.9-2.35 m (Envirolab)

BD2/080915 is the replicate sample of BH213/2.9-3.35 m (Envirolab)

BD3/090915 is the replicate sample of BH212/2.9-3.35 m (Envirolab)

BD5/100915 is the replicate sample of BH207/0.9-1.35 m (Envirolab)

BD4/100915 is the replicate sample of BH201/0.9-1.35 m (ALS)

BD6/100915 is the replicate sample of BH206/0.9-1.35 m (ALS)

BD7/100915 is the replicate sample of BH208/3.9-4.35 m (ALS)

Douglas Partners
Geotechnics | Environment | Groundwater

Table 3: Summary Results for PAH, OCP, OPP, PCB, Phenols and Cyanide

Test Location ID	Depth (m)	Total PAH	Naphthalene	B(a)P	B(a)P TEQ	Total OCP	Aldrin + Dieldrin	Chlordane	DDT+DDE+ DDD	Endosulfan	Endrin	Heptachlor	HCB	Methoxychlor	Total OPP	Chlorpyrifos	PCB [3]	Total Phenols	Total Cyanide
BH/MW216	0.1-0.2	2.6	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH/MW216	3.9-4.35	0.53	<0.1	0.07	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH/MW216	5.9-6.35	0.47	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH/MW218	0.9-1.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH/MW218	2.9-2.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	0.6
BH/MW218	5.9-6.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH201	0.1-0.2	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	0.6
BH201	0.9-1.35	0.28	<0.1	0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH202	0.9-1.35	4.5	<0.1	0.4	0.6	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH202	1.9-2.35	1.8	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH203	0.1-0.2	1.6	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH203	0.9-1.35	1.2	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH203	2.9-3.35	17	<0.1	1.5	2.1	0.3	0.3	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH204	0.1-0.2	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH204	1.9-2.35	0.51	<0.1	0.08	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<1	<5	<0.5
BH204	3.9-4.35	1.9	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<1	<5	<0.5
BH205	0.9-1.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH205	2.9-3.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH205	3.9-4.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH206	0.1-0.2	17	<0.1	1.1	1.7	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH206	0.9-1.35	<1.45	<0.1	<0.05	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH206	2.35-2.9	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH206	4.35-4.9	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	0.5
BH207	0.1-0.2	250	0.4	20	29	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	0.6	<0.1	<0.7	<5	<0.5
BH207	0.9-1.35	<1.45	<0.1	<0.05	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH208	1.9-2.35	8.5	<0.1	0.65	1	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH208	0.9-1.35	1.9	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH208	3.9-4.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH209	0.1-0.2	13	<0.1	1.1	1.7	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH209	0.9-1.35	110	<0.1	9.5	14	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH209	1.9-2.35	10	<0.1	0.86	1.3	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	4.4
BH209	3.9-4.35	0.76	<0.1	0.1	<0.5	0.2	0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH210	0.1-0.2	28	<0.1	2.8	4.2	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH210	2.0-2.45	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH211	0.1-0.2	0.59	<0.1	0.07	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH211	0.9-1.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH211	2.9-2.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH212	0.1-0.2	7	<0.1	0.4	0.7	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH212	2.9-3.35	3.9	<0.1	0.4	0.7	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	0.5
BH213	0.1-0.2	3.6	<0.1	0.3	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH213	2.9-3.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH214	0.1-0.2	2.5	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH214	2.2-2.65	0.3	<0.1	0.06	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH215	0.9-1.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH215	1.9-2.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH220	0.1-0.2	0.43	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	3.7	<5	<0.5
BH221	0.1-0.2	0.36	<0.1	0.09	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH221	1.9-2.35	0.54	<0.1	0.09	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH221	2.9-3.35	2.9	<0.1	0.3	<0.5	0.1	0.1	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH221	3.9-4.35	0.49	<0.1	0.06	<0.5	0.3	<0.2	<0.2	0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH222	0.1-0.2	2.1	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH222	0.9-1.35	46	2.5	3.6	5.4	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BH223	2.0-2.45	6.9	<0.1	0.51	0.8	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK103a	0.1-0.2	5	<0.1	0.56	1	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK103a	1.9-2.35	0.38	<0.1	0.08	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK103a	2.9-3.35	150	0.6	13	17	1	<0.2	<0.2	0.7	0.1	0.2	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK103a	5.9-6.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK107a	0.1-0.2	2.8	<0.1	0.3	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK107a	1.9-2.35	0.33	<0.1	0.07	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK107a	7.9-8.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK107a	8.9-9.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK118a	0.1-0.2	1.9	<0.1	0.2	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK118a	1.9-2.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
JK118a	4.9-5.35	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
SS217	0.0-0.1	1.3	<0.1	0.1	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	-
SS219	0.0-0.1	3.4	<0.1	0.3	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	-
BD1/070815	-	<1.45	<0.1	<0.05	<0.5	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BD2/080915	-	7.5	<0.1	0.77	1.2	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BD3/090915	-	3.3	<0.1	0.4	0.6	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.7	<5	<0.5
BD5/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD4/100915	-	<0.5	<0.1	<0.05	1.2	<2.0	<0.2	<0.2	<0.3	<0.3	<0.1	<0.2	<0.1	<0.1	<0.8	<0.1	<0.1	<5	<0.5
BD6/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD7/100915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Laboratory PQL		0.05/0.2	1	0.05	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	5	0.5
NEPM HIL A [1]		300	NC	NC	3	NC	6	50	240	270	10	6	10	300	NC	160	1	3000 [4]	250
NEPM EIL Residential A,B,C [2]		NC	170	NC	NC	NC	NC	NC	180 [5]	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
NEPM ESL Residential A,B,C [2] - Fine and Coarse Soils		NC	NC	0.7	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

Notes to Table:

All results in mg/kg on a dry weight basis

NC - No Criteria

NT - Not Tested

PQL - Practical Quantitation Limits

TEQ - Toxicity Equivalent Quotient

Total PAH - Sum of positive and PQL values

1 - Health Based Criteria for Residential with Accessible Soils Land Use

2- ESLs apply from the surface to 2 m depth below finished surface/ground level

3- PCB HILs relates to non-dioxin-like PCB only

4- Criterion based on phenol

5- Criterion is for DDT only

exceeds NEPM Health-Based Criteria for Residential with Accessible Soils Landuse

Underline results exceed NEPM EIL or ESL

BD1/070815 is the replicate sample of JK107a/1.9-2.35 m (Envirolab)

BD2/080915 is the replicate sample of BH213/2.9-3.35 m (Envirolab)

BD3/090915 is the replicate sample of BH212/2.9-3.35 m (Envirolab)

BD5/100915 is the replicate sample of BH207/0.9-1.35 m (Envirolab)

BD4/100915 is the replicate sample of BH201/0.9-1.35 m (ALS)

BD6/100915 is the replicate sample of BH206/0.9-1.35 m (ALS)

BD7/100915 is the replicate sample of BH208/3.9-4.35 m (ALS)

Douglas Partners
Geotechnics / Environment / Groundwater

Table 4: Summary Results for TCLP Metals and PAH

Test Location ID	Depth (m)	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn	Total PAH
JK103a	2.9-3.35	-	-	-	-	-	-	-	-	0.029
BH221	2.9-3.35	<0.05	<0.01	<0.01	<0.01	0.2	<0.0005	<0.02	1.1	-
BH222	0.9-1.35	-	-	-	-	-	-	-	-	<0.016
BH209	0.9-1.35	-	-	-	-	-	-	-	-	<0.016
BH203	2.9-3.35	<0.05	0.01	<0.01	0.04	1	<0.0005	<0.02	1.8	-
BH207	0.1-0.2	-	-	-	-	-	-	-	-	<0.016

Notes to Table:

All results in mg/L

Appendix E

Summary of Landfill Gas Results (DP, 2016)

Summary of Non-Methane Organic Compound Results (DP, 2016)

Landfill Gas Sampling Results

Landfill gas monitoring was undertaken on 19 August 2015, 1 October 2015, 27 October 2015 and 10 February 2016. The results, along with the CSV and CGS are summarised in the following tables.

Table 1: Landfill Gas Sampling Results for 19/08/15

Well ID	Flow Rate Peak	Methane Peak %	GSV	CO_2 Peak %	GSV	CGS [1]
JKBH/MW1	0.2	1.3	<0.01	1.7	<0.01	2
JKBH/MW16	0.2	22	0.04	6.7	0.01	2
JKBH/MW7	0.2	14	0.03	9.6	0.02	2
JKBH/MW9	0.3	20.9	0.06	6.1	0.02	2
JK101	0.2	14	0.03	7.7	0.02	2
JK102	0.1	13.2	0.01	7.8	0.01	2
JK103	0.1	0.8	<0.01	1.9	<0.01	1
JK104	0.1	0.5	<0.01	3.1	<0.01	1
JK106	0.2	16.1	0.03	4.2	0.01	2
JK110	0.4	23.2	0.09	6.3	0.03	2
JK113	0.1	9.9	0.01	15.9	0.02	2
JK114	0.2	24.6	0.05	8	0.02	2
JK115	0.2	8.6	0.02	11.1	0.02	2
JK119	0.9	10.5	0.09	6.7	0.06	2
Max Value	**0.9**	**24.6**	**0.22**	**15.9**	**0.14**	**2**

Notes to Table 1:

1. Where methane >1% or CO_2 >5% CGS has been increased to Situation 2 as per Table 6 of NSW EPA (2012)

Atmospheric pressure start 1024 mb end 1024 mb – pressure steady

Table 2: Landfill Gas Sampling Results for 1/10/15

Well ID	Flow Rate Peak	Methane Peak %	GSV	CO_2 Peak %	GSV	CGS [1]
BH/MW216	0.2	16	0.03	6.3	0.01	2
BH/MW218	0.2	24.2	0.05	10.2	0.02	2
BH202	0.2	1.1	<0.01	12.4	0.02	2
BH211	0.3	0	<0.01	1.5	<0.01	1
BH211b	-	0	-	3.7	-	-
BH223	0.2	1.1	<0.01	3.4	0.01	2
JKBH/MW1	0.2	0	<0.01	2	<0.01	1
JKBH/MW7	0.2	4.1	0.01	7	0.01	2
JKBH/MW9	0.1	0	<0.01	2.9	<0.01	1
JK101	0.3	14.3	0.04	7.3	0.02	2
JK102	0.3	12	0.04	6.4	0.02	2
JK103a	0.7	0.7	<0.01	3.1	0.02	1
JK103b	0.3	1.4	<0.01	1.2	<0.01	2
JK104	0.2	0	<0.01	4	0.01	1
JK106	0.4	13.2	0.05	4.5	0.02	2
JKBH/MW107a	0.4	3	0.01	0.2	<0.01	2
JK107b	0.2	10.2	0.02	5.6	0.01	2
JK110	0.5	19	0.1	6.3	0.03	2
JK113	0.4	6	0.02	14.5	0.06	2
JK114	0.2	22.2	0.04	5.3	0.01	2
JK114b	0.2	20.2	0.04	7.2	0.01	2
JK115	0.2	0.6	<0.01	9.1	0.02	1
JKBH/MW16	0.3	8.5	0.03	6.5	0.02	2
JK118a	0.3	17.3	0.05	5.7	0.02	2
JK118b	0.2	12.9	0.03	4.5	0.01	2
JK119	0.7	11.9	0.08	3.1	0.02	2
Max Value	**0.7**	**24.2**	**0.17**	**14.5**	**0.10**	**2**

Notes to Table 2:

1. Where methane >1% or CO_2 >5% CGS has been increased to Situation 2 as per Table 6 of NSW EPA (2012)

Atmospheric pressure start 1023 end1032 mb – pressure increasing

Table 3: Landfill Gas Sampling Results for 27/10/15

Well ID	Flow Rate Peak	Methane Peak %	GSV	CO_2 Peak %	GSV	CGS [1]
BH/MW216	0.1	14.7	0.01	6.7	0.01	2
BH/MW218	-0.2	32.5	<0.01	13.8	<0.01	2
BH202	0.4	0.8	<0.01	13.2	0.05	2
BH211	0.4	0	<0.01	1.7	0.01	1
BH211b	0.3	0	<0.01	3.9	0.01	1
BH223	0.6	3.7	0.02	8.2	0.05	2
BH224	0.4	0	<0.01	10.3	0.04	2
BH225	0.2	0	<0.01	9.6	0.02	2
JKBH/MW1	0.2	0	<0.01	2.2	<0.01	1
JKBH/MW7	0.3	8.5	0.03	3.2	0.01	2
JKBH/MW9	0.2	0	<0.01	3.2	0.01	1
JKBH/MW16	0.2	2.8	0.01	8.3	0.02	2
JK101	0.3	14.1	0.04	10.2	0.03	2
JK102	0.2	13.2	0.03	6.6	0.01	2
JK103a	0.4	0	<0.01	1.7	0.01	1
JK103b	0.6	1.1	0.01	0.7	<0.01	2
JK104	0.5	0	<0.01	1.7	0.01	1
JK106	0.4	10	0.04	3.3	0.01	2
JKBH/MW107a	0.1	15	0.02	5.2	0.01	2
JK107b	0.2	14.4	0.03	2.9	0.01	2
JK110	0.1	25	0.03	6.4	0.01	2
JK113	0.2	1	<0.01	4.5	0.01	1
JK114	0.1	21.2	0.02	6.4	0.01	2
JK114b	0.3	19.1	0.06	7.5	0.02	2
JK115	0.3	7.2	0.02	7	0.02	2
JK118a	0.3	15.2	0.05	5.1	0.02	2
JK118b	0.3	14.5	0.04	4.8	0.01	2
JK119	0.6	16.2	0.1	5.8	0.03	2
Max Value	**0.6**	**32.5**	**0.20**	**13.8**	**0.08**	**2**

Notes to Table 3:

1. Where methane >1% or CO_2 >5% CGS has been increased to Situation 2 as per Table 6 of NSW EPA (2012)

Atmospheric pressure start 1022 mb to 1026 mb – pressure increasing

Table 4: Landfill Gas Sampling Results for 10/02/16

Well ID	Flow Rate Peak	Methane Peak %	GSV	CO_2 Peak %	GSV	CGS [1]
BH/MW216	0.3	16.1	0.05	5.2	0.02	2
BH202	0.2	1.1	<0.01	3.4	0.01	2
BH211a	0.1	1.1	<0.01	5	0.01	2
BH211b	0.2	0.5	<0.01	1.9	<0.01	1
BH223	0.1	3.7	<0.01	10	0.01	2
BH224	0.3	0.1	<0.01	14.4	0.04	2
BH225	0.3	0.2	<0.01	12.1	0.04	2
JKBH/MW1	0.1	0.2	<0.01	3.4	<0.01	1
JKBH/MW7	0	0.5	<0.01	6.8	<0.01	2
JKBH/MW9	0.2	17.5	0.04	23.8	0.05	2
JKBH/MW16	0.3	0.1	<0.01	9.7	0.03	2
JK101	0.3	15.7	0.05	11.4	0.03	2
JK103	6.8	1.7	0.12	0.6	0.04	2
JK103a	0.3	0.9	<0.01	0.2	<0.01	1
JK103b	0.3	5.1	0.02	2.6	0.01	2
JK106	0	14.2	<0.01	6.7	<0.01	2
JKBH/MW107a	0.3	16.4	0.05	0.9	<0.01	2
JK107b	0.2	17.3	0.03	3.8	0.01	2
JK104	0.2	0.5	<0.01	2.3	<0.01	1
JK113	0.1	0.1	<0.01	1	<0.01	1
JK114	0.2	25.3	0.05	4.7	0.01	2
JK114b	0.3	0.1	<0.01	0	<0.01	1
JK115	0.2	0.1	<0.01	0	<0.01	1
JK117*	0.6	11.7	0.07	6.8	0.04	2
JK119	0.4	21.3	0.09	6.9	0.03	2
Max Value	**6.8**	**25.3**	**1.72**	**23.8**	**1.62**	**3**

Notes to Table 4:

1. Where methane >1% or CO_2 >5% CGS has been increased to Situation 2 as per Table 6 of NSW EPA (2012)

*JK117 was inaccessible for previous monitoring events due to stockpile placement

Atmospheric pressure start 1016 mb end 1011 mb – pressure decreasing

The peak methane concentration data for each of the landfill gas monitoring events were used to generate concentration contours on the following drawings in Appendix C:

- Drawing 3 - Peak Methane Concentration Contours 19/08/15;
- Drawing 4 - Peak Methane Concentration Contours 1/10/15;
- Drawing 5 - Peak Methane Concentration Contours 27/10/15; and
- Drawing 6 - Peak Methane Concentration Contours 10/02/16.

Where a shallow and deep gas well is present at the one location, the well with the highest methane peak was used to generate the contours. It should also be noted that some wells have been destroyed due to the site owner undertaking a further trial remediation excavation at the south-western portion of the site.

							BTEX				MAH				Chlorinated Hydrocarbons																							Halo
				Freon 113	2-Propanol	Propene	1,2-Dichlorotetrafluoroethane	Benzene	Ethylbenzene	Toluene	Xylene (m & p)	Xylene (o)	1,2,4-trimethylbenzene	1,3,5-trimethylbenzene	1-methyl-4 ethyl benzene	Styrene	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane	1,1-dichloroethane	1,1-dichloroethene	1,2-dichloroethane	1,2-dichloropropane	Benzyl chloride	Bromodichloromethane	Bromoform	Carbon tetrachloride	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-dichloroethene	cis-1,3-dichloropropene	Hexachlorobutadiene	Trichloroethene	Tetrachloroethene	trans-1,2-dichloroethene	trans-1,3-dichloropropene	Vinyl chloride	1,2-dibromoethane
				µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	ug/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3
PQL				**3.8**	**1**	**0.9**	**2.5**	**1.6**	**2**	**1.9**	**4**	**2**	**2.5**	**2.5**	**2.5**	**2**	**2.7**	**3**	**2.7**	**2**	**2**	**2**	**2**	**2.6**	**3**	**5**	**3**	**1.6**	**1**	**2**	**1**	**2**	**2**	**5**	**2.7**	**3**	**2**	**2**	**1**	**3.8**
NEPM 2013 Table 1A(2) Res A Soil Vap VOCC HILs																	60000														80			20	2000			30	
NEPM 2013 Table 1A(5) Res Soil Vapour HSL A/B for Vapour Intrusion, Sand																																							
0-1m								1000	330000	1300000																														
Field_ID	**LocCode**	**WellCode**	**Sampled_Date-Time**																																					
BH/MW216	BH/MW216		27/10/2015	<3.8	<1	<0.9	<2.5	**5**	**7**	**9**	**10**	**4**	**5**	<2.5	<2.5	**10**	<2.7	<3	<2.7	<2	<2	<2	<2	<2.6	<3	<5	<3	<1.6	**3**	<2	<1	**6**	<2	<5	**5**	<3	<2	<2	<1	<3.8
BD1	BH/MW216		27/10/2015	<3.8	<1	<0.9	<2.5	**6**	**7**	**8**	**9**	**3**	**5**	<2.5	<2.5	**10**	<2.7	<3	<2.7	<2	<2	<2	<2	<2.6	<3	<5	<3	<1.6	**4**	<2	<1	**7**	<2	<5	<2.7	<3	<2	<2	<1	<3.8
JK101	JK101		27/10/2015	<3.8	<1	<0.9	<2.5	**4**	**5**	**9**	**10**	**4**	**6**	<2.5	<2.5	<2	<2.7	<3	<2.7	<2	<2	<2	<2	<2.6	<3	<5	<3	<1.6	<1	<2	<1	<2	<2	<5	<2.7	<3	<2	<2	<1	<3.8
JK107B	JK107B		27/10/2015	<3.8	<1	<0.9	<2.5	**8**	**6**	**8**	**10**	**4**	**5**	<2.5	<2.5	**43**	<2.7	<3	<2.7	<2	<2	<2	<2	<2.6	<3	<5	<3	<1.6	**4**	<2	<1	<2	<2	<5	<2.7	<3	<2	<2	<1	<3.8

				genated Hydrocarbons			Halogenated Benzenes					VOCs			Solvents														PAH/Phenols
				Bromomethane	Dichlorodifluoromethane	Trichlorofluoromethane	1,2,4-trichlorobenzene	1,2-dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	Chlorobenzene	1,3-Butadiene	Acrolein	Methyl Methacrylate	1,4-Dioxane	Methyl Ethyl Ketone	2-hexanone (MBK)	4-Methyl-2-pentanone	Carbon disulfide	Cyclohexane	Ethanol	Ethyl acetate	Heptane	Hexane	MTBE	Tetrahydrofuran	Vinyl acetate	Naphthalene
				µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	ug/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3
PQL				**1.9**	**2.5**	**2.8**	**3.7**	**3**	**3**	**3**	**2**	**1**	**1**	**2**	**1.8**	**1.5**	**2**	**2**	**1.6**	**1.7**	**0.9**	**1.8**	**2**	**1.8**	**1.8**	**1.5**	**1.8**	**2.6**
NEPM 2013 Table 1A(2) Res A Soil Vap VOCC HILs																											
NEPM 2013 Table 1A(5) Res Soil Vapour HSL A/B for Vapour Intrusion, Sa																											
0-1m																											800
Field_ID	**LocCode**	**WellCode**	**Sampled_Date-Time**																								
BH/MW216	BH/MW216		27/10/2015	<1.9	**210**	<2.8	<3.7	<3	<3	<3	<2	<1	<1	<2	<1.8	<1.5	<2	<2	<1.6	**88**	**18**	<1.8	**4**	**47**	<1.8	<1.5	<1.8	**7**
BD1	BH/MW216		27/10/2015	<1.9	**230**	<2.8	<3.7	<3	<3	<3	<2	<1	<1	<2	<1.8	<1.5	<2	<2	<1.6	**98**	**19**	<1.8	**5**	**53**	<1.8	<1.5	<1.8	**4**
JK101	JK101		27/10/2015	<1.9	**20**	<2.8	<3.7	<3	<3	<3	<2	<1	<1	<2	<1.8	<1.5	<2	<2	**6**	**110**	**22**	<1.8	**30**	**100**	<1.8	<1.5	<1.8	**10**
JK107B	JK107B		27/10/2015	<1.9	**120**	<2.8	<3.7	<3	<3	<3	<2	<1	<1	<2	<1.8	<1.5	<2	<2	**2**	**130**	**17**	<1.8	**10**	**38**	<1.8	<1.5	<1.8	**10**

Appendix F

Summary of Groundwater and Surface Water Results (DP, 2016)

			Inorganics						Metals													
			Ammonia (as N)	Chloride	Nitrate (as N)	Nitrite (as N)	Nitrogen (Total Oxidised)	Sulphate	Arsenic (Filtered)	Cadmium (Filtered)	Chromium (III+VI) (Filtered)	Copper (Filtered)	Lead (Filtered)	Manganese (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Phosphorus	Zinc (Filtered)	C10-C16	C16-C34	C34-C40
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.005	1	0.005	0.005		1	0.001	0.0001	0.001	0.001	0.001	0.001	0.00005	0.001	0.01	0.001	0.05	0.1	0.1
ANZECC 2000, Marine Waters, 95% of Species			0.91							0.0007		0.0013	0.0044		0.0001	0.007		0.015			
ANZECC 2000 LOW RELIABILITY MW									0.0045					0.08							
ANZECC 2000 Fresh Waters GILs for 95% of Species			0.9		0.161					0.0002	0.0274	0.0014	0.0034	1.9	0.00006	0.011		0.008			
ANZECC 2000 LOW RELIABILITY FRESH WATER																					
ADWG 2011 Aesthetic			0.5					250				1		0.1				3			
ADWG 2011 Drinking Water					11.5	0.9		500	0.01	0.002		2	0.01	0.5	0.001	0.02					
ANZECC 2000 Recreational water quality and aesthetics			0.1	400	10	1		400	0.05	0.005	0.05	1	0.05	0.1	0.001	0.1		5			
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																					
2-4m																					
4-8m																					
>8m																					
Field_ID	**LocCode**	**Sampled_Date-Time**																			
BH/MW216	BH/MW216	1-Oct-15	20	2200	<0.005	<0.005	-	91	0.002	<0.0001	0.001	0.001	0.001	1.4	<0.00005	0.009	0.7	0.06	<0.05	<0.1	<0.1
BH/MW218	BH/MW218	1-Oct-15	30	2300	<0.25	<0.25	-	410	0.011	<0.0001	0.19	0.017	0.007	0.65	<0.00005	0.16	0.3	0.084	<0.05	<0.1	<0.1
JKBH/MW1	JKBH/MW1	2-Oct-15	3.2	750	0.01	<0.005	-	1100	0.001	0.0001	<0.001	0.005	<0.001	0.95	<0.00005	0.03	<0.05	0.097	<0.05	<0.1	<0.1
BD1/021015	BD1/021015	2-Oct-15	2.56	-	0.03	<0.01	0.03	-	0.003	<0.0001	<0.001	<0.001	<0.001	0.985	<0.0001	0.046	3.58	0.245	<0.1	<0.1	<0.1
JKBH/MW107A	JKBH/MW107A	1-Oct-15	10	700	0.006	<0.005	-	75	0.003	<0.0001	<0.001	0.007	<0.001	0.42	<0.00005	0.012	<0.05	0.079	<0.05	<0.1	<0.1
JKBH/MW16	JKBH/MW16	1-Oct-15	4.9	3400	0.02	<0.005	-	1700	<0.001	0.0001	<0.001	0.004	<0.001	4.4	<0.00005	0.02	<0.05	0.82	<0.05	<0.1	<0.1
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.005	<0.00005	<0.001	-	<0.001	<0.05	<0.1	<0.1
SW1	SW1	1-Oct-15	0.025	6900	0.29	0.006	-	890	<0.001	<0.0001	<0.001	0.002	<0.001	0.012	<0.00005	0.001	<0.05	0.006	<0.05	<0.1	<0.1
SW2	SW2	1-Oct-15	8.4	2700	0.11	0.08	-	590	0.002	<0.0001	<0.001	<0.001	<0.001	0.42	<0.00005	0.005	<0.05	0.005	<0.05	<0.1	<0.1
BD2/011015	SW2	1-Oct-15	8.2	-	0.16	0.083	-	-	0.002	<0.0001	<0.001	<0.001	<0.001	0.4	<0.00005	0.005	<0.05	0.005	<0.05	<0.1	<0.1
SW3	SW3	2-Oct-15	0.017	91	0.02	<0.005	-	12	<0.001	<0.0001	<0.001	<0.001	<0.001	0.1	<0.00005	0.002	<0.05	0.018	<0.05	<0.1	<0.1

			TRH								BTEX								
			F2-NAPHTHALENE	C6 - C9	C10 - C14	C15 - C28	C29-C36	+C10 - C36 (Sum of total)	C10 - C40 (Sum of total)	C6-C10 less BTEX (F1)	C6-C10	Benzene	Ethylbenzene	Toluene	Total BTEX	Xylene (m & p)	Xylene (o)	Xylene Total	1,2,4-trimethylbenzene	1,3,5-trimethylbenzene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.05	0.01	0.05	0.1	0.05			0.01	0.01	0.001	0.001	0.001		0.002	0.001		0.001	0.001
ANZECC 2000, Marine Waters, 95% of Species												0.5								
ANZECC 2000 LOW RELIABILITY MW													0.005	0.18				0.625		
ANZECC 2000 Fresh Waters GILs for 95% of Species												0.95					0.35			
ANZECC 2000 LOW RELIABILITY FRESH WATER																				
ADWG 2011 Aesthetic													0.003	0.025				0.02		
ADWG 2011 Drinking Water												0.001	0.3	0.8				0.6		
ANZECC 2000 Recreational water quality and aesthetics												0.01								
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																				
2-4m			1							1		0.8	NL	NL				NL		
4-8m			1							1		0.8	NL	NL				NL		
>8m			1							1		0.9	NL	NL				NL		
Field_ID	**LocCode**	**Sampled_Date-Time**																		
BH/MW216	BH/MW216	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
BH/MW218	BH/MW218	1-Oct-15	<0.05	<0.1	<0.05	<0.1	<0.1	-	-	<0.01	<0.1	<0.01	<0.01	<0.01	-	<0.02	<0.01	-	<0.01	<0.01
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
BD1/021015	BD1/021015	2-Oct-15	<0.1	<0.02	<0.05	<0.1	<0.05	<0.05	<0.1	<0.02	<0.02	<0.001	<0.002	<0.002	<0.001	<0.002	<0.002	<0.002	-	-
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
R1/021015	R1/021015	2-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	-	-
SW1	SW1	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
SW2	SW2	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
BD2/011015	SW2	1-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001
SW3	SW3	2-Oct-15	<0.05	<0.01	<0.05	<0.1	<0.1	-	-	<0.01	<0.01	<0.001	<0.001	<0.001	-	<0.002	<0.001	-	<0.001	<0.001

			MAH																	
			Isopropylbenzene	n-butylbenzene	n-propylbenzene	p-isopropyltoluene	sec-butylbenzene	Styrene	tert-butylbenzene	1,1,1,2-tetrachloroethane	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane	1,1-dichloroethane	1,1-dichloroethene	1,1-dichloropropene	1,2,3-trichloropropane	1,2-dibromo-3-chloropropane	1,2-dichloroethane	1,2-dichloropropane
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
ANZECC 2000, Marine Waters, 95% of Species													1.9							
ANZECC 2000 LOW RELIABILITY MW															0.7					
ANZECC 2000 Fresh Waters GILs for 95% of Species													6.5							
ANZECC 2000 LOW RELIABILITY FRESH WATER											0.27	0.4	1.9						1.9	0.9
ADWG 2011 Aesthetic								0.004												
ADWG 2011 Drinking Water								0.03							0.03				0.003	
ANZECC 2000 Recreational water quality and aesthetics															0.0003				0.01	
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																				
2-4m																				
4-8m																				
>8m																				
Field_ID	**LocCode**	**Sampled_Date-Time**																		
BH/MW216	BH/MW216	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BH/MW218	BH/MW218	1-Oct-15	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BD1/021015	BD1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW1	SW1	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SW2	SW2	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BD2/011015	SW2	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SW3	SW3	2-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

			Chlorinated Hydrocarbons																	
			1,3-dichloropropane	2,2-dichloropropane	Bromochloromethane	Bromodichloromethane	Bromoform	Carbon tetrachloride	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-dichloroethene	cis-1,3-dichloropropene	Dibromomethane	Hexachlorobutadiene	Trichloroethene	Tetrachloroethene	trans-1,2-dichloroethene	trans-1,3-dichloropropene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.01	0.001	0.01	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
ANZECC 2000, Marine Waters, 95% of Species																				
ANZECC 2000 LOW RELIABILITY MW																				
ANZECC 2000 Fresh Waters GILs for 95% of Species																				
ANZECC 2000 LOW RELIABILITY FRESH WATER			1.1					0.24			0.37			0.0008			0.33	0.07		0.0008
ADWG 2011 Aesthetic																				
ADWG 2011 Drinking Water																0.0007		0.05		
ANZECC 2000 Recreational water quality and aesthetics								0.003									0.03	0.01		
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																				
2-4m																				
4-8m																				
>8m																				
Field_ID	**LocCode**	**Sampled_Date-Time**																		
BH/MW216	BH/MW216	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BH/MW218	BH/MW218	1-Oct-15	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BD1/021015	BD1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW1	SW1	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SW2	SW2	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BD2/011015	SW2	1-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SW3	SW3	2-Oct-15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

			Halogenated Hydrocarbons				Halogenated Benzenes										Solvents	PA
			Vinyl chloride	1,2-dibromoethane	Bromomethane	Dichlorodifluoromethane	Trichlorofluoromethane	1,2,3-trichlorobenzene	1,2,4-trichlorobenzene	1,2-dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	2-chlorotoluene	4-chlorotoluene	Bromobenzene	Chlorobenzene	Hexachlorobenzene	Cyclohexane	7,12-dimethylbenz(a)anthracene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.01	0.001	0.01	0.01	0.01	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000001	0.001	
ANZECC 2000, Marine Waters, 95% of Species									0.02										
ANZECC 2000 LOW RELIABILITY MW			0.1																
ANZECC 2000 Fresh Waters GILs for 95% of Species								0.003	0.085	0.16	0.26	0.06							
ANZECC 2000 LOW RELIABILITY FRESH WATER								0.003		0.16	0.26	0.06							
ADWG 2011 Aesthetic										0.001	0.02	0.0003							
ADWG 2011 Drinking Water			0.0003	0.001	0.001					1.5		0.04							
ANZECC 2000 Recreational water quality and aesthetics																			
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																			
2-4m																			
4-8m																			
>8m																			
Field_ID	**LocCode**	**Sampled_Date-Time**																	
BH/MW216	BH/MW216	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
BH/MW218	BH/MW218	1-Oct-15	<0.1	<0.01	<0.1	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.000001	<0.01	-
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
BD1/021015	BD1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.00001	-	<0.0001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.000001	-	-
SW1	SW1	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
SW2	SW2	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
BD2/011015	SW2	1-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-
SW3	SW3	2-Oct-15	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.000001	<0.001	-

	AH	PAH/Phenols														
	Benzo[b+j]fluoranthene	2,4-dimethylphenol	2-methylnaphthalene	2-methylphenol	2-nitrophenol	3-&4-methylphenol	3-methylcholanthrene	4-chloro-3-methylphenol	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(b)&(k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL									0.0001	0.0001	0.0001	0.0001	0.00005	0.0002	0.0001	
ANZECC 2000, Marine Waters, 95% of Species																
ANZECC 2000 LOW RELIABILITY MW											0.00001		0.0002			
ANZECC 2000 Fresh Waters GILs for 95% of Species																
ANZECC 2000 LOW RELIABILITY FRESH WATER																
ADWG 2011 Aesthetic																
ADWG 2011 Drinking Water																
ANZECC 2000 Recreational water quality and aesthetics													0.00001			
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																
2-4m																
4-8m																
>8m																

Field_ID	LocCode	Sampled_Date-Time															
BH/MW216	BH/MW216	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
BH/MW218	BH/MW218	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
JKBH/MW1	JKBH/MW1	2-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
BD1/021015	BD1/021015	2-Oct-15	<0.0001	<0.001	<0.0001	<0.001	<0.001	<0.002	<0.0001	<0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00005	-	<0.0001	<0.0001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
JKBH/MW16	JKBH/MW16	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
SW1	SW1	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
SW2	SW2	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
BD2/011015	SW2	1-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-
SW3	SW3	2-Oct-15	-	-	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	-

													Halogenated Phenols					
			Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	PAHs (Sum of total)	Phenanthrene	Phenol	Phenolics Total	Pyrene	2,4,5-trichlorophenol	2,4,6-trichlorophenol	2,4-dichlorophenol	2,6-dichlorophenol	2-chlorophenol	Pentachlorophenol
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.0001	0.0001	0.0001	0.0001	0.0001	0.0001		0.0001		0.05	0.0001						
ANZECC 2000, Marine Waters, 95% of Species								0.05			0.4								0.011
ANZECC 2000 LOW RELIABILITY MW					0.0014					0.002									
ANZECC 2000 Fresh Waters GILs for 95% of Species								0.016			0.32				0.003	0.12		0.34	0.0036
ANZECC 2000 LOW RELIABILITY FRESH WATER																			
ADWG 2011 Aesthetic															0.002	0.0003		0.0001	
ADWG 2011 Drinking Water									0.00001						0.02	0.2		0.3	0.01
ANZECC 2000 Recreational water quality and aesthetics														0.001	0.01				0.01
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																			
2-4m								NL											
4-8m								NL											
>8m								NL											
Field_ID	**LocCode**	**Sampled_Date-Time**																	
BH/MW216	BH/MW216	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
BH/MW218	BH/MW218	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
BD1/021015	BD1/021015	2-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00005	<0.0001	<0.001	-	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
R1/021015	R1/021015	2-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
SW1	SW1	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
SW2	SW2	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
BD2/011015	SW2	1-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-
SW3	SW3	2-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	-	<0.0001	-	<0.05	<0.0001	-	-	-	-	-	-

			Polychlorinated Biphenyls								SVOCs				
			Arochlor 1016	Arochlor 1221	Arochlor 1232	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	PCBs (Sum of total)	Benzo(e)pyrene	Coronene	EPN	Perylene	4,4-DDE
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001					0.000001
ANZECC 2000, Marine Waters, 95% of Species															
ANZECC 2000 LOW RELIABILITY MW															
ANZECC 2000 Fresh Waters GILs for 95% of Species						0.0003		0.00001							
ANZECC 2000 LOW RELIABILITY FRESH WATER			0.000009	0.001	0.0003	0.0006	0.00003	0.00003	0.025						
ADWG 2011 Aesthetic															
ADWG 2011 Drinking Water															
ANZECC 2000 Recreational water quality and aesthetics															
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand															
2-4m															
4-8m															
>8m															
Field_ID	**LocCode**	**Sampled_Date-Time**													
BH/MW216	BH/MW216	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
BH/MW218	BH/MW218	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
BD1/021015	BD1/021015	2-Oct-15	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00005	<0.0001	<0.00001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
R1/021015	R1/021015	2-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
SW1	SW1	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
SW2	SW2	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
BD2/011015	SW2	1-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001
SW3	SW3	2-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	<0.000001

														Organochlorine Pesticide
			a-BHC	Aldrin	b-BHC	chlordane	Chlordane (cis)	Chlordane (trans)	d-BHC	DDD	DDT	DDT+DDE+DDD	Dieldrin	Endosulfan
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.000001	0.000001	0.000001		0.000001	0.000001	0.000001	0.000001	0.000001		0.000001	
ANZECC 2000, Marine Waters, 95% of Species														0.000005
ANZECC 2000 LOW RELIABILITY MW				0.000003			0.000001	0.000001			0.0000004	0.0000005	0.00001	
ANZECC 2000 Fresh Waters GILs for 95% of Species						0.00003					0.000006			0.00003
ANZECC 2000 LOW RELIABILITY FRESH WATER														
ADWG 2011 Aesthetic														
ADWG 2011 Drinking Water											0.009			0.02
ANZECC 2000 Recreational water quality and aesthetics				0.001		0.006					0.003		0.001	0.04
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand														
2-4m														
4-8m														
>8m														
Field_ID	**LocCode**	**Sampled_Date-Time**												
BH/MW216	BH/MW216	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000008	-
BH/MW218	BH/MW218	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000076	-
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000001	-
BD1/021015	BD1/021015	2-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000003	-
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000003	-
R1/021015	R1/021015	2-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	<0.000001	-
SW1	SW1	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000001	-
SW2	SW2	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000004	-
BD2/011015	SW2	1-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	0.000004	-
SW3	SW3	2-Oct-15	<0.000001	<0.000001	<0.000001	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	-	<0.000001	-

	s											
	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	Endrin ketone	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Methoxychlor	Oxychlordane	Azinophos methyl
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.00001
ANZECC 2000, Marine Waters, 95% of Species				0.000004								
ANZECC 2000 LOW RELIABILITY MW	0.000005	0.000005						0.0000004		0.000004		
ANZECC 2000 Fresh Waters GILs for 95% of Species				0.00001			0.0002	0.00001				
ANZECC 2000 LOW RELIABILITY FRESH WATER												
ADWG 2011 Aesthetic												
ADWG 2011 Drinking Water							0.01	0.0003		0.3		0.03
ANZECC 2000 Recreational water quality and aesthetics				0.001			0.01	0.003				0.01
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand												
2-4m												
4-8m												
>8m												
Field_ID	**LocCode**	**Sampled_Date-Time**										
BH/MW216	BH/MW216	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
BH/MW218	BH/MW218	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
BD1/021015	BD1/021015	2-Oct-15	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.000005	<0.00001	<0.00001	<0.00001	<0.00002
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
R1/021015	R1/021015	2-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
SW1	SW1	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
SW2	SW2	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
BD2/011015	SW2	1-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001
SW3	SW3	2-Oct-15	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001	<0.00001

			Bolstar (Sulprofos)	Bromophos-ethyl	Carbophenothion	Azinphos Ethyl	Chlorfenvinphos	Chlorfenvinphos E	Chlorfenvinphos Z	Chlorpyrifos	Chlorpyrifos-methyl	Coumaphos	Demeton-O	Demeton-S	Diazinon	Dichlorvos
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL						0.00001		0.00001	0.00001	0.00001	0.00001				0.00001	0.00001
ANZECC 2000, Marine Waters, 95% of Species										0.000009						
ANZECC 2000 LOW RELIABILITY MW																
ANZECC 2000 Fresh Waters GILs for 95% of Species										0.00001					0.00001	
ANZECC 2000 LOW RELIABILITY FRESH WATER																
ADWG 2011 Aesthetic																
ADWG 2011 Drinking Water			0.01	0.01						0.01					0.004	0.005
ANZECC 2000 Recreational water quality and aesthetics			0.02	0.02	0.001		0.01			0.002					0.01	0.02
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																
2-4m																
4-8m																
>8m																
Field_ID	**LocCode**	**Sampled_Date-Time**														
BH/MW216	BH/MW216	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
BH/MW218	BH/MW218	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
JKBH/MW1	JKBH/MW1	2-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
BD1/021015	BD1/021015	2-Oct-15	<0.00005	<0.0001	<0.00002	<0.00002	<0.00002	-	-	<0.00002	<0.0002	<0.00001	<0.00002	<0.00002	<0.00001	<0.0002
JKBH/MW107A	JKBH/MW107A	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
JKBH/MW16	JKBH/MW16	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
R1/021015	R1/021015	2-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
SW1	SW1	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
SW2	SW2	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
BD2/011015	SW2	1-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001
SW3	SW3	2-Oct-15	-	-	-	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	<0.00001	<0.00001

			Organophosphorous Pesticides												
			Dimethoate	Disulfoton	Ethion	Ethoprop	Fenitrothion	Fensulfothion	Fenthion	Malathion	Methidathion	Methyl parathion	Mevinphos (Phosdrin)	Monocrotophos	Omethoate	Phorate
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL			0.00001		0.00001		0.00001		0.00001	0.00001		0.00001				
ANZECC 2000, Marine Waters, 95% of Species																
ANZECC 2000 LOW RELIABILITY MW																
ANZECC 2000 Fresh Waters GILs for 95% of Species			0.00015				0.0002			0.00005						
ANZECC 2000 LOW RELIABILITY FRESH WATER																
ADWG 2011 Aesthetic																
ADWG 2011 Drinking Water			0.007	0.004	0.004	0.001	0.007	0.01	0.007	0.07	0.006	0.0007	0.005	0.002	0.001	
ANZECC 2000 Recreational water quality and aesthetics			0.1	0.006	0.006	0.001	0.02	0.02		0.1	0.06	0.006	0.006	0.002	0.0004	
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																
2-4m																
4-8m																
>8m																
Field_ID	**LocCode**	**Sampled_Date-Time**														
BH/MW216	BH/MW216	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
BH/MW218	BH/MW218	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
JKBH/MW1	JKBH/MW1	2-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
BD1/021015	BD1/021015	2-Oct-15	<0.00002	<0.00005	<0.00002	<0.00001	<0.002	<0.00001	<0.00005	<0.00002	<0.0001	<0.0005	<0.00002	<0.00002	<0.00001	<0.0001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
JKBH/MW16	JKBH/MW16	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
R1/021015	R1/021015	2-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
SW1	SW1	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
SW2	SW2	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
BD2/011015	SW2	1-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-
SW3	SW3	2-Oct-15	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	<0.00001	-	<0.00001	-	-	-	-

																	Pesticides
			Prothiofos	Pyrazophos	Ronnel	Terbufos	Thiometon	Trichloronate	Tetrachlorvinphos	Acephate	Demeton-S-methyl	Fenamiphos	Formothion	Parathion	Pirimiphos-methyl	Pirimphos-ethyl	Profenofos
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PQL											0.00001			0.00001	0.00001	0.00001	
ANZECC 2000, Marine Waters, 95% of Species																	
ANZECC 2000 LOW RELIABILITY MW																	
ANZECC 2000 Fresh Waters GILs for 95% of Species														0.000004			
ANZECC 2000 LOW RELIABILITY FRESH WATER																	
ADWG 2011 Aesthetic																	
ADWG 2011 Drinking Water				0.02		0.0009	0.004		0.1	0.008		0.0005	0.05	0.02	0.09	0.0005	0.0003
ANZECC 2000 Recreational water quality and aesthetics				1	0.06		0.02			0.02			0.1	0.03	0.06	0.001	0.0006
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																	
2-4m																	
4-8m																	
>8m																	
Field_ID	**LocCode**	**Sampled_Date-Time**															
BH/MW216	BH/MW216	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
BH/MW218	BH/MW218	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
JKBH/MW1	JKBH/MW1	2-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
BD1/021015	BD1/021015	2-Oct-15	<0.0001	<0.0001	<0.01	<0.00001	<0.0005	<0.0005	<0.00001	<0.0005	<0.00002	<0.00001	<0.02	<0.0002	<0.00001	<0.00001	<0.00001
JKBH/MW107A	JKBH/MW107A	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
JKBH/MW16	JKBH/MW16	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
SW1	SW1	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
SW2	SW2	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
BD2/011015	SW2	1-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-
SW3	SW3	2-Oct-15	-	-	-	-	-	-	-	-	<0.00001	-	-	<0.00001	<0.00001	<0.00001	-

								Fungicides	Other
		Sulfotepp	Temephos	Trichlorfon	Bensulide	Demeton-O & Demeton-S	Naftalofos	Fosetyl-al	Triazophos
		mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	mg/L	mg/L
PQL									
ANZECC 2000, Marine Waters, 95% of Species			0.00005						
ANZECC 2000 LOW RELIABILITY MW									
ANZECC 2000 Fresh Waters GILs for 95% of Species									
ANZECC 2000 LOW RELIABILITY FRESH WATER									
ADWG 2011 Aesthetic									
ADWG 2011 Drinking Water			0.4	0.007					
ANZECC 2000 Recreational water quality and aesthetics			0.03	0.01					
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand									
2-4m									
4-8m									
>8m									
Field_ID	**LocCode**	**Sampled_Date-Time**							
BH/MW216	BH/MW216	1-Oct-15	-	-	-	-	-	-	-	-
BH/MW218	BH/MW218	1-Oct-15	-	-	-	-	-	-	-	-
JKBH/MW1	JKBH/MW1	2-Oct-15	-	-	-	-	-	-	-	-
BD1/021015	BD1/021015	2-Oct-15	<0.000005	<0.00002	<0.00002	<0.1	<0.02	<1	<0.01	<0.000005
JKBH/MW107A	JKBH/MW107A	1-Oct-15	-	-	-	-	-	-	-	-
JKBH/MW16	JKBH/MW16	1-Oct-15	-	-	-	-	-	-	-	-
R1/021015	R1/021015	2-Oct-15	-	-	-	-	-	-	-	-
SW1	SW1	1-Oct-15	-	-	-	-	-	-	-	-
SW2	SW2	1-Oct-15	-	-	-	-	-	-	-	-
BD2/011015	SW2	1-Oct-15	-	-	-	-	-	-	-	-
SW3	SW3	2-Oct-15	-	-	-	-	-	-	-	-

Appendix G

Summary of EIS Soil and Groundwater Results (EIS, 2013)

REPORT TABLES

TABLE A-1
SOIL LABORATORY RESULTS COMPARED TO HIL
All data in mg/kg unless stated otherwise

			HEAVY METALS									PAHs		ORGANOCHLORINE PESTICIDES (OCPs)							OP PESTICIDES (OPPs)	TOTAL PCBs	ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Chromium VI	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P TEQ [2]	HCB	Endosulfan	Methoxychlor	Aldrin & Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor	Chlorpyrifos		
PQL - Envirolab Services			4	0.5	1	1	1	1	0.1	1	1	-	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0,1	0.1	100
Site Assessment Criteria (SAC) [1]			100	20	nsl	100	6000	300	40	400	7400	300	3	10	270	300	6	50	240	6	160	1	Detect/Not Detect
Sample Reference	**Sample Depth**	**Sample Description**																					
JK1	0.0-0.2	Fill - Silty Sand Clay	8	0.4	31	NA	68	170	0.1	44	230	13.2	2	LPQL	LPQL	LPQL	0.1	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK1	1.3-1.5	Fill - Silty Clay	9	0.5	37	NA	74	200	0.1	41	220	5.57	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK1	2.7-3.0	Silty Clay	LPQL	LPQL	14	NA	11	16	LPQL	2	7	0.2	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK2	0.0-0.2	Fill - Silty Sand	5	LPQL	11	NA	36	45	LPQL	9	88	2.14	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK2	0.8-1.0	Silty Clay	5	LPQL	23	NA	10	30	LPQL	5	11	LPQL	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK3	0.3-0.5	Fill - Silty Sand	LPQL	LPQL	21	NA	76	60	LPQL	9	63	7.25	1	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK3	3.5-3.8	Fill - Silty Clay	8	LPQL	17	NA	44	96	0.1	7	250	0.69	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK3	4.3-4.5	Silty Clay	6	LPQL	10	NA	11	32	LPQL	3	470	LPQL	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK4	0.0-0.2	Fill - Silty Sand	5	LPQL	24	NA	34	46	LPQL	13	77	3.13	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK4	1.3-1.5	Fill - Silty Clay	10	LPQL	20	NA	110	68	0.2	13	100	3.18	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK5	0.0-0.2	Fill - Silty Sand	4	LPQL	15	NA	32	110	0.2	10	120	15.1	2	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK5	0.65-0.95	Fill - Silty Clay	4	0.5	19	NA	68	160	0.2	13	200	7.69	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK5	3.0-3.15	Fill - Silty Clay	7	LPQL	17	NA	30	83	0.1	9	150	8.95	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK5	6.0-6.2	Clayey Silt	5	LPQL	13	NA	15	24	LPQL	3	39	0.61	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK6	0.05-0.2	Fill - Gravelly Clayey Sand	LPQL	LPQL	28	NA	57	23	LPQL	28	42	21.1	3	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK6	1.3-1.5	Fill - Clayey Sand	6	LPQL	15	NA	32	46	LPQL	10	52	7.31	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK6	3.0-3.45	Fill - Silty Clay	6	LPQL	13	NA	25	37	LPQL	14	100	LPQL	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK7	0.0-0.2	Fill - Silty Clay	LPQL	LPQL	110	NA	56	9	LPQL	9	25	4.27	1	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK7[a]	2.7-3.0	Fill - Clayey Sandy Gravel	11	LPQL	2800	LPQL	91	97	0.1	59	130	3.2	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK7	5.8-6.0	Fill - Gravelly Sandy Clay	7	LPQL	33	NA	48	100	0.1	9	140	8.5	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK8	0.0-0.2	Fill - Silty Sand	LPQL	LPQL	11	NA	34	35	LPQL	7	100	3.39	1	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK8	2.7-3.0	Fill - Sandy Gravelly Clay	5	LPQL	33	NA	48	47	LPQL	19	120	0.27	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK8	4.3-4.5	Fill - Sandy Clay	7	LPQL	14	NA	38	27	LPQL	9	70	LPQL	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK9	0.0-0.2	Fill - Silty Sand	LPQL	LPQL	18	NA	29	29	LPQL	10	53	2.47	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detected
JK9	0.5-0.7	Fill - Silty Sandy Clay	7	LPQL	17	NA	150	86	0.2	8	270	2.22	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK9	2.6-2.8	Fill - Silty Sandy Clay	5	LPQL	16	NA	58	51	LPQL	6	81	7.25	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Number of Samples			26	26	26	1	26	26	26	26	26	26	26	9	9	9	9	9	9	9	9	9	9
Maximum Value			11	0.5	2800	LPQL	150	200	0.2	59	470	21.1	3	LPQL	LPQL	LPQL	0.1	LPQL	LPQL	LPQL	LPQL	LPQL	nc

Explanation:

1 - Site Assessment Criteria (SAC): NEPM 2013, HIL-A: 'Residential with garden/accessible soils; children's day care centers; preschools; and primary schools'

2 - B(a)P TEQ - Benzo(a)pyrene Toxicity Equivalence Quotient has been calculated based on 8 carcinogenic PAHs and their Toxic Equivalence Factors (TEFs) outlined in NEPM 2013

a - Hexavalent Chromium (Cr VI) results are presented in Envirolab Report 99558-A

Concentration above the SAC **VALUE**

Abbreviations:

PAHs: Polycyclic Aromatic Hydrocarbons
B(a)P: Benzo(a)pyrene
PQL: Practical Quantitation Limit
LPQL: Less than PQL
OPP: Organophosphorus Pesticides
OCP: Organochlorine Pesticides
PCBs: Polychlorinated Biphenyls
UCL: Upper Level Confidence Limit on Mean Value
HILs: Health Investigation Levels
NA: Not Analysed
nc: Not Calculated
nsl: No Set Limit
SAC: Site Assessment Criteria
NEPM: National Environmental Protection Measure

Copyright Environmental Investigation Services

TABLE A-2
SOIL LABORATORY RESULTS COMPARED TO HIL
All data in mg/kg unless stated otherwise

			HEAVY METALS									PAHs		ORGANOCHLORINE PESTICIDES (OCPs)							OP PESTICIDES (OPPs)	TOTAL PCBs	ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Chromium VI	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P TEQ [2]	HCB	Endosulfan	Methoxychlor	Aldrin & Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor	Chlorpyrifos		
PQL - Envirolab Services			4	0.5	1	1	1	1	0.1	1	1	-	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0,1	0.1	100
Site Assessment Criteria (SAC) [1]			100	20	nsl	100	6000	300	40	400	7400	300	3	10	270	300	6	50	240	6	160	1	Detect/Not Detect
Sample Reference	**Sample Depth**	**Sample Description**																					
JK10	0.0-0.2	Fill - Silty Gravelly Sand	LPQL	LPQL	6	NA	30	33	LPQL	4	68	0.5	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detect
JK10	1.3-1.5	Fill - Clayey Sand	LPQL	LPQL	10	NA	17	34	0.1	6	44	3.87	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK10	2.7-3.0	Fill - Silty Sandy Gravel	8	0.4	22	NA	64	270	0.6	12	230	1.35	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Detect
JK10	5.7-6.0	Fill - Sandy Clay	5	0.6	17	NA	120	170	0.4	11	400	8.11	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK10	7.3-7.5	Fill - Sandy Clay	9	LPQL	20	NA	57	140	0.2	6	220	3.82	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	**Chrysotile & Crocidolite Asbestos**
JK11	0.0-0.2	Fill - Gravelly Clayey Sand	5	LPQL	19	NA	150	68	0.1	14	150	2.25	LPQL	LPQL	LPQL	LPQL	5.2	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detect
JK11	4.0-4.5	Fill - Clayey Gravelly Sand	LPQL	LPQL	18	NA	8	11	LPQL	6	32	LPQL	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK11	6.0-6.45	Silty Clay	LPQL	LPQL	7	NA	9	8	LPQL	1	5	LPQL	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK12	0.0-0.2	Fill - Silty Gravelly Sand	LPQL	LPQL	10	NA	31	43	LPQL	5	96	2.65	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK12	0.5-0.7	Fill - Silty Gravelly Sand	LPQL	LPQL	68	NA	56	11	LPQL	6	27	10.12	1	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detect
JK12	1.3-1.5	Fill - Silty Gravelly Sand	LPQL	LPQL	7	NA	47	81	LPQL	4	57	139.1	**13**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK12	4.3-4.5	Fill - Silty Sand	15	3.2	25	NA	190	270	0.1	42	640	1.55	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK13	0.0-0.2	Fill - Silty Sand	LPQL	LPQL	9	NA	34	38	LPQL	5	120	2.74	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detect
JK13	0.8-1.0	Fill - Sandy Clay	4	LPQL	9	NA	25	75	LPQL	4	97	2.17	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK13	2.7-3.0	Fill - Sandy Clayey Gravel	10	3.5	26	NA	43	180	0.1	10	250	2.3	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK14	0.0-0.2	Fill - Silty Sand	5	LPQL	14	NA	46	93	0.1	9	220	3.87	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detect
JK14	2.7-3.0	Fill - Silty Clay	6	LPQL	17	NA	54	71	0.1	11	230	6.96	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK14	7.3-7.5	Fill - Silty Sand	5	LPQL	11	NA	30	89	0.2	6	260	1.24	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK14	8.7-9.0	Fill - Silty Sand	6	LPQL	12	NA	41	190	0.1	8	230	2.65	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK15	0.0-0.2	Fill - Silty Sand	LPQL	LPQL	5	NA	40	12	0.3	6	37	2.13	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detect
JK15	0.3-0.5	Fill - Silty Sand	6	LPQL	3	NA	12	26	LPQL	2	52	LPQL	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK15	2.8-3.0	Fill - Silty Clayey Sand	8	LPQL	18	NA	83	110	0.1	13	170	12.6	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK15	5.7-6.0	Fill - Silty Sand	LPQL	LPQL	4	NA	4	9	LPQL	8	21	LPQL	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK16	0.0-0.2	Fill - Silty Sand	5	LPQL	15	NA	36	**350**	0.1	14	250	14.7	1	LPQL	LPQL	LPQL	0.4	LPQL	LPQL	LPQL	LPQL	LPQL	Not Detect
JK16	1.3-1.5	Fill - Silty Sand	LPQL	LPQL	26	NA	26	24	LPQL	22	80	6.27	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JK16	2.7-3.0	Fill - Clayey Sand	9	LPQL	16	NA	15	25	LPQL	11	64	4.01	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Number of Samples			26	26	26	0	26	26	26	26	26	26	26	7	7	7	7	7	7	7	7	7	9
Maximum Value			15	3.5	68	0	190	350	0.6	42	640	139.1	13	LPQL	LPQL	LPQL	5.2	LPQL	LPQL	LPQL	LPQL	LPQL	nc

Explanation:

1 - Site Assessment Criteria (SAC): NEPM 2013, HIL-A: 'Residential with garden/accessible soils; children's day care centers; preschools; and primary schools'

2 - B(a)P TEQ - Benzo(a)pyrene Toxicity Equivalence Quotient has been calculated based on 8 carcinogenic PAHs and their Toxic Equivalence Factors (TEFs) outlined in NEPM 2013

Concentration above the SAC **VALUE**

Abbreviations:

PAHs: Polycyclic Aromatic Hydrocarbons
B(a)P: Benzo(a)pyrene
PQL: Practical Quantitation Limit
LPQL: Less than PQL
OPP: Organophosphorus Pesticides
OCP: Organochlorine Pesticides
PCBs: Polychlorinated Biphenyls
UCL: Upper Level Confidence Limit on Mean Value
HILs: Health Investigation Levels
NA: Not Analysed
nc: Not Calculated
nsl: No Set Limit
SAC: Site Assessment Criteria
NEPM: National Environmental Protection Measure

Copyright Environmental Investigation Services

TABLE B-1
SOIL LABORATORY RESULTS COMPARED TO HSL
All data in mg/kg unless stated otherwise

				C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	PID [2]
PQL - Envirolab Services				25	50	0.2	0.5	1	3	1	
HSL Land Use Category [1]				**RESIDENTIAL WITH ACCESSIBLE SOIL**							
Sample Reference	**Sample Depth**	**Depth Category**	**Soil Category**								
JK1	0.0-0.2	0m to < 1m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK1	1.3-1.5	1m to <2m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK1	2.7-3.0	2m to <4m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK2	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK2	0.8-1.0	0m to < 1m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK3	0.3-0.5	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK3	3.5-3.8	2m to <4m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK3	4.3-4.5	4m+	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK4	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK4	1.3-1.5	1m to <2m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK5	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK5	0.65-0.95	0m to < 1m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK5	3.0-3.15	2m to <4m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK5	6.0-6.2	4m+	Silt	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK6	0.05-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.5
JK6	1.3-1.5	1m to <2m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK6	3.0-3.45	2m to <4m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.4
JK7	0.0-0.2	0m to < 1m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK7	2.7-3.0	2m to <4m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK7	5.8-6.0	4m+	Clay	LPQL	240	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK8	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK8	2.7-3.0	2m to <4m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK8	4.3-4.5	4m+	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK9	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK9	0.5-0.7	0m to < 1m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK9	2.6-2.8	2m to <4m	Clay	LPQL	53	LPQL	LPQL	LPQL	LPQL	LPQL	0
Total Number of Samples [3]				26	26	26	26	26	26	26	26
Maximum Value				LPQL	240	LPQL	LPQL	LPQL	LPQL	LPQL	0.5

Explanation:
1 - Site Assessment Criteria (SAC): NEPM 2013
2 - Field PID values obtained during the investigation

Concentration above the SAC VALUE

Abbreviations:
UCL: Upper Level Confidence Limit on Mean Value
HSLs: Health Screening Levels
na: Not Analysed
nc: Not Calculated
NL: Not Limiting
PQL: Practical Quantitation Limit
LPQL: Less than PQL
SAC: Site Assessment Criteria
NEPM: National Environmental Protection Measure

E26930KBrpt
December, 2013

SITE ASSESSMENT CRITERIA

				C_6-C10 (F1)	$>C_{10}$-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
PQL - Envirolab Services				25	50	0.2	0.5	1	3	1
HSL Land Use Category [1]				**RESIDENTIAL WITH ACCESSIBLE SOIL**						
Sample Reference	**Sample Depth**	**Depth Category**	**Soil Category**							
JK1	0.0-0.2	0m to < 1m	Clay	50	280	0.7	480	NL	110	5
JK1	1.3-1.5	1m to <2m	Clay	90	NL	1	NL	NL	310	NL
JK1	2.7-3.0	2m to <4m	Clay	150	NL	2	NL	NL	NL	NL
JK2	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK2	0.8-1.0	0m to < 1m	Clay	50	280	0.7	480	NL	110	5
JK3	0.3-0.5	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK3	3.5-3.8	2m to <4m	Clay	150	NL	2	NL	NL	NL	NL
JK3	4.3-4.5	4m+	Clay	290	NL	3	NL	NL	NL	NL
JK4	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK4	1.3-1.5	1m to <2m	Clay	90	NL	1	NL	NL	310	NL
JK5	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK5	0.65-0.95	0m to < 1m	Clay	50	280	0.7	480	NL	110	5
JK5	3.0-3.15	2m to <4m	Clay	150	NL	2	NL	NL	NL	NL
JK5	6.0-6.2	4m+	Silt	190	NL	2	NL	NL	NL	NL
JK6	0.05-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK6	1.3-1.5	1m to <2m	Sand	70	240	0.5	220	NL	60	NL
JK6	3.0-3.45	2m to <4m	Clay	150	NL	2	NL	NL	NL	NL
JK7	0.0-0.2	0m to < 1m	Clay	50	280	0.7	480	NL	110	5
JK7	2.7-3.0	2m to <4m	Sand	110	440	0.5	310	NL	95	NL
JK7	5.8-6.0	4m+	Clay	290	NL	3	NL	NL	NL	NL
JK8	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK8	2.7-3.0	2m to <4m	Clay	150	NL	2	NL	NL	NL	NL
JK8	4.3-4.5	4m+	Clay	290	NL	3	NL	NL	NL	NL
JK9	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK9	0.5-0.7	0m to < 1m	Clay	50	280	0.7	480	NL	110	5
JK9	2.6-2.8	2m to <4m	Clay	150	NL	2	NL	NL	NL	NL

Copyright Environmental Investigation Services

TABLE B-2
SOIL LABORATORY RESULTS COMPARED TO HSL
All data in mg/kg unless stated otherwise

				C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	PID [2]
PQL - Envirolab Services				25	50	0.2	0.5	1	3	1	
HSL Land Use Category [1]				RESIDENTIAL WITH ACCESSIBLE SOIL							
Sample Reference	**Sample Depth**	**Depth Category**	**Soil Category**								
JK10	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK10	1.3-1.5	1m to <2m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK10	2.7-3.0	2m to <4m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK10	5.7-6.0	4m+	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK10	7.3-7.5	4m+	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK11	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.4
JK11	4.0-4.5	4m+	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	1.9
JK11	6.0-6.45	4m+	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.4
JK12	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK12	0.5-0.7	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK12	1.3-1.5	1m to <2m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK12	4.3-4.5	4m+	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK13	0.0-0.2	0m to < 1m	Sand	LPQL	190	LPQL	LPQL	LPQL	LPQL	LPQL	1
JK13	0.8-1.0	0m to < 1m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK13	2.7-3.0	2m to <4m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK14	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK14	2.7-3.0	2m to <4m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK14	7.3-7.5	4m+	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK14	8.7-9.0	4m+	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK15	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK15	0.3-0.5	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK15	2.8-3.0	2m to <4m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK15	5.7-6.0	4m+	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK16	0.0-0.2	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK16	1.3-1.5	1m to <2m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK16	2.7-3.0	2m to <4m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
Total Number of Samples [3]				26	26	26	26	26	26	26	26
Maximum Value				LPQL	190	LPQL	LPQL	LPQL	LPQL	LPQL	1.9

Explanation:
1 - Site Assessment Criteria (SAC): NEPM 2013
2 - Field PID values obtained during the investigation

Concentration above the SAC VALUE

Abbreviations:
UCL: Upper Level Confidence Limit on Mean Value
HSLs: Health Screening Levels
na: Not Analysed
nc: Not Calculated
NL: Not Limiting
PQL: Practical Quantitation Limit
LPQL: Less than PQL
SAC: Site Assessment Criteria
NEPM: National Environmental Protection Measure

E26930KBrpt
December, 2013

SITE ASSESSMENT CRITERIA

				C_6-C10 (F1)	$>C_{10}$-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
PQL - Envirolab Services				25	50	0.2	0.5	1	3	1
HSL Land Use Category [1]				RESIDENTIAL WITH ACCESSIBLE SOIL						
Sample Reference	**Sample Depth**	**Depth Category**	**Soil Category**							
JK10	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK10	1.3-1.5	1m to <2m	Sand	70	240	0.5	220	NL	60	NL
JK10	2.7-3.0	2m to <4m	Sand	110	440	0.5	310	NL	95	NL
JK10	5.7-6.0	4m+	Clay	290	NL	3	NL	NL	NL	NL
JK10	7.3-7.5	4m+	Clay	290	NL	3	NL	NL	NL	NL
JK11	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK11	4.0-4.5	4m+	Sand	200	NL	0.5	540	NL	170	NL
JK11	6.0-6.45	4m+	Clay	290	NL	3	NL	NL	NL	NL
JK12	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK12	0.5-0.7	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK12	1.3-1.5	1m to <2m	Sand	70	240	0.5	220	NL	60	NL
JK12	4.3-4.5	4m+	Sand	200	NL	0.5	540	NL	170	NL
JK13	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK13	0.8-1.0	0m to < 1m	Clay	50	280	0.7	480	NL	110	5
JK13	2.7-3.0	2m to <4m	Sand	110	440	0.5	310	NL	95	NL
JK14	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK14	2.7-3.0	2m to <4m	Clay	150	NL	2	NL	NL	NL	NL
JK14	7.3-7.5	4m+	Sand	200	NL	0.5	540	NL	170	NL
JK14	8.7-9.0	4m+	Sand	200	NL	0.5	540	NL	170	NL
JK15	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK15	0.3-0.5	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK15	2.8-3.0	2m to <4m	Sand	110	440	0.5	310	NL	95	NL
JK15	5.7-6.0	4m+	Sand	200	NL	0.5	540	NL	170	NL
JK16	0.0-0.2	0m to < 1m	Sand	45	110	0.5	160	55	40	3
JK16	1.3-1.5	1m to <2m	Sand	70	240	0.5	220	NL	60	NL
JK16	2.7-3.0	2m to <4m	Sand	110	440	0.5	310	NL	95	NL

Copyright Environmental Investigation Services

TABLE C
SUMMARY OF LABORATORY RESULTS - VOLATILE ORGANIC COMPOUNDS (VOCs)

Sample Reference	Sample Depth (m)	Sample Description	Total VOCs
JK12[a]	0.5-0.7	Fill - Silty Gravelly Sand	ALPQL
JK6[b]	0.05-0.2	Fill - Gravelly Clayey Sand	ALPQL
JK7[b]	0.0-0.2	Fill - Silty Clay	ALPQL
JK7[b]	5.8-6.0	Fill - Gravelly Sandy Clay	ALPQL
JK9[b]	0.5-0.7	Fill - Silty Sandy Clay	ALPQL
JK13[b]	0.0-0.2	Fill - Silty Sand	ALPQL
Total Number of Samples			6
Minimum Value			ALPQL
Maximum Value			ALPQL

EXPLANATION:

a - Reference should be made to Envirolab Report 99467-A for more information on individual values

b - Reference should be made to Envirolab Report 99558-A for more information on individual values

Values Exceeding Action Criteria **VALUE**

Abbreviations:

ALPQL: All Values Less than PQL

PQL: Practical Quantitation Limit

E26930KBrpt
December, 2013

Copyright Environmental Investigation Services

TABLE D
SUMMARY OF LABORATORY RESULTS - ASBESTOS IN MATERIAL

Sample Reference	Sample Depth (m)	Sample Description	Asbestos
JK5	5.7	Material	**Chrysotile asbestos detected, Amosite asbestos detected**
JK10	4.3-4.5	Material	**Chrysotile asbestos detected, Amosite asbestos detected**
JK10	7.3-7.5	Material	**Chrysotile asbestos detected, Crocidolite asbestos detected**
JK10	11	Material	**Chrysotile asbestos detected, Crocidolite asbestos detected**
JK14	1.3-1.5	Material	No asbestos detected
JK14	7.3-7.5	Material	**Chrysotile asbestos detected**
S1	-	Material	**Chrysotile asbestos detected, Amosite asbestos detected, Crocidolite asbestos detected**
Total Number of Samples			7

EXPLANATION:

a - Reference should be made to Envirolab Report 99467-A for more information on individual values

Values Exceeding Action Criteria **VALUE**

Abbreviations:

ALPQL: All Values Less than PQL

PQL: Practical Quantitation Limit

Copyright Environmental Investigation Services

TABLE E
SUMMARY OF LABORATORY RESULTS - ACID SULFATE SOILS ANALYSIS (POCAS)

Sample Reference	Sample Depth (m)	Sample Description	pH_{KCL}	TAA pH 6.5	pH_{ox}	TPA pH 6.5	TSA pH 6.5	S_{POS} %w/w	Ca A %w/w	Mg A %w/w	Liming Rate kg $CaCO_3$/tonne
JK1	1.3-1.5	Fill - Silty Clay	6.1	5	**4.5**	**30**	**25**	**0.08**	0.017	LPQL	4.2
JK3	3.5-3.8	Fill - Silty Clay	8.8	LPQL	7	LPQL	LPQL	**0.2**	0.55	0.025	LPQL
JK3	5.7-6.0	Silty Clay	6.5	LPQL	**3**	**170.0**	**170**	**0.4**	0.05	LPQL	15
JK5	6.3-6.5	Clayey Silt	6.4	LPQL	**4.9**	LPQL	LPQL	0.03	LPQL	0.006	1.7
JK15	2.8-3.0	Fill - Silty Clayey Sand	8.3	LPQL	7.4	LPQL	LPQL	**0.06**	0.72	0.013	LPQL
JK15	4.3-4.5	Fill - Silty Sand	6.2	LPQL	**3.3**	**65**	**62**	**0.13**	LPQL	LPQL	6.4
JK16	1.8-2.0	Fill - Silty Sand	10.1	LPQL	8	LPQL	LPQL	0.01	0.48	0.027	LPQL
JK16	4.3-4.5	Silty Sand	5.6	5	**2.6**	**85**	**80**	**0.31**	0.008	LPQL	15
Total Number of Samples			8	8	8	8	8	8	8	8	8
Minimum Value			5.6	5	2.6	30	25	0.01	0.008	0.006	1.7
Maximum Value			10.1	5	8	170	170	0.4	0.72	0.027	15

EXPLANATION:

Action criteria are defined as follows:

- coarse textured soils (sands to loamy sands):
  - pH < 5
  - TAA/TSA/TPA (pH 5.5) > 18mol H^+/tonne
  - S_{pos} > 0.03% sulfure oxidisable

Values Exceeding Action Criteria **VALUE**

Abbreviations:

pH_{KCL} : pH of filtered 1:20, 1M KCL extract, shaken overnight

TAA pH 6.5 : Total Actual Acidity in 1M KCL extract titrated to pH6.5

pH_{ox} : pH filtered 1:20 1M KCl after peroxide digestion

TPA : Total Potential Acidity, 1M KCL peroxide digest titrated to pH6.5

TSA: Total Sulfide Acidity

S_{POS}: Peroxide oxidisable Sulfur (SP - SKCL)

Ca $_A$/Mg $_A$: Calcium/Magnesium reacted with acid generated by peroxide digest

Calcium and Magnesium values used to estimate additional Ca/Mg from acid-shell/carbonate/dolomite reaction

Reference: ASSMAC (Acid Sulfate Soils management Advisory Committee - Acid Sulfate Soil Manual, August 1998).

Copyright Environmental Investigation Services

TABLE F
SUMMARY OF GROUNDAWATER LABORATORY RESULTS
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	GIL - ANZECC 2000 [1] Fresh Waters	GIL - US EPA[3]	GIL - Drinking Water[2]	SAMPLES MW1	MW7	MW9	MW16
Field Measurements [4]								
Dissolved oxygen (ppm)	-	nsl	-	>85%[d]	0.5	0.5	0.6	1.6
Redox potential (mV)	-	nsl	-	nsl	-77.2	151.7	250.5	-8
pH	-	6.5 - 8.5[i]	-	6.5 - 8.5[d]	**6.45**	6.96	**4.25**	6.72
Conductivity (µS/cm)	-	nsl	-	nsl	3,092	6,447	2,225	12,535
Temperature °C	-	nsl	-	nsl	19.6	20.7	25.5	20.3
Inorganic Compounds and Parameters								
pH	0.1	6.5 - 8.5[i]	-	6.5 - 8.5[d]	7.6	8	**4.8**	7.4
Electrical Conductivity (µS/cm)	1	nsl	-	nsl	3,500	7,100	2,300	14,000
Hardness (mgCaCo3/L)	3	nsl	-	200[d]	**800**	**1400**	110	**3400**
Heavy Metals								
Arsenic (As III)	1	24	-	10	2	2	**33**	1
Cadmium	0.1	0.2	-	2	LPQL	LPQL	LPQL	LPQL
Chromium (total)	2	3.3[a#]	-	nsl	LPQL	LPQL	2	1
Copper	1	1.4	-	2000	LPQL	LPQL	**12**	**2**
Lead	1	3.4	-	10	LPQL	LPQL	**4**	LPQL
Mercury (inorganic)	0.05	0.6	-	1	LPQL	LPQL	LPQL	LPQL
Nickel	1	11	-	20	4	5	**120**	**26**
Zinc	1	8	-	3000[d]	6	3	**200**	**39**
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)								
Benzene	1	950[a]	-	1	LPQL	LPQL	LPQL	LPQL
Toluene	1	180[a]	-	800	LPQL	LPQL	LPQL	LPQL
Ethylbenzene	1	80[a]	-	300	LPQL	LPQL	LPQL	LPQL
m + p-xylene	2	75[m]	-	nsl	LPQL	LPQL	LPQL	LPQL
o-xylene	1	350[a]	-	nsl	LPQL	LPQL	LPQL	LPQL
Total xylenes	3	nsl	-	600	LPQL	LPQL	LPQL	LPQL
Volatile Organic Compounds (VOCs)								
Total VOCs	-	nsl	-	-	ALPQL	ALPQL	ALPQL	ALPQL
Polycyclic Aromatic Hydrocarbons (PAHs)								
Naphthalene	0.1	16[a]	0.14	nsl	LPQL	LPQL	LPQL	**0.2**
Acenaphthylene	0.1	nsl	nsl	nsl	LPQL	LPQL	LPQL	LPQL
Acenaphthene	0.1	nsl	400	nsl	LPQL	LPQL	LPQL	LPQL
Fluorene	0.1	nsl	220	nsl	LPQL	LPQL	LPQL	LPQL
Phenanthrene	0.1	0.6[c]	nsl	nsl	LPQL	LPQL	LPQL	LPQL
Anthracene	0.1	0.01[c]	1300	nsl	LPQL	LPQL	LPQL	LPQL
Fluoranthene	0.1	1[c]	630	nsl	LPQL	LPQL	LPQL	LPQL
Pyrene	0.1	nsl	87	nsl	LPQL	LPQL	LPQL	LPQL
Benzo(a)anthracene	0.1	nsl	0.029	nsl	LPQL	LPQL	LPQL	LPQL
Chrysene	0.1	nsl	2.9	nsl	LPQL	LPQL	LPQL	LPQL
Benzo(b,k)fluoranthene	0.2	nsl	0.029[r]	nsl	LPQL	LPQL	LPQL	LPQL
Benzo(a)pyrene	0.1	0.1[c]	0.003	0.01	LPQL	LPQL	LPQL	LPQL
Indeno(1,2,3-c,d)pyrene	0.1	nsl	0.029	nsl	LPQL	LPQL	LPQL	LPQL
Dibenzo(a,h)anthracene	0.1	nsl	0.003	nsl	LPQL	LPQL	LPQL	LPQL
Benzo(g,h,i)perylene	0.1	nsl	nsl	nsl	LPQL	LPQL	LPQL	LPQL
Total PAHs	-	nsl	nsl	nsl	LPQL	LPQL	LPQL	0.2
Organochlorine Pesticides (OCPs)								
Aldrin	0.001	0.001[a]	-	0.3	LPQL	LPQL	LPQL	LPQL
Chlordane	0.001	0.03[c]	-	1	LPQL	LPQL	LPQL	LPQL
DDE	0.001	0.03[a]	nsl	nsl	0.001	LPQL	LPQL	LPQL
DDT	0.001	0.006[c]	-	9	0.001	LPQL	LPQL	LPQL
Dieldrin	0.001	0.01[a]	-	0.3	0.004	0.005	LPQL	0.004
Endosulfan	0.001	0.03[c]	-	20	LPQL	LPQL	LPQL	LPQL
Endrin	0.001	0.01[c]	11	nsl	LPQL	LPQL	LPQL	LPQL
Heptachlor	0.001	0.01[c]	-	0.3	LPQL	LPQL	LPQL	LPQL
Methoxychlor	0.001	0.005[c]	-	300	LPQL	LPQL	LPQL	LPQL
Organophosphate Pesticides (OPPs)								
Dichlorovos	0.001	nsl	-	5	LPQL	LPQL	LPQL	LPQL
Mevinphos (Phesdrin)	0.001	nsl	-	5	LPQL	LPQL	LPQL	LPQL
Naled	0.001	nsl	73	nsl	LPQL	LPQL	LPQL	LPQL
Phorate	0.001	nsl	7.3	nsl	LPQL	LPQL	LPQL	LPQL
Dimethoate	0.001	0.15[a]	-	7	LPQL	LPQL	LPQL	LPQL
Diazinon	0.001	0.01[a]	-	4	LPQL	LPQL	LPQL	LPQL
Disulfoton	0.001	nsl	-	4	LPQL	LPQL	LPQL	LPQL
Chlorpyriphos-methyl	0.001	nsl	370	nsl	LPQL	LPQL	LPQL	LPQL
Methyl Parathion	0.001	nsl	-	nsl	LPQL	LPQL	LPQL	LPQL
Ronnel (fenchlorphos)	0.001	nsl	1800	nsl	LPQL	LPQL	LPQL	LPQL
Fenitrothion	0.001	0.2[a]	-	10	LPQL	LPQL	LPQL	LPQL
Malathion	0.001	0.05[a]	730	70	LPQL	LPQL	LPQL	LPQL
Chlorpyriphos	0.001	0.01	-	10	**0.014**	**0.02**	**0.023**	LPQL
Bromophos-ethyl	0.001	nsl	-	10	LPQL	LPQL	LPQL	LPQL
Methidathion	0.001	nsl	-	6	LPQL	LPQL	LPQL	LPQL
Phenamiphos	0.001	nsl	nsl	nsl	LPQL	LPQL	LPQL	LPQL
Ethion	0.001	nsl	-	4	LPQL	LPQL	LPQL	LPQL
Phosalone	0.001	nsl	nsl	nsl	LPQL	LPQL	LPQL	LPQL
Azinphos-methyl	0.001	0.01[c]	-	3	LPQL	LPQL	LPQL	LPQL
Coumaphos	0.001	nsl	nsl	nsl	LPQL	LPQL	LPQL	LPQL
Polychlorinated Biphenyls (PCBs)								
Total PCBs	0.01	nsl	nsl	nsl	ALPQL	ALPQL	ALPQL	ALPQL

EXPLANATION:

1 - ANZECC Australian Water Quality Guidelines for Fresh Waters, 2000 - Trigger Values for protection of 95% of species
2 - NHMRC Australian Drinking Water Guidelines (2011)
3 - In the absence of Australian guidelines, the USEPA (2010) Region 9 Screening Levels for tapwater have been adopted as a preliminary screening tool
4 - Field Measurements obtained during sampling on 6-11-13

a - In the absence of a high reliability guideline concentration, the moderate or low reliability guideline concentration has been quoted
c - 99% trigger values adopted due to the potential for bioaccumulation effects
d - In the absence of a health guideline the aesthetic guideline concentration has been quoted
i - ANZECC 2000 - Level for NSW Lowland Rivers.
m - Guideline value adopted for m-Xylene. We note that the m-Xylene guideline value is 75ug/L and the p-Xylene guideline value is 200ug/L. However these two isomers cannot be distinguished analytically. Therefore EIS have adopted the more conservative guideline value
r - The more conservative value for Benzo(b)fluoranthene has been adopted
a# - The GIL for Cr III has been adopted as Cr VI is relatively unstable and breakdown rapidly

Concentration above the GIL **VALUE**

ABBREVIATIONS:

na: Not Analysed
nsl: No Set Limit
GIL - Groundwater Investigation Levels
PQL: Practical Quantitation Limit
LPQL: Less than Practical Quantitation Limit
ALPQL: All results less than the PQL
(-) : Not Applicable

Copyright Environmental Investigation Services

TABLE G
GROUNDWATER LABORATORY RESULTS COMPARED AGAINST THE HSLs
All data in µg/L unless stated otherwise

				C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	PID [2]
PQL - Envirolab Services				10	50	1	1	1	3	1	
Land Use Category [1]				**LOW DENSITY RESIDENTIAL**							
Sample Reference	**Water Depth**	**Depth Category**	**Soil Category**								
MW1	1.65	0m to <2m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	NA
MW7	4.58	4m to <8m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	NA
MW9	5.75	4m to <8m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	NA
MW16	4.49	4m to <8m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	NA
Total Number of Samples				4	4	4	4	4	4	4	0
Maximum Value				LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0

Explanation:
1 - Groundwater Investigation Levels (GILs): NEPM 2013
2 - Field PID values obtained during the investigation

Concentration above the SAC VALUE
Site specific assesment required VALUE

Abbreviations:
UCL: Upper Level Confidence Limit on Mean Value
HSLs: Health Screening Levels
NA: Not Analysed
nc: Not Calculated
NL: Not Limiting
PQL: Practical Quantitation Limit
LPQL: Less than PQL
SAC: Site Assessment Criteria
NEPM: National Environmental Protection Measure
SSA: Site Specific Assessment

E26930KBrpt
December, 2013

HSL GROUNDWATER ASSESSMENT CRITERIA

				C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
PQL - Envirolab Services				10	50	1	1	1	3	1
Land Use Category [1]				**LOW DENSITY RESIDENTIAL**						
Sample Reference	**Water Depth**	**Depth Category**	**Soil Category**							
MW1	1.65	0m to <2m	Clay	SSA	SSA	SSA	SSA	SSA	SSA	SSA
MW7	4.58	4m to <8m	Clay	NL	NL	5000	NL	NL	NL	NL
MW9	5.75	4m to <8m	Clay	NL	NL	5000	NL	NL	NL	NL
MW16	4.49	4m to <8m	Sand	1000	1000	800	NL	NL	NL	NL

Copyright Environmental Investigation Services

TABLE H-1
SOIL LABORATORY RESULTS COMPARED AGAINST THE EILs and ESLs
All data in mg/kg unless stated otherwise

Land Use Category [1]			URBAN RESIDENTIAL AND PUBLIC OPEN SPACE																			
						AGED HEAVY METALS-EILs						EILs		ESLs								
			pH	CEC ($cmol_c/kg$)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	$>C_6$-C_{10}	$>C_{10}$-C_{16}	$>C_{16}$-C_{34}	$>C_{34}$-C_{40}	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services			-	1	-	4	1	1	1	1	1	0.05	0.1	25	50	100	100	0.2	0.5	1	3	0.05
Ambient Background Concentration (ABC) [2]			-	-	-	nsl	13	28	nsl	5	122	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl
Sample Reference	**Sample Depth**	**Soil Texture**	**Average Values from Table I [3]**																			
JK1	0.0-0.2	Fine	8.64	25.43	13.75	8	31	68	170	44	230	LPQL	LPQL	LPQL	LPQL	240	180	LPQL	LPQL	LPQL	LPQL	1.2
JK1	1.3-1.5	Fine	8.64	25.43	13.75	9	37	74	200	41	220	LPQL	NA	LPQL	LPQL	300	190	LPQL	LPQL	LPQL	LPQL	0.47
JK1	2.7-3.0	Fine	8.64	25.43	13.75	LPQL	14	11	16	2	7	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
JK2	0.0-0.2	Coarse	8.64	25.43	13.75	5	11	36	45	9	88	LPQL	LPQL	LPQL	LPQL	220	LPQL	LPQL	LPQL	LPQL	LPQL	0.24
JK2	0.8-1.0	Fine	8.64	25.43	13.75	5	23	10	30	5	11	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
JK3	0.3-0.5	Coarse	8.64	25.43	13.75	LPQL	21	76	60	9	63	LPQL	LPQL	LPQL	LPQL	120	140	LPQL	LPQL	LPQL	LPQL	0.75
JK3	3.5-3.8	Fine	8.64	25.43	13.75	8	17	44	96	7	250	LPQL	NA	LPQL	LPQL	180	160	LPQL	LPQL	LPQL	LPQL	0.09
JK3	4.3-4.5	Fine	8.64	25.43	13.75	6	10	11	32	3	470	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
JK4	0.0-0.2	Coarse	8.64	25.43	13.75	5	24	34	46	13	77	LPQL	LPQL	LPQL	LPQL	170	230	LPQL	LPQL	LPQL	LPQL	0.33
JK4	1.3-1.5	Fine	8.64	25.43	13.75	10	20	110	68	13	100	LPQL	NA	LPQL	LPQL	150	140	LPQL	LPQL	LPQL	LPQL	0.28
JK5	0.0-0.2	Coarse	8.64	25.43	13.75	4	15	32	110	10	120	LPQL	LPQL	LPQL	LPQL	110	LPQL	LPQL	LPQL	LPQL	LPQL	1.4
JK5	0.65-0.95	Fine	8.64	25.43	13.75	4	19	68	160	13	200	LPQL	NA	LPQL	LPQL	170	110	LPQL	LPQL	LPQL	LPQL	0.79
JK5	3.0-3.15	Fine	8.64	25.43	13.75	7	17	30	83	9	150	LPQL	NA	LPQL	LPQL	290	120	LPQL	LPQL	LPQL	LPQL	0.85
JK5	6.0-6.2	Fine	8.64	25.43	13.75	5	13	15	24	3	39	LPQL	NA	LPQL	LPQL	140	LPQL	LPQL	LPQL	LPQL	LPQL	0.11
JK6	0.05-0.2	Coarse	8.64	25.43	13.75	LPQL	28	57	23	28	42	LPQL	LPQL	LPQL	LPQL	490	750	LPQL	LPQL	LPQL	LPQL	2.4
JK6	1.3-1.5	Coarse	8.64	25.43	13.75	6	15	32	46	10	52	LPQL	NA	LPQL	LPQL	220	340	LPQL	LPQL	LPQL	LPQL	0.81
JK6	3.0-3.45	Fine	8.64	25.43	13.75	6	13	25	37	14	100	LPQL	NA	LPQL	LPQL	140	230	LPQL	LPQL	LPQL	LPQL	LPQL
JK7	0.0-0.2	Fine	8.64	25.43	13.75	LPQL	110	56	9	9	25	LPQL	LPQL	LPQL	LPQL	320	690	LPQL	LPQL	LPQL	LPQL	0.57
JK7	2.7-3.0	Coarse	8.64	25.43	13.75	11	2800	91	97	59	130	LPQL	NA	LPQL	LPQL	210	240	LPQL	LPQL	LPQL	LPQL	0.3
JK7	5.8-6.0	Fine	8.64	25.43	13.75	7	33	48	100	9	140	LPQL	NA	LPQL	240	700	340	LPQL	LPQL	LPQL	LPQL	0.7
JK8	0.0-0.2	Coarse	8.64	25.43	13.75	LPQL	11	34	35	7	100	LPQL	LPQL	LPQL	LPQL	240	150	LPQL	LPQL	LPQL	LPQL	0.39
JK8	2.7-3.0	Fine	8.64	25.43	13.75	5	33	48	47	19	120	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.07
JK8	4.3-4.5	Fine	8.64	25.43	13.75	7	14	38	27	9	70	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
JK9	0.0-0.2	Coarse	8.64	25.43	13.75	LPQL	18	29	29	10	53	LPQL	LPQL	LPQL	LPQL	220	240	LPQL	LPQL	LPQL	LPQL	0.18
JK9	0.5-0.7	Fine	8.64	25.43	13.75	7	17	150	86	8	270	LPQL	NA	LPQL	LPQL	2300	700	LPQL	LPQL	LPQL	LPQL	0.22
JK9	2.6-2.8	Fine	8.64	25.43	13.75	5	16	58	51	6	81	LPQL	NA	LPQL	53	470	160	LPQL	LPQL	LPQL	LPQL	0.65
Total Number of Samples			26	26	23	26	26	26	26	26	26	26	9	26	26	26	26	26	26	26	26	26
Maximum Value			8.64	25.43	13.75	11	2800	150	200	59	470	LPQL	LPQL	LPQL	240	2300	750	LPQL	LPQL	LPQL	LPQL	2.4

Explanation:

1 - Site Assessment Criteria (SAC): NEPM 2013

2 - ABC Values for selected metals has been adopted from the published background concentrations presented in Olszowy et al (1995), Trace Element Concentrations in Soils from Rural and Urban New South Wales (old/new Suburbs high traffic 25th percentile values quoted)

3 - The average values for pH, % Clay and CEC are presented in Table I

Concentration above the SAC **VALUE**

Abbreviations:

EILs: Ecological Investigation Levels
B(a)P: Benzo(a)pyrene
nsl: No Set Limit
UCL: Upper Level Confidence Limit on Mean Value
ESLs: Ecological Screening Levels
PQL: Practical Quantitation Limit
LPQL: Less than PQL
SAC: Site Assessment Criteria
NEPM: National Environmental Protection Measure
NA: Not Analysed
nc: Not Calculated

E26930KBrpt
December, 2013

EIL AND ESL ASSESSMENT CRITERIA

Land Use Category [1]			URBAN RESIDENTIAL AND PUBLIC OPEN SPACE																			
						AGED HEAVY METALS-EILs						EILs		ESLs								
			pH	CEC ($cmol_c/kg$)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	$>C_6$-C_{10}	$>C_{10}$-C_{16}	$>C_{16}$-C_{34}	$>C_{34}$-C_{40}	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services			-	1	-	4	1	1	1	1	1	0.05	0.1	25	50	100	100	0.2	0.5	1	3	0.05
Ambient Background Concentration (ABC) [2]			-	-	-	nsl	13	28	nsl	5	122	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl
Sample Reference	**Sample Depth**	**Soil Texture**	**Average Values from Table I**																			
JK1	0.0-0.2	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	1300	5600	60	105	125	45	0.7
JK1	1.3-1.5	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK1	2.7-3.0	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK2	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK2	0.8-1.0	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK3	0.3-0.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK3	3.5-3.8	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK3	4.3-4.5	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK4	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK4	1.3-1.5	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK5	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK5	0.65-0.95	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK5	3.0-3.15	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK5	6.0-6.2	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK6	0.05-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK6	1.3-1.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK6	3.0-3.45	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK7	0.0-0.2	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	1300	5600	60	105	125	45	0.7
JK7	2.7-3.0	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK7	5.8-6.0	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK8	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK8	2.7-3.0	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK8	4.3-4.5	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK9	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK9	0.5-0.7	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK9	2.6-2.8	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7

Copyright Environmental Investigation Services

TABLE H-2
SOIL LABORATORY RESULTS COMPARED AGAINST THE EILs and ESLs
All data in mg/kg unless stated otherwise

Land Use Category [1]			URBAN RESIDENTIAL AND PUBLIC OPEN SPACE																		
						AGED HEAVY METALS-EILs						EILs		ESLs							
			pH	CEC ($cmol_c/kg$)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	$>C_6$-C_{10}	$>C_{10}$-C_{16}	$>C_{16}$-C_{34}	$>C_{34}$-C_{40}	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services			-	1	-	4	1	1	1	1	1	0.05	0.1	25	50	100	100	0.2	0.5	1	3	0.05
Ambient Background Concentration (ABC) [2]			-	-	-	nsl	13	28	nsl	5	122	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl
Sample Reference	**Sample Depth**	**Soil Texture**	**Average Values from Table I [3]**																		
JK10	0.0-0.2	Coarse	8.64	25.43	13.75	LPQL	6	30	33	4	68	LPQL	LPQL	LPQL	LPQL	130	LPQL	LPQL	LPQL	LPQL	LPQL	0.1
JK10	1.3-1.5	Coarse	8.64	25.43	13.75	LPQL	10	17	34	6	44	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.37
JK10	2.7-3.0	Coarse	8.64	25.43	13.75	8	22	64	270	12	230	LPQL	NA	LPQL	LPQL	160	LPQL	LPQL	LPQL	LPQL	LPQL	0.15
JK10	5.7-6.0	Fine	8.64	25.43	13.75	5	17	120	170	11	400	LPQL	NA	LPQL	LPQL	410	LPQL	LPQL	LPQL	LPQL	LPQL	0.81
JK10	7.3-7.5	Fine	8.64	25.43	13.75	9	20	57	140	6	220	LPQL	NA	LPQL	LPQL	220	110	LPQL	LPQL	LPQL	LPQL	0.32
JK11	0.0-0.2	Coarse	8.64	25.43	13.75	5	19	150	68	14	150	LPQL	LPQL	LPQL	LPQL	260	150	LPQL	LPQL	LPQL	LPQL	0.25
JK11	4.0-4.5	Coarse	8.64	25.43	13.75	LPQL	18	8	11	6	32	LPQL	NA	LPQL	LPQL	120	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
JK11	6.0-6.45	Fine	8.64	25.43	13.75	LPQL	7	9	8	1	5	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
JK12	0.0-0.2	Coarse	8.64	25.43	13.75	LPQL	10	31	43	5	96	LPQL	NA	LPQL	LPQL	160	LPQL	LPQL	LPQL	LPQL	LPQL	0.25
JK12	0.5-0.7	Coarse	8.64	25.43	13.75	LPQL	68	56	11	6	27	LPQL	LPQL	LPQL	LPQL	500	900	LPQL	LPQL	LPQL	LPQL	0.72
JK12	1.3-1.5	Coarse	8.64	25.43	13.75	LPQL	7	47	81	4	57	LPQL	NA	LPQL	LPQL	360	LPQL	LPQL	LPQL	LPQL	LPQL	8.6
JK12	4.3-4.5	Coarse	8.64	25.43	13.75	15	25	190	270	42	640	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.15
JK13	0.0-0.2	Coarse	8.64	25.43	13.75	LPQL	9	34	38	5	120	LPQL	LPQL	LPQL	190	890	280	LPQL	LPQL	LPQL	LPQL	0.24
JK13	0.8-1.0	Fine	8.64	25.43	13.75	4	9	25	75	4	97	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.17
JK13	2.7-3.0	Coarse	8.64	25.43	13.75	10	26	43	180	10	250	LPQL	NA	LPQL	LPQL	450	240	LPQL	LPQL	LPQL	LPQL	0.2
JK14	0.0-0.2	Coarse	8.64	25.43	13.75	5	14	46	93	9	220	LPQL	LPQL	LPQL	LPQL	110	LPQL	LPQL	LPQL	LPQL	LPQL	0.37
JK14	2.7-3.0	Coarse	8.64	25.43	13.75	6	17	54	71	11	230	LPQL	NA	LPQL	LPQL	170	LPQL	LPQL	LPQL	LPQL	LPQL	0.36
JK14	7.3-7.5	Coarse	8.64	25.43	13.75	5	11	30	89	6	260	LPQL	NA	LPQL	LPQL	150	LPQL	LPQL	LPQL	LPQL	LPQL	0.14
JK14	8.7-9.0	Coarse	8.64	25.43	13.75	6	12	41	190	8	230	LPQL	NA	LPQL	LPQL	130	LPQL	LPQL	LPQL	LPQL	LPQL	0.25
JK15	0.0-0.2	Coarse	8.64	25.43	13.75	LPQL	5	40	12	6	37	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0.13
JK15	0.3-0.5	Coarse	8.64	25.43	13.75	6	3	12	26	2	52	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
JK15	2.8-3.0	Coarse	8.64	25.43	13.75	8	18	83	110	13	170	LPQL	NA	LPQL	LPQL	260	170	LPQL	LPQL	LPQL	LPQL	1.1
JK15	5.7-6.0	Coarse	8.64	25.43	13.75	LPQL	4	4	9	8	21	LPQL	NA	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
JK16	0.0-0.2	Coarse	8.64	25.43	13.75	5	15	36	350	14	250	LPQL	LPQL	LPQL	LPQL	140	LPQL	LPQL	LPQL	LPQL	LPQL	1.1
JK16	1.3-1.5	Coarse	8.64	25.43	13.75	LPQL	26	26	24	22	80	LPQL	NA	LPQL	LPQL	170	200	LPQL	LPQL	LPQL	LPQL	0.37
JK16	2.7-3.0	Coarse	8.64	25.43	13.75	9	16	15	25	11	64	LPQL	NA	LPQL	LPQL	120	160	LPQL	LPQL	LPQL	LPQL	0.31
Total Number of Samples			26	26	23	26	26	26	26	26	26	26	7	26	26	26	26	26	26	26	26	26
Maximum Value			8.64	25.43	13.75	15	68	190	350	42	640	LPQL	LPQL	LPQL	190	890	900	LPQL	LPQL	LPQL	LPQL	8.6

Explanation:

1 - Site Assessment Criteria (SAC): NEPM 2013

2 - ABC Values for selected metals has been adopted from the published background concentrations presented in Olszowy et al (1995), Trace Element Concentrations in Soils from Rural and Urban New South Wales (old/new Suburbs high traffic 25th percentile values quoted)

3 - The average values for pH, % Clay and CEC are presented in Table I

Concentration above the SAC **VALUE**

Abbreviations:

EILs: Ecological Investigation Levels
B(a)P: Benzo(a)pyrene
nsl: No Set Limit
UCL: Upper Level Confidence Limit on Mean Value
ESLs: Ecological Screening Levels
PQL: Practical Quantitation Limit
LPQL: Less than PQL
SAC: Site Assessment Criteria
NEPM: National Environmental Protection Measure
NA: Not Analysed
nc: Not Calculated

EIL AND ESL ASSESSMENT CRITERIA

Land Use Category [1]			URBAN RESIDENTIAL AND PUBLIC OPEN SPACE																		
						AGED HEAVY METALS-EILs						EILs		ESLs							
			pH	CEC ($cmol_c/kg$)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	$>C_6$-C_{10}	$>C_{10}$-C_{16}	$>C_{16}$-C_{34}	$>C_{34}$-C_{40}	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services			-	1	-	4	1	1	1	1	1	0.05	0.1	25	50	100	100	0.2	0.5	1	3	0.05
Ambient Background Concentration (ABC) [2]			-	-	-	nsl	13	28	nsl	5	122	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl
Sample Reference	**Sample Depth**	**Soil Texture**	**Average Values from Table I [3]**																		
JK10	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK10	1.3-1.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK10	2.7-3.0	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK10	5.7-6.0	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK10	7.3-7.5	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK11	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK11	4.0-4.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK11	6.0-6.45	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK12	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK12	0.5-0.7	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK12	1.3-1.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK12	4.3-4.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK13	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK13	0.8-1.0	Fine	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	1300	5600	60	105	125	45	0.7
JK13	2.7-3.0	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK14	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK14	2.7-3.0	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK14	7.3-7.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK14	8.7-9.0	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK15	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK15	0.3-0.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK15	2.8-3.0	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK15	5.7-6.0	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK16	0.0-0.2	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	180	180	120	300	2800	50	85	70	105	0.7
JK16	1.3-1.5	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7
JK16	2.7-3.0	Coarse	8.64	25.43	13.75	100	413	248	1100	355	1082	710	--	180	120	300	2800	50	85	70	105	0.7

Copyright Environmental Investigation Services

TABLE I
SUMMARY OF LABORATORY RESULTS - ECOLOGY PARAMETERS

Sample Reference	Sample Depth (m)	Sample Description	pH (1:5 soil:water)	Clay (% w/w)	Ca (meq/100g)	K (meq/100g)	Mg (meq/100g)	Na (meq/100g)	CEC (med/100g)
JK1	0.0-0.2	Fill - Silty Sand Clay	7.1	24	12	1	2.6	0.32	16
JK7	0.0-0.2	Fill - Silty Clay	10.7	4	22	0	1	0.27	23
JK9	0.5-0.7	Fill - Silty Sand Clay	9.4	21	37	0.8	0.61	0.42	39
JK13	0.0-0.2	Fill - Silty Sand	8.1	11	16.0	0	0.42	0.2	17
JK16	0.0-0.2	Fill - Silty Sand	8.4	16	31	0	1	0.56	33
JK2	0.0-0.2	Fill - Silty Sand	7.9	10	22	0	1	0.26	24
JK3	0.3-0.5	Fill - Silty Sand	9.8	8	NA	NA	NA	NA	NA
JK5	0.65-0.95	Fill - Silty Clay	7.7	16	25	0.3	0.31	0.22	26
Total Number of Samples			8	8	7	7	7	7	7
Minimum Value			7.1	4	12	0	0	0.2	16
Maximum Value			10.7	24	37	1	3	0.56	39
Average Value			8.64	13.75	23.57	0.41	0.98	0.32	25.43

EXPLANATION:

The average values of the ecological parameters have been used in calcualting the EILs in Table H.

ABBREVIATIONS:

Ca - Calcium
K - Potassium
Mg - Magnesium
Na - Sodium
CEC - Cation Exchange Capacity

Copyright Environmental Investigation Services

TABLE J-1
SOIL INTRA-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: JK5 (0-0.2)	Arsenic	4	4	LPQL	4	NC
Dup Ref = Dup A	Cadmium	0.5	LPQL	LPQL	NC	NC
	Chromium	1	15	12	13.5	22.2
Envirolab Report: 99467	Copper	1	32	34	33	6.1
	Lead	1	110	90	100	20.0
	Mercury	0.1	0.2	0.1	0.15	66.7
	Nickel	1	10	9	9.5	10.5
	Zinc	1	120	110	115	8.7
	Naphthalene	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	0.1	0.1	0.1	0.0
	Acenaphthene	0.1	0.2	LPQL	0.2	NC
	Fluorene	0.1	0.1	LPQL	0.1	NC
	Phenanthrene	0.1	1.1	1.3	1.2	16.7
	Anthracene	0.1	0.4	0.4	0.4	0.0
	Fluoranthene	0.1	2.6	2.8	2.7	7.4
	Pyrene	0.1	2.5	2.8	2.65	11.3
	Benzo(a)anthracene	0.1	1.3	1.3	1.3	0.0
	Chrysene	0.1	1.1	1.2	1.15	8.7
	Benzo(b)&(k)fluorant	0.2	2.2	2.1	2.15	4.7
	Benzo(a)pyrene	0.05	1.4	1.4	1.4	0.0
	Indeno(123-cd)pyrene	0.1	1	0.8	0.9	22.2
	Dibenzo(ah)anthracene	0.1	0.2	0.2	0.2	0.0
	Benzo(ghi)perylene	0.1	0.9	0.7	0.8	25.0
	TRH >C6-C9 (F1)	25	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	110	150	130	30.8
	TRH >C34-C40	100	LPQL	LPQL	NC	NC
	Benzene	0.5	LPQL	LPQL	NC	NC
	Toluene	0.5	LPQL	LPQL	NC	NC
	Ethylbenzene	1	LPQL	LPQL	NC	NC
	m + p-xylene	2	LPQL	LPQL	NC	NC
	o-xylene	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value < = 50% are acceptable
Results between 5 & 10 times PQL = RPD value < = 75% are acceptable
Results < 5 times PQL = RPD value < = 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
na: Not Analysed
nc: Not Calculated
OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PCBs: Polychlorinated Biphenyls
TPH: Total Petroleum Hydrocarbons

Copyright Environmental Investigation Services

TABLE J-2
SOIL INTRA-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: JK10 (0-0.2)	Arsenic	4	LPQL	LPQL	NC	NC
Dup Ref = Dup B	Cadmium	0.5	LPQL	LPQL	NC	NC
	Chromium	1	6	8	7	28.6
Envirolab Report: 99467	Copper	1	30	24	27	22.2
	Lead	1	33	37	35	11.4
	Mercury	0.1	LPQL	0.1	0.1	NC
	Nickel	1	4	5	4.5	22.2
	Zinc	1	68	92	80	30.0
	Naphthalene	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	LPQL	LPQL	NC	NC
	Acenaphthene	0.1	LPQL	LPQL	NC	NC
	Fluorene	0.1	LPQL	LPQL	NC	NC
	Phenanthrene	0.1	LPQL	LPQL	NC	NC
	Anthracene	0.1	LPQL	LPQL	NC	NC
	Fluoranthene	0.1	0.2	0.2	0.2	0.0
	Pyrene	0.1	0.2	0.2	0.2	0.0
	Benzo(a)anthracene	0.1	LPQL	0.1	0.1	NC
	Chrysene	0.1	LPQL	0.1	0.1	NC
	Benzo(b)&(k)fluorant	0.2	LPQL	0.2	0.2	NC
	Benzo(a)pyrene	0.05	0.1	0.13	0.115	26.1
	Indeno(123-cd)pyrene	0.1	LPQL	LPQL	NC	NC
	Dibenzo(ah)anthracene	0.1	LPQL	LPQL	NC	NC
	Benzo(ghi)perylene	0.1	LPQL	LPQL	NC	NC
	TRH >C6-C9 (F1)	25	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	130	140	135	7.4
	TRH >C34-C40	100	LPQL	LPQL	NC	NC
	Benzene	0.5	LPQL	LPQL	NC	NC
	Toluene	0.5	LPQL	LPQL	NC	NC
	Ethylbenzene	1	LPQL	LPQL	NC	NC
	m+p-xylene	2	LPQL	LPQL	NC	NC
	o-xylene	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value < = 50% are acceptable
Results between 5 & 10 times PQL = RPD value < = 75% are acceptable
Results < 5 times PQL = RPD value < = 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
na: Not Analysed
nc: Not Calculated
OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PCBs: Polychlorinated Biphenyls
TPH: Total Petroleum Hydrocarbons

Copyright Environmental Investigation Services

TABLE J-3
SOIL INTRA-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: JK12 (1.3-1.5)	Arsenic	4	LPQL	LPQL	NC	NC
Dup Ref = Dup C	Cadmium	0.5	LPQL	LPQL	NC	NC
	Chromium	1	7	6	6.5	15.4
Envirolab Report: 99467	Copper	1	47	45	46	4.3
	Lead	1	81	73	77	10.4
	Mercury	0.1	LPQL	LPQL	NC	NC
	Nickel	1	4	6	5	40.0
	Zinc	1	57	52	54.5	9.2
	Naphthalene	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	0.1	LPQL	NC	NC
	Acenaphthene	0.1	1.5	0.7	1.1	72.7
	Fluorene	0.1	1	0.5	0.75	66.7
	Phenanthrene	0.1	14	6.8	10.4	69.2
	Anthracene	0.1	4.3	1.9	3.1	77.4
	Fluoranthene	0.1	32	18	25	56.0
	Pyrene	0.1	29	16	22.5	57.8
	Benzo(a)anthracene	0.1	12	6.6	9.3	58.1
	Chrysene	0.1	11	6.2	8.6	55.8
	Benzo(b)&(k)fluorant	0.2	16	8.6	12.3	60.2
	Benzo(a)pyrene	0.05	8.6	4.6	6.6	60.6
	Indeno(123-cd)pyrene	0.1	4.8	2.5	3.65	63.0
	Dibenzo(ah)anthracene	0.1	0.9	0.4	0.65	76.9
	Benzo(ghi)perylene	0.1	3.9	2.1	3	60.0
	TRH >C6-C9 (F1)	25	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	360	290	325	21.5
	TRH >C34-C40	100	LPQL	120	NC	NC
	Benzene	0.5	LPQL	LPQL	NC	NC
	Toluene	0.5	LPQL	LPQL	NC	NC
	Ethylbenzene	1	LPQL	LPQL	NC	NC
	m+p-xylene	2	LPQL	LPQL	NC	NC
	o-xylene	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value <= 50% are acceptable
Results between 5 & 10 times PQL = RPD value <= 75% are acceptable
Results < 5 times PQL = RPD value <= 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
na: Not Analysed
nc: Not Calculated
OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PCBs: Polychlorinated Biphenyls
TPH: Total Petroleum Hydrocarbons

Copyright Environmental Investigation Services

TABLE J-4
SOIL INTRA-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: JK1 (0.0-0.2)	Arsenic	4	8	9	8.5	11.8
Dup Ref = Dup F	Cadmium	0.5	0.4	0.4	0.4	0.0
	Chromium	1	31	31	31	0.0
Envirolab Report: 99558	Copper	1	68	62	65	9.2
	Lead	1	170	140	155	19.4
	Mercury	0.1	0.1	0.1	0.1	0.0
	Nickel	1	44	42	43	4.7
	Zinc	1	230	200	215	14.0
	Naphthalene	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	LPQL	LPQL	NC	NC
	Acenaphthene	0.1	LPQL	LPQL	NC	NC
	Fluorene	0.1	LPQL	LPQL	NC	NC
	Phenanthrene	0.1	1.3	0.7	1	60.0
	Anthracene	0.1	0.3	0.2	0.25	40.0
	Fluoranthene	0.1	2.4	2.5	2.45	4.1
	Pyrene	0.1	2.3	2.5	2.4	8.3
	Benzo(a)anthracene	0.1	0.9	0.9	0.9	0.0
	Chrysene	0.1	0.9	0.8	0.85	11.8
	Benzo(b)&(k)fluorant	0.2	1.8	1.8	1.8	0.0
	Benzo(a)pyrene	0.05	1.2	1.2	1.2	0.0
	Indeno(123-cd)pyrene	0.1	1	0.7	0.85	35.3
	Dibenzo(ah)anthracene	0.1	0.1	LPQL	0.1	NC
	Benzo(ghi)perylene	0.1	1	0.7	0.85	35.3
	TRH >C6-C9 (F1)	25	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	240	230	235	4.3
	TRH >C34-C40	100	180	180	180	0.0
	Benzene	0.5	LPQL	LPQL	NC	NC
	Toluene	0.5	LPQL	LPQL	NC	NC
	Ethylbenzene	1	LPQL	LPQL	NC	NC
	m+p-xylene	2	LPQL	LPQL	NC	NC
	o-xylene	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value <= 50% are acceptable
Results between 5 & 10 times PQL = RPD value <= 75% are acceptable
Results < 5 times PQL = RPD value <= 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
na: Not Analysed
nc: Not Calculated
OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PCBs: Polychlorinated Biphenyls
TPH: Total Petroleum Hydrocarbons

Copyright Environmental Investigation Services

TABLE J-5
SOIL INTRA-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: JK6 (0.05-0.2)	Arsenic	4	LPQL	LPQL	NC	NC
Dup Ref = Dup I	Cadmium	0.5	LPQL	LPQL	NC	NC
	Chromium	1	28	62	45	75.6
Envirolab Report: 99558	Copper	1	57	76	66.5	28.6
	Lead	1	23	26	24.5	12.2
	Mercury	0.1	LPQL	LPQL	NC	NC
	Nickel	1	28	34	31	19.4
	Zinc	1	42	47	44.5	11.2
	Naphthalene	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	LPQL	LPQL	NC	NC
	Acenaphthene	0.1	LPQL	LPQL	NC	NC
	Fluorene	0.1	LPQL	LPQL	NC	NC
	Phenanthrene	0.1	0.4	0.5	0.45	22.2
	Anthracene	0.1	0.2	0.2	0.2	0.0
	Fluoranthene	0.1	3.5	3.4	3.45	2.9
	Pyrene	0.1	3.6	3.5	3.55	2.8
	Benzo(a)anthracene	0.1	1.7	1.7	1.7	0.0
	Chrysene	0.1	1.6	1.6	1.6	0.0
	Benzo(b)&(k)fluorant	0.2	4.1	3.7	3.9	10.3
	Benzo(a)pyrene	0.05	2.4	2.1	2.25	13.3
	Indeno(123-cd)pyrene	0.1	1.6	1.5	1.55	6.5
	Dibenzo(ah)anthracene	0.1	0.3	0.2	0.25	40.0
	Benzo(ghi)perylene	0.1	1.7	1.5	1.6	12.5
	TRH >C6-C9 (F1)	25	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	490	490	490	0.0
	TRH >C34-C40	100	750	900	825	18.2
	Benzene	0.5	LPQL	LPQL	NC	NC
	Toluene	0.5	LPQL	LPQL	NC	NC
	Ethylbenzene	1	LPQL	LPQL	NC	NC
	m+p-xylene	2	LPQL	LPQL	NC	NC
	o-xylene	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value <= 50% are acceptable
Results between 5 & 10 times PQL = RPD value <= 75% are acceptable
Results < 5 times PQL = RPD value <= 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
na: Not Analysed
nc: Not Calculated
OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PCBs: Polychlorinated Biphenyls
TPH: Total Petroleum Hydrocarbons

Copyright Environmental Investigation Services

TABLE K-1
SOIL INTER-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	Envirolab (VIC) PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: JK8 (0.0-0.2)	Arsenic	4	4	LPQL	LPQL	NC	NC
Dup Ref = Dup D	Cadmium	0.4	0.4	LPQL	LPQL	NC	NC
	Chromium	1	1	9	15	12	50.0
Envirolab Report: 99467 (Primary)	Copper	1	1	34	42	38	21.1
Environlab VIC QA Report: 2762	Lead	1	1	25	39	32	43.8
	Mercury	0.1	0.1	LPQL	LPQL	NC	NC
	Nickel	1	1	7	13	10	60.0
	Zinc	1	1	79	100	89.5	23.5
	Naphthalene	0.1	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	0.1	LPQL	LPQL	NC	NC
	Acenaphthene	0.1	0.1	LPQL	LPQL	NC	NC
	Fluorene	0.1	0.1	LPQL	LPQL	NC	NC
	Phenanthrene	0.1	0.1	0.2	0.2	0.2	0.0
	Anthracene	0.1	0.1	LPQL	LPQL	NC	NC
	Fluoranthene	0.1	0.1	0.6	0.7	0.65	15.4
	Pyrene	0.1	0.1	0.6	0.6	0.6	0.0
	Benzo(a)anthracene	0.1	0.1	0.3	0.3	0.3	0.0
	Chrysene	0.1	0.1	0.3	0.2	0.25	40.0
	Benzo(b)&(k)fluorant	0.2	0.2	0.6	0.6	0.6	0.0
	Benzo(a)pyrene	0.05	0.05	0.39	0.4	0.395	2.5
	Indeno(123-cd)pyrene	0.1	0.1	0.2	0.2	0.2	0.0
	Dibenzo(ah)anthracene	0.1	0.1	LPQL	LPQL	NC	NC
	Benzo(ghi)perylene	0.1	0.1	0.2	0.2	0.2	0.0
	TRH >C6-C9 (F1)	25	25	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	100	240	230	235	4.3
	TRH >C34-C40	100	100	150	180	165	18.2
	Benzene	0.2	0.2	LPQL	LPQL	NC	NC
	Toluene	0.5	0.5	LPQL	LPQL	NC	NC
	Ethylbenzene	1	1	LPQL	LPQL	NC	NC
	m+p-xylene	2	2	LPQL	LPQL	NC	NC
	o-xylene	1	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value < = 50% are acceptable
Results between 5 & 10 times PQL = RPD value < = 75% are acceptable
Results < 5 times PQL = RPD value < = 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
na: Not Analysed
nc: Not Calculated
OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PCBs: Polychlorinated Biphenyls
TPH: Total Petroleum Hydrocarbons

Copyright Environmental Investigation Services

TABLE K-2
SOIL INTER-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	Envirolab (VIC) PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: JK2 (0.8-1)	Arsenic	4	4	5	4	4.5	22.2
Dup Ref = Dup E	Cadmium	0.4	0.4	LPQL	LPQL	NC	NC
	Chromium	1	1	23	21	22	9.1
Envirolab Report: 99467 (Primary)	Copper	1	1	10	10	10	0.0
Environlab VIC QA Report: 2762	Lead	1	1	30	29	29.5	3.4
	Mercury	0.1	0.1	LPQL	LPQL	NC	NC
	Nickel	1	1	5	4	4.5	22.2
	Zinc	1	1	11	12	11.5	8.7
	Naphthalene	0.1	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	0.1	LPQL	LPQL	NC	NC
	Acenaphthene	0.1	0.1	LPQL	LPQL	NC	NC
	Fluorene	0.1	0.1	LPQL	LPQL	NC	NC
	Phenanthrene	0.1	0.1	LPQL	LPQL	NC	NC
	Anthracene	0.1	0.1	LPQL	LPQL	NC	NC
	Fluoranthene	0.1	0.1	LPQL	LPQL	NC	NC
	Pyrene	0.1	0.1	LPQL	LPQL	NC	NC
	Benzo(a)anthracene	0.1	0.1	LPQL	LPQL	NC	NC
	Chrysene	0.1	0.1	LPQL	LPQL	NC	NC
	Benzo(b)&(k)fluorant	0.2	0.2	LPQL	LPQL	NC	NC
	Benzo(a)pyrene	0.05	0.05	LPQL	LPQL	NC	NC
	Indeno(123-cd)pyrene	0.1	0.1	LPQL	LPQL	NC	NC
	Dibenzo(ah)anthracene	0.1	0.1	LPQL	LPQL	NC	NC
	Benzo(ghi)perylene	0.1	0.1	LPQL	LPQL	NC	NC
	TRH >C6-C9 (F1)	25	25	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	100	LPQL	LPQL	NC	NC
	TRH >C34-C40	100	100	LPQL	LPQL	NC	NC
	Benzene	0.2	0.2	LPQL	LPQL	NC	NC
	Toluene	0.5	0.5	LPQL	LPQL	NC	NC
	Ethylbenzene	1	1	LPQL	LPQL	NC	NC
	m+p-xylene	2	2	LPQL	LPQL	NC	NC
	o-xylene	1	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value < = 50% are acceptable
Results between 5 & 10 times PQL = RPD value < = 75% are acceptable
Results < 5 times PQL = RPD value < = 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
na: Not Analysed
nc: Not Calculated
OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PCBs: Polychlorinated Biphenyls
TPH: Total Petroleum Hydrocarbons

E26930KBrpt
December, 2013

Copyright Environmental Investigation Services

TABLE K-3
SOIL INTER-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	Envirolab (VIC) PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: JK15 (2.8-3)	Arsenic	4	4	8	6	7	28.6
Dup Ref = Dup H	Cadmium	0.4	0.4	LPQL	LPQL	NC	NC
	Chromium	1	1	18	17	17.5	5.7
Envirolab Report: 99558 (Primary)	Copper	1	1	83	71	77	15.6
Environlab VIC QA Report: 2762	Lead	1	1	110	100	105	9.5
	Mercury	0.1	0.1	0.1	0.1	0.1	0.0
	Nickel	1	1	13	12	12.5	8.0
	Zinc	1	1	170	140	155	19.4
	Naphthalene	0.1	0.1	0.2	LPQL	0.2	NC
	Acenaphthylene	0.1	0.1	0.2	0.3	0.25	40.0
	Acenaphthene	0.1	0.1	LPQL	LPQL	NC	NC
	Fluorene	0.1	0.1	0.2	LPQL	0.2	NC
	Phenanthrene	0.1	0.1	1.6	2.1	1.85	27.0
	Anthracene	0.1	0.1	0.4	0.4	0.4	0.0
	Fluoranthene	0.1	0.1	2	2	2	0.0
	Pyrene	0.1	0.1	2.1	2.1	2.1	0.0
	Benzo(a)anthracene	0.1	0.1	1.1	1	1.05	9.5
	Chrysene	0.1	0.1	0.9	1	0.95	10.5
	Benzo(b)&(k)fluorant	0.2	0.2	1.6	1.8	1.7	11.8
	Benzo(a)pyrene	0.05	0.05	1.1	1.1	1.1	0.0
	Indeno(123-cd)pyrene	0.1	0.1	0.6	0.6	0.6	0.0
	Dibenzo(ah)anthracene	0.1	0.1	0.1	0.1	0.1	0.0
	Benzo(ghi)perylene	0.1	0.1	0.5	0.7	0.6	33.3
	TRH >C6-C9 (F1)	25	25	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	100	260	270	265	3.8
	TRH >C34-C40	100	100	170	120	145	34.5
	Benzene	0.2	0.2	LPQL	LPQL	NC	NC
	Toluene	0.5	0.5	LPQL	LPQL	NC	NC
	Ethylbenzene	1	1	LPQL	LPQL	NC	NC
	m+p-xylene	2	2	LPQL	LPQL	NC	NC
	o-xylene	1	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value < = 50% are acceptable
Results between 5 & 10 times PQL = RPD value < = 75% are acceptable
Results < 5 times PQL = RPD value < = 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
na: Not Analysed
nc: Not Calculated
OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PCBs: Polychlorinated Biphenyls
TPH: Total Petroleum Hydrocarbons

Copyright Environmental Investigation Services

TABLE L
GROUNDWATER INTRA-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in µg/L unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample = MW9	Arsenic	1	33	32	32.5	3.1
Dup Ref = Dup GF2	Cadmium	0.1	LPQL	LPQL	NC	NC
	Chromium	1	2	1	1.5	66.7
Envirolab Report: 100418	Copper	1	12	12	12	0.0
	Lead	1	4	4	4	0.0
	Mercury	0.5	LPQL	LPQL	NC	NC
	Nickel	1	120	120	120	0.0
	Zinc	1	200	210	205	4.9
	Naphthalene	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	LPQL	LPQL	NC	NC
	Acenaphthene	0.1	LPQL	LPQL	NC	NC
	Fluorene	0.1	LPQL	LPQL	NC	NC
	Phenanthrene	0.1	LPQL	LPQL	NC	NC
	Anthracene	0.1	LPQL	LPQL	NC	NC
	Fluoranthene	0.1	LPQL	LPQL	NC	NC
	Pyrene	0.1	LPQL	LPQL	NC	NC
	Benzo(a)anthracene	0.1	LPQL	LPQL	NC	NC
	Chrysene	0.1	LPQL	LPQL	NC	NC
	Benzo(b)&(k)fluorant	0.2	LPQL	LPQL	NC	NC
	Benzo(a)pyrene	0.1	LPQL	LPQL	NC	NC
	Indeno(123-cd)pyrene	0.1	LPQL	LPQL	NC	NC
	Dibenzo(ah)anthracene	0.1	LPQL	LPQL	NC	NC
	Benzo(ghi)perylene	0.1	LPQL	LPQL	NC	NC
	TRH >C6-C9 (F1)	10	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	LPQL	LPQL	NC	NC
	TRH >C34-C40	100	LPQL	LPQL	NC	NC
	Benzene	1	LPQL	LPQL	NC	NC
	Toluene	1	LPQL	LPQL	NC	NC
	Ethylbenzene	1	LPQL	LPQL	NC	NC
	m + p-xylene	2	LPQL	LPQL	NC	NC
	o-xylene	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value < = 50% are acceptable
Results between 5 & 10 times PQL = RPD value < = 75% are acceptable
Results < 5 times PQL = RPD value < = 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
na: Not Analysed
nc: Not Calculated
OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PCBs: Polychlorinated Biphenyls
TPH: Total Petroleum Hydrocarbons

Copyright Environmental Investigation Services

TABLE M
GROUNDWATER INTER-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in µg/L unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	Envirolab (VIC) PQL	INITIAL	REPEAT	MEAN	RPD %
Primary Sample: MW7	Arsenic	1	1	2	2	2	0.0
Dup Ref = DupGF1	Cadmium	0.1	0.1	LPQL	LPQL	NC	NC
	Chromium	1	1	LPQL	1	1	NC
Envirolab Report: 100418 (Primary)	Copper	1	1	LPQL	LPQL	NC	NC
Environlab VIC QA Report: 2831	Lead	1	1	LPQL	LPQL	NC	NC
	Mercury	0.05	0.05	LPQL	LPQL	NC	NC
	Nickel	1	1	5	5	5	0.0
	Zinc	1	1	3	7	5	80.0
	Naphthalene	0.1	0.1	LPQL	LPQL	NC	NC
	Acenaphthylene	0.1	0.1	LPQL	LPQL	NC	NC
	Acenaphthene	0.1	0.1	LPQL	LPQL	NC	NC
	Fluorene	0.1	0.1	LPQL	LPQL	NC	NC
	Phenanthrene	0.1	0.1	LPQL	LPQL	NC	NC
	Anthracene	0.1	0.1	LPQL	LPQL	NC	NC
	Fluoranthene	0.1	0.1	LPQL	LPQL	NC	NC
	Pyrene	0.1	0.1	LPQL	LPQL	NC	NC
	Benzo(a)anthracene	0.1	0.1	LPQL	LPQL	NC	NC
	Chrysene	0.1	0.1	LPQL	LPQL	NC	NC
	Benzo(b)&(k)fluorant	0.2	0.2	LPQL	LPQL	NC	NC
	Benzo(a)pyrene	0.1	0.1	LPQL	LPQL	NC	NC
	Indeno(123-cd)pyrene	0.1	0.1	LPQL	LPQL	NC	NC
	Dibenzo(ah)anthracene	0.1	0.1	LPQL	LPQL	NC	NC
	Benzo(ghi)perylene	0.1	0.1	LPQL	LPQL	NC	NC
	TRH >C6-C9 (F1)	10	10	LPQL	LPQL	NC	NC
	TRH >C10 - C16 (F2)	50	50	LPQL	LPQL	NC	NC
	TRH >C16-C34	100	100	LPQL	740	740	NC
	TRH >C34-C40	100	100	LPQL	LPQL	NC	NC
	Benzene	1	1	LPQL	LPQL	NC	NC
	Toluene	1	1	LPQL	LPQL	NC	NC
	Ethylbenzene	1	1	LPQL	LPQL	NC	NC
	m + p-xylene	2	2	LPQL	LPQL	NC	NC
	o-xylene	1	1	LPQL	LPQL	NC	NC

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value < = 50% are acceptable

Results between 5 & 10 times PQL = RPD value < = 75% are acceptable

Results < 5 times PQL = RPD value < = 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
na: Not Analysed
nc: Not Calculated
OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PCBs: Polychlorinated Biphenyls
TPH: Total Petroleum Hydrocarbons

Copyright Environmental Investigation Services

TABLE N
SUMMARY OF QA/QC - TRIP SPIKE AND TRIP BLANK RESULTS

ANALYSIS	Envirolab PQL		$TB1^S$	$TB2^S$	$TB1^S$	$TB2^S$	$TS1^S$	TS^W
			18/10/2013	21/10/2013	22/10/2013	23/10/2013	22/10/2013	6/11/2013
	mg/kg	µg/L	99467	99467	99558	99558	99467	100418
			mg/kg	mg/kg	mg/kg	mg/kg	% Recovery	% Recovery
Benzene	1	1	LPQL	LPQL	LPQL	LPQL	67%	105%
Toluene	1	1	LPQL	LPQL	LPQL	LPQL	87%	102%
Ethylbenzene	1	1	LPQL	LPQL	LPQL	LPQL	104%	104%
m + p-xylene	2	2	LPQL	LPQL	LPQL	LPQL	104%	108%
o-xylene	1	1	LPQL	LPQL	LPQL	LPQL	104%	108%

EXPLANATION:

^{W} Sample type (water)

^{S} Sample type (sand)

BTEX concentrations in trip spikes are presented as % recovery

Values above PQLs/Acceptance criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
(-) : Not Applicable / Not Analysed
OPP: Organophosphorus Pesticides
OCP: Organochlorine Pesticides
PCBs: Polychlorinated Biphenyls

TB: Trip Blank
TS: Trip Spike
RS: Rinsate Sample
na: Not Analysed
nc: Not Calculated
TPH: Total Petroleum Hydrocarbons

E26930KBrpt
December, 2013

Copyright Environmental Investigation Services

Appendix E: Statistical Calculation Sheets

General UCL Statistics for Full Data Sets

User Selected Options

From File		WorkSheet.wst	
Full Precision		OFF	
Confidence Coefficient		95%	
Number of Bootstrap Operations		2000	

TRH F2

General Statistics

Number of Valid Observations				47	Number of Distinct Observations					4
Raw Statistics					Log-transformed Statistics					
Minimum				25	Minimum of Log Data					3.219
Maximum				240	Maximum of Log Data					5.481
Mean				33.68	Mean of log Data					3.326
Median				25	SD of log Data					0.448
SD				39.2						
Std. Error of Mean				5.718						
Coefficient of Variation				1.164						
Skewness				4.741						

Warning: There are only 4 Distinct Values in this data
There are insufficient Distinct Values to perform some GOF tests and bootstrap methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values to compute bootstrap methods.
However, results obtained using 4 to 9 distinct values may not be reliable.
It is recommended to have 10-15 or more observations for accurate and meaningful bootstrap results.

Relevant UCL Statistics

Normal Distribution Test					Lognormal Distribution Test				
Shapiro Wilk Test Statistic			0.245		Shapiro Wilk Test Statistic				0.265
Shapiro Wilk Critical Value			0.946		Shapiro Wilk Critical Value				0.946
Data not Normal at 5% Significance Level					Data not Lognormal at 5% Significance Level				
Assuming Normal Distribution					Assuming Lognormal Distribution				
95% Student's-t UCL			43.28		95% H-UCL				34.78
95% UCLs (Adjusted for Skewness)					95% Chebyshev (MVUE) UCL				39.81
95% Adjusted-CLT UCL (Chen-1995)			47.31		97.5% Chebyshev (MVUE) UCL				43.75
95% Modified-t UCL (Johnson-1978)			43.94		99% Chebyshev (MVUE) UCL				51.5
Gamma Distribution Test					Data Distribution				
k star (bias corrected)			2.613		Data do not follow a Discernable Distribution (0.05)				
Theta Star			12.89						
MLE of Mean			33.68						
MLE of Standard Deviation			20.84						
nu star			245.6						
Approximate Chi Square Value (.05)			210.3		Nonparametric Statistics				
Adjusted Level of Significance			0.0449		95% CLT UCL				43.09
Adjusted Chi Square Value			209.3		95% Jackknife UCL				43.28
					95% Standard Bootstrap UCL				42.44
Anderson-Darling Test Statistic			16.34		95% Bootstrap-t UCL				85.07
Anderson-Darling 5% Critical Value			0.757		95% Hall's Bootstrap UCL				84.65
Kolmogorov-Smirnov Test Statistic			0.542		95% Percentile Bootstrap UCL				43.15
Kolmogorov-Smirnov 5% Critical Value			0.13		95% BCA Bootstrap UCL				46.34
Data not Gamma Distributed at 5% Significance Level					95% Chebyshev(Mean, Sd) UCL				58.61
					97.5% Chebyshev(Mean, Sd) UCL				69.39
Assuming Gamma Distribution					99% Chebyshev(Mean, Sd) UCL				90.58
95% Approximate Gamma UCL			39.33						
95% Adjusted Gamma UCL			39.52						
Potential UCL to Use					**Use 95% Student's-t UCL**				**43.28**
					or 95% Modified-t UCL				**43.94**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

B(a)P TEQ

General Statistics

Number of Valid Observations					47	Number of Distinct Observations				5
Raw Statistics						Log-transformed Statistics				
Minimum					0.25	Minimum of Log Data				-1.386
Maximum					13	Maximum of Log Data				2.565
Mean					0.899	Mean of log Data				-0.733
Median					0.25	SD of log Data				0.929
SD					1.904					
Std. Error of Mean					0.278					
Coefficient of Variation					2.119					
Skewness					5.843					

Relevant UCL Statistics

Normal Distribution Test						Lognormal Distribution Test				
Shapiro Wilk Test Statistic					0.351	Shapiro Wilk Test Statistic				0.704
Shapiro Wilk Critical Value					0.946	Shapiro Wilk Critical Value				0.946
Data not Normal at 5% Significance Level						Data not Lognormal at 5% Significance Level				
Assuming Normal Distribution						Assuming Lognormal Distribution				
95% Student's-t UCL					1.365	95% H-UCL				1.007
95% UCLs (Adjusted for Skewness)						95% Chebyshev (MVUE) UCL				1.227
95% Adjusted-CLT UCL (Chen-1995)					1.609	97.5% Chebyshev (MVUE) UCL				1.443
95% Modified-t UCL (Johnson-1978)					1.405	99% Chebyshev (MVUE) UCL				1.865
Gamma Distribution Test						Data Distribution				
k star (bias corrected)					0.884	Data do not follow a Discernable Distribution (0.05)				
Theta Star					1.017					
MLE of Mean					0.899					
MLE of Standard Deviation					0.956					
nu star					83.11					
Approximate Chi Square Value (.05)					63.1	Nonparametric Statistics				
Adjusted Level of Significance					0.0449	95% CLT UCL				1.356
Adjusted Chi Square Value					62.55	95% Jackknife UCL				1.365
						95% Standard Bootstrap UCL				1.345
Anderson-Darling Test Statistic					6.282	95% Bootstrap-t UCL				2.299
Anderson-Darling 5% Critical Value					0.782	95% Hall's Bootstrap UCL				3.06
Kolmogorov-Smirnov Test Statistic					0.358	95% Percentile Bootstrap UCL				1.41
Kolmogorov-Smirnov 5% Critical Value					0.133	95% BCA Bootstrap UCL				1.67
Data not Gamma Distributed at 5% Significance Level						95% Chebyshev(Mean, Sd) UCL				2.11
						97.5% Chebyshev(Mean, Sd) UCL				2.634
Assuming Gamma Distribution						99% Chebyshev(Mean, Sd) UCL				3.663
95% Approximate Gamma UCL					1.184					
95% Adjusted Gamma UCL					1.194					
Potential UCL to Use						**Use 95% Chebyshev (Mean, Sd) UCL**				**2.11**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Lead

General Statistics

Number of Valid Observations					47	Number of Distinct Observations				40
Raw Statistics						Log-transformed Statistics				
Minimum					9	Minimum of Log Data				2.197
Maximum					350	Maximum of Log Data				5.858
Mean					86.13	Mean of log Data				4.076
Median					68	SD of log Data				0.926
SD					76.42					
Std. Error of Mean					11.15					
Coefficient of Variation					0.887					
Skewness					1.599					

Relevant UCL Statistics

Normal Distribution Test						Lognormal Distribution Test				
Shapiro Wilk Test Statistic					0.833	Shapiro Wilk Test Statistic				0.967
Shapiro Wilk Critical Value					0.946	Shapiro Wilk Critical Value				0.946
Data not Normal at 5% Significance Level						Data appear Lognormal at 5% Significance Level				
Assuming Normal Distribution						Assuming Lognormal Distribution				
95% Student's-t UCL					104.8	95% H-UCL				123.1
95% UCLs (Adjusted for Skewness)						95% Chebyshev (MVUE) UCL				150
95% Adjusted-CLT UCL (Chen-1995)					107.2	97.5% Chebyshev (MVUE) UCL				176.2
95% Modified-t UCL (Johnson-1978)					105.3	99% Chebyshev (MVUE) UCL				227.7
Gamma Distribution Test						Data Distribution				
k star (bias corrected)					1.383	Data appear Gamma Distributed at 5% Significance Level				
Theta Star					62.28					
MLE of Mean					86.13					
MLE of Standard Deviation					73.24					
nu star					130					
Approximate Chi Square Value (.05)					104.7	Nonparametric Statistics				
Adjusted Level of Significance					0.0449	95% CLT UCL				104.5
Adjusted Chi Square Value					103.9	95% Jackknife UCL				104.8
						95% Standard Bootstrap UCL				104.6
Anderson-Darling Test Statistic					0.357	95% Bootstrap-t UCL				109.2
Anderson-Darling 5% Critical Value					0.768	95% Hall's Bootstrap UCL				108.4
Kolmogorov-Smirnov Test Statistic					0.0933	95% Percentile Bootstrap UCL				104.3
Kolmogorov-Smirnov 5% Critical Value					0.132	95% BCA Bootstrap UCL				107.1
Data appear Gamma Distributed at 5% Significance Level						95% Chebyshev(Mean, Sd) UCL				134.7
						97.5% Chebyshev(Mean, Sd) UCL				155.7
Assuming Gamma Distribution						99% Chebyshev(Mean, Sd) UCL				197
95% Approximate Gamma UCL					107					
95% Adjusted Gamma UCL					107.7					
Potential UCL to Use						**Use 95% Approximate Gamma UCL**				**107**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Appendix E: HGG Monitoring Data Sheets

E26930KB
146 Newbridge Road, Moorebank

Date: 18/10/2013
Page: 1 of 1
By: GF

BH	Depth	Pressure	CH4	CO2	O2	CO	H2S
JK5	0.5	1026	0.00	0.00	21.0	1	0.0
	1.5	1026	0.01	0.00	21.1	4	0.0
	3.0	1026	0.00	0.00	21.3	0	0.0
	4.5	1026	1.30	0.05	19.3	6	0.0
	6.0	1026	0.30	0.10	20.9	2	0.0
	7.5	1026	0.30	0.10	20.9	2	0.0
JK10	0.5	1026	0.00	0.00	20.9	1	0.0
	1.5	1026	0.00	0.00	20.5	0	0.0
	3.0	1026	2.80	0.30	18.9	1	0.0
	4.5	1026	3.10	0.40	18.8	0	0.0
	6.0	1026	2.70	0.30	17.6	0	0.0
	7.5	1026	3.20	0.60	18.1	0	0.0
	7.0	1026	16.60	4.40	6.1	0	0.0
	10.5	1025	7.10	2.30	17.5	1	0.0
JK12	0.5	1023	0.20	0.00	20.3	0	0.0
	1.5	1023	0.10	0.00	20.1	0	0.0
	3.0	1023	0.10	0.00	20.6	0	0.0
	4.5	1023	0.10	0.00	20.7	0	0.0
	6.0	1023	0.30	0.00	20.7	0	0.0
	7.5	1023	0.10	0.00	20.8	0	0.0
JK14	1.5	1024	0.60	0.10	30.6	1	0.0
	3.0	1024	0.70	0.50	20.0	2	0.0
	4.5	1024	22.60	9.40	3.4	0	0.0
	6.0	1024	20.80	10.10	11.5	1	0.0
	7.5	1024	19.30	9.50	7.8	0	0.0
Min	**0.5**	**1023**	**0.00**	**0.00**	**3.4**	**0**	**0.0**
Max	**10.5**	**1026**	**22.60**	**10.10**	**30.6**	**6**	**0.0**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 21/10/2013
Page: 1 of 1
By: GF

BH	Depth	Pressure	CH4	CO2	O2	CO	H2S
JK8	0.5	1017	0.0	0.0	20.0	2	0
	1.5	1017	1.7	0.1	20.0	3	0
	3.0	1017	21.9	1.9	20.0	1	0
	4.5	1017	2.2	0.1	9.4	1	0
	6.0	1017	0.1	0.0	19.7	2	0
	7.5	1017	0.1	0.0	20.6	2	0
JK3	0.5	1015	0.1	0.0	20.5	2	0
	1.5	1015	0.1	0.0	20.5	1	0
	4.5	1012	0.4	11.6	6.5	1	0
	6.0	1012	0.2	11.6	6.4	1	0
JK2	0.5	1010	0.2	0.0	20.0	2	0
Min	**0.5**	**1010**	**0**	**0**	**6.4**	**1**	**0**
Max	**7.5**	**1017**	**21.9**	**11.6**	**20.6**	**3**	**0**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 22/10/2013
Page: 1of1
By: GF

BH	Depth	Pressure	CH4	CO2	O2	CO	H2S
JK1	0.5	1017	0	0.2	20.6	1	0
	1.5	1017	0	0.2	20.5	1	0
	3	1017	0	0.1	20.5	0	0
JK16	0.5	1015	0.1	0	20.7	0	0
	1.5	1015	0.1	0	20.6	0	0
	3	1015	0.1	0	20.7	0	0
	4.5	1015	0.1	0	20.7	1	0
	6	1015	0.1	0	20.7	1	0
	7.5	1015	0.1	0	20.5	1	0
JK15	0.5	1012	0.1	0	20.6	0	0
	1.5	1012	0.1	0	20.6	0	0
	2	1012	0.1	0	20.5	1	0
	4.5	1012	0.1	0	20.6	0	0
	6	1012	0.1	0	20.5	0	0
	7.5	1012	0.1	0	20.6	0	0
JK13	0.5	1012	0.1	0.1	20.3	0	0
	1.5	1012	0.1	0	20.7	0	0
	3	1012	0.1	0	20.1	0	0
	4.5	1011	0.9	0.4	18.7	2	0
	6	1011	1	0.4	18.2	0	0
	7.5	1011	0.3	0.1	20.4	0	0
Min	**0.5**	**1011**	**0.00**	**0.00**	**18.20**	**0**	**0**
Max	**7.5**	**1017**	**1.00**	**0.40**	**20.70**	**2**	**0**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 23/10/2013
Page: 1 of 1
By: GF

BH	Depth	Pressure	CH4	CO2	O2	CO	H2S
JK11	0.5	1003	0.1	0	19.9	0	0
	1.5	1003	0.1	0	20	1	0
	3	1003	0.1	0	20.1	0	0
	4.5	1003	0.1	0	20	1	0
	6	1003	0.1	0	19.9	1	0
	7.5	1003	0.1	0	20	1	0
JK9	9	1010	0.1	0	20.5	0	0
JK7	9	1007	0.1	0	20.4	0	0
JK4	0.5	1000	0.1	0	20.6	0	0
	1.5	1000	0.1	0	20.7	0	0
	3	1000	0.2	0	20.6	0	0
	4.5	1000	0.2	0	20	0	0
	6	1000	0.2	0	20	0	0
	7.5	1000	0.2	0	20.1	0	0
JK6	7.95	1008	0.1	0	20.5	0	0
Min	**0.5**	**1000**	**0.1**	**0**	**19.9**	**0**	**0**
Max	**9**	**1010**	**0.2**	**0**	**20.7**	**1**	**0**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 25/10/2013
Page: 1 of 1
By: MD

BH	Depth	Pressure	CH4	CO2	O2	CO	H2S
1	NA	1024	0	1.50	20.40	2	0
9	NA	-	0.1	0.8	20.1	0	0
7	NA	1023	4.5	9.6	0.02	0	2
4	NA	1023	0.06	3.6	15	1	0
16	NA	1022	0.1	4.9	14.1	8	0
Min	**-**	**1022**	**0**	**0.8**	**0.02**	**0**	**0**
Max	**-**	**1024**	**4.5**	**9.6**	**20.4**	**8**	**2**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 6/11/2013
Page: 1 of 1
By: GF

BH	Depth	Pressure	CH4	CO2	O2	CO	H2S
MW7	-	1017	1	2.4	15.5	0	0
MW9	-	1017	16.8	16.1	9.1	0	0
MW16	-	1017	0.1	14.9	14.1	1	0
MW1	-	1017	0	1.5	20.4	0	0
Min	**-**	**1017**	**0**	**1.5**	**9.1**	**0**	**0**
Max	**-**	**1017**	**16.8**	**16.1**	**20.4**	**1**	**0**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 17/12/2013
Page: 1 of 1
By: JDC

BH	Depth	Fill Inclusions	Pressure	CH4	CO2	O2	CO	H2S
JK101	1.5	Wood Chips	1022	9.8	10.2	16.9	3	6
	3.0	-	1022	0.0	0.0	16.1	0	2
	4.5	-	1022	0.0	0.0	16.0	0	2
	6.0	-	1022	0.0	0.0	15.9	0	2
at 15.20	-	-	1022	0.1	0.2	14.5	11	9
on 18-12-13	-	-	1023	10.2	2.2	2.7	1.03	37
JK119	1.5	-	1022	0.0	1.0	20.1	0	0
	3.0	-	1022	0.0	0.0	19.6	0	0
	4.5	-	1022	0.0	0.0	19.5	0	0
	6.0	-	1022	0.0	0.0	20.4	0	1
	7.5	-	1022	0.0	0.0	20.2	0	1
	9.0	-	1022	0.0	1.0	20.1	0	1
at 15.30	-	-	1022	0.0	0.0	14.8	1	6
on 18-12-13	-	-	1023	1.4	1.8	12.6	61	34
Min	**-**	**-**	**1022**	**0.0**	**0.0**	**2.7**	**0.0**	**0.0**
Max	**-**	**-**	**1023**	**10.2**	**10.2**	**20.4**	**61.0**	**37.0**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 18/12/2013
Page: 1 of 1
By: JDC

BH	Depth	Fill Inclusions	Pressure	CH4	CO2	O2	CO	H2S
JK116	1.5	-	1023	0.0	0.0	20.3	0	1
	3.0	-	1023	0.0	0.0	20.4	0	1
JK113	1.5	-	1023	0.0	0.0	14.5	0	3
	3.0	-	1023	0.0	0.0	14.7	1	2
	9.0	-	1023	0.1	1.2	14.5	3	6
JK106	1.5	-	1023	0.0	0.2	14.5	0	4
	3.0	-	1023	3.1	1.7	10.9	20	17
Min	**-**	**-**	**1023**	**0.0**	**0.0**	**10.9**	**0.0**	**1.0**
Max	**-**	**-**	**1023**	**3.1**	**1.7**	**20.4**	**20.0**	**17.0**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 19/12/2013
Page: 1 of 1
By: JDC

BH	Depth	Fill Inclusions	Pressure	CH4	CO2	O2	CO	H2S
JK104	1.5	-	1022	0.1	0.1	20.8	0	0
	3.0	-	1022	0.4	1.0	19.7	4	3
	9.0	-	1022	0.0	0.1	20.6	1	2
JK102	1.5	-	1022	0.0	0.0	14.3	1	4
	3.0	-	1022	0.0	0.0	14.4	0	4
JK16	-	-	1022	0.0	1.5	11.3	1	4
JK113	-	-	1022	0.3	2.8	10.6	16	19
JK9	-	-	1022	15.5	14.7	5.5	1	14
JK104	-	-	1022	0.0	0.0	13.7	4	7
JK119	-	-	1022	2.3	1.7	10.4	117	40
JK101	-	-	1022	14.8	2.5	0.6	44	20
JK7	-	-	1022	2.5	8.3	1.1	1	7
JK1	-	-	1022	0.0	8.9	8.4	1	5
Min	**-**	**-**	**1022**	**0.0**	**0.0**	**0.6**	**0.0**	**0.0**
Max	**-**	**-**	**1022**	**15.5**	**14.7**	**20.8**	**117.0**	**40.0**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 20/01/2014
Page: 1 of 1
By: JDC

BH	Depth	Fill Inclusions	Pressure	CH4	CO2	O2	CO	H2S
BH106	4.5	Timber	1009	1.7	0.1	16.0	29	32
	6.0	Timber	1009	11.7	8.2	1.9	0	8
	7.5	-	1009	11.7	8.1	2.7	0	4
JK103	1.5	-	1009	0.0	0.0	19.6	2	2
	4.5	-	1009	0.0	0.0	19.8	0	2
	6.0	-	1009	0.0	0.1	19.6	0	2
	7.5	-	1009	0.0	0.0	20.1	1	2
JK102	4.5	Timber	1009	24.5	5.4	1.9	2	2
	6.0	-	1009	24.8	5.1	1.2	8	4
	7.5	-	1009	25.6	5.1	1.2	0	4
Min	**-**		**1009**	**0.0**	**0.0**	**1.2**	**0.0**	**2.0**
Max	**-**		**1009**	**25.6**	**8.2**	**20.1**	**29.0**	**32.0**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 22/01/2014
Page: 1 of 1
By: JDC

BH	Depth	Fill Inclusions	Pressure	CH4	CO2	O2	CO	H2S
JK115	0.5	-	1017	0.0	0.1	20.8	0	0
	1.5	-	1017	0.0	0.2	20.6	0	0
	3.0	-	1017	0.0	0.1	20.7	0	0
	4.5	-	1017	0.0	0.1	20.6	1	0
	6.0	Timber/wood	1017	0.0	0.5	20.0	1	0
	7.5	-	1017	0.0	1.6	19.5	0	0
JK107	1.5	Timber	1019	0.0	0.0	20.9	0	0
	3.0	-	1019	0.5	0.1	21.1	1	0
	4.5	-	1019	5.2	0.1	18.0	7	1
	6.0	-	1019	15.5	0.5	21.2	0	0
	7.5		1019	8.6	0.1	20.5	1	0
JK114	0.5	-	1017	0.0	0.1	20.9	0	0
	1.5	-	1019	0.0	0.7	20.2	1	0
	3.0	-	1019	0.0	0.9	19.7	1	0
	4.5	Timber	1019	1.4	2.0	17.4	3	0
	6.0	Timber	1019	20.4	10.5	9.1	1	0
	7.5	Timber	1019	19.2	0.2	15.5	1	0
Min	**-**		**1017**	**0**	**0**	**9.1**	**0**	**0**
Max	**-**		**1019**	**20.4**	**10.5**	**21.2**	**7**	**1**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 24/01/2014
Page: 1 of 1
By: GF

BH	Depth	Pressure	CH4	CO2	O2	CO	H2S
MW1	-	1013	0.0	15.0	7.8	1	0
JK101	-	1013	16.4	7.4	2.7	0	0
JK106	-	1013	13.0	0.0	1.0	7	5
MW7	-	1013	12.5	0.1	0.4	0	5
JK107	-	1013	30.0	0.4	0.0	0	7
JK102	-	1013	25.4	5.7	0.0	0	3
JK119	-	1013	3.5	7.9	0.0	0	2
JK103	-	1013	0.6	0.1	19.6	0	1
JK104	-	1013	0.0	20.4	0.6	0	1
MW9	-	1013	24.2	31.2	0.8	1	1
JK115	-	1013	0.0	2.3	14.5	5	1
JK114	-	1013	24.1	10.3	0.0	0	1
MW116	-	1013	0.0	8.9	2.8	1	1
JK113	-	1013	0.0	0.9	19.0	0	0
Min	**-**	**1013**	**0**	**0**	**0**	**0**	**0**
Max	**-**	**1013**	**30**	**31.2**	**19.6**	**7**	**7**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

E26930KB
146 Newbridge Road, Moorebank

Date: 28/01/2014
Page: 1 of 1
By: GF

BH	Depth	Fill Inclusions	Pressure	CH4	CO2	O2	CO	H2S
JK110	1.0	-	1020	0.0	0.0	20.0	0	0
	3.0	Timber	1020	15.4	6.3	0.1	0	4
	4.5	Timber	1020	14.6	6.2	1.4	2	2
	6.0	Timber	1020	14.5	6.2	1.0	2	3
	7.5	Timber	1020	15.1	6.1	0.1	2	3
JK118	0.5	-	1020	0.0	0.0	12.3	7	4
	1.5	-	1020	0.0	0.0	13.0	83	18
	3.0	Timber	1020	0.0	0.0	12.9	7	21
	4.5	Timber	1020	11.9	3.7	3.5	5	10
	6.0	Timber	1020	7.9	2.8	6.0	2	6
	7.5	Timber	1020	1.1	0.4	10.6	6	6
Min	**-**		**1020**	**0**	**0**	**0.1**	**0**	**0**
Max	**-**		**1020**	**15.4**	**6.3**	**20**	**83**	**21**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v

REPORT TABLES

Job No: E26930KB
Address: 146 Newbridge Road, Moorebank
Recorded by: VB/JDC

Date: 21/02/2014
Page: 1 of 1

Site Conditions: Sunny with light winds and some cloud cover

BH	Pressure	CH4	CH4	CO2	O2	CO	H2S	SWL	Flow Measurements			
		%v/v	%LEL	%v/v	%v/v	%v/v	%v/v	m	Average	Peak	Snapshot	Duration
MW1	1016	0.00	-	14.20	6.4	2	0	1.59	-	0.00	-	3
JK119	1018	6.10	-	11.90	0.7	1	0	6.50	-	4.70	-	3
JK102	1018	23.80	-	5.80	0.3	0	2	4.76	-	0.10	-	3
JK103	1018	0.60	-	0.60	18.7	0	1	3.10	-	0.00	-	3
JK104	1017	0.00	-	27.40	0.8	1	1	5.72	-	2.00	-	3
MW9	1018	21.50	-	31.30	0.3	1	2	5.82	-	0.20	-	3
JK107	1018	28.40	-	0.50	0.2	0	2	-	-	0.10	-	3
JK101	1018	14.70	-	7.40	0.0	0	2	5.59	-	0.10	-	3
MW7	1018	2.10	-	9.90	1.2	1	2	2.76	-	0.00	-	3
JK106	1019	13.00	-	1.70	0.2	0	2	4.94	-	0.20	-	3
JK113	1019	0.00	-	0.70	13.0	0	3	5.89	-	0.30	-	3
JK110	1019	15.40	-	6.40	0.3	1	2	5.24	-	0.40	-	3
JK118	1019	15.60	-	1.70	0.2	1	4	5.28	-	0.40	-	3
JK117	1019	12.10	-	1.30	0.2	1	2	6.80	-	0.20	-	3
JK114	1019	24.50	-	8.00	0.2	1	3	6.55	-	0.20	-	3
JK115	1019	0.00	-	7.70	6.7	1	2	5.70	-	0.00	-	3
MW16	1019	0.00	-	8.40	1.8	2.00	3.00	2.63	-	0.50	-	3
Min	**1016**	**0**	**-**	**0.5**	**0**	**0**	**0**	**1.59**	**-**	**0**	**-**	**3**
Max	**1019**	**28.4**	**-**	**31.3**	**18.7**	**2**	**4**	**6.8**	**-**	**4.7**	**-**	**3**

Notes:
SWL is in meters below ground level
Pressure is in mb
Gases are in %v/v
Flow in L/h
Duration is in minutes

Job No: E26930KB
Address: 146 Newbridge Road, Moorebank
Recorded by: GF/JDC

Date: 6/02/2014

BH	Pressure	CH4	CO2	O2	CO	H2S	Flow Measurements			
							Average	Peak	Snapshot	Duration
JK/MW1	1018	0.00	14.80	7.4	1	0	-	-	-	-
JK101	1018	15.40	7.70	1.1	0	0	-	0.3	-	1
JK119	1018	4.70	10.30	0.1	0	1	-	0.3	-	1
JK107	1017	29.30	0.30	0.0	0	1	-	0.5	-	1
JK106	1017	13.10	0.40	0.1	0	0	-	0.1	-	1
JK/MW7	1017	0.50	8.60	4.7	0	0	-	0.1	-	1
JK110	1017	14.60	6.30	0.1	0	1	-	0.1	-	1
JK118	1017	13.00	5.60	0.0	0	1	-	0.0	-	1
JK117	1017	12.30	1.10	0.2	0	1	-	0.2	-	1
JK/MW16	1017	0.00	6.70	4.4	1	1	-	-	-	
JK114	1017	23.50	9.70	0.0	0	2	-	0.1	-	1
JK115	1017	0.00	6.00	12.9	0	1	-	-	-	
JK113	1017	0.00	2.60	16.6	0	1	-	-	-	
MW9	1017	23.10	29.30	0.2	1	1	-	0.1	-	1
JK104	1017	0.00	24.30	0.2	1	1	-	-	-	
JK103	1017	1.50	0.70	18.2	2	2	-	0.1	-	1
JK102	1017	23.80	5.60	0.0	0	4	-	0.2	-	1
Min	**1017**	**0**	**0.3**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Max	**1018**	**29.3**	**29.3**	**18.2**	**2**	**4**	**0**	**0.5**	**0**	**1**

Notes:
Depth is in meters below ground level
Pressure is in mb
Gases are in %v/v
Flow in L/h
Duration in minutes

REPORT TABLES

Job No: E26930KB
Address: 146 Newbridge Road, Moorebank
Recorded by: GF/JDC

Date: 7/03/2014
Page: 1 of 1

Site Conditions: Sunny with some cloud cover

BH	Pressure	CH4	CH4	CO2	O2	CO	H2S	SWL	Flow Measurements			
		%v/v	%LEL	%v/v	%v/v	%v/v	%v/v	m	Average	Peak	Snapshot	Duration
MW1	1018	0.10	-	13.90	1.1	2	0	1.63	-	0.40	-	3
JK119	1018	10.80	-	13.90	0.1	1	0	6.48	-	3.70	-	3
JK102	1018	29.60	-	6.10	0.1	1	3	4.73	-	0.10	-	3
JK103	1018	0.10	-	0.10	20.2	1	0	3.90	-	0.00	-	3
JK104	1018	0.00	-	31.60	0.2	1	1	5.64	-	7.30	-	3
MW9	1018	26.60	-	33.10	0.1	1	1	5.72	-	0.00	-	3
JK107	1018	35.00	-	0.20	0.1	1	1	-	-	0.10	-	3
JK101	1018	19.80	-	8.30	0.0	1	0	5.49	-	0.10	-	3
MW7	1021	5.00	-	10.90	0.5	1	2	4.50	-	0.00	-	3
JK106	1021	16.50	-	2.40	0.1	1	2	4.90	-	0.10	-	3
JK113	1021	0.00	-	0.10	19.0	0	1	5.80	-	0.10	-	3
JK110	1021	19.80	-	6.60	0.4	1	2	5.18	-	0.00	-	3
JK118	1021	15.20	-	1.10	0.3	1	18	5.22	-	0.10	-	3
JK117	1021	16.10	-	1.10	0.1	1	2	6.75	-	0.20	-	3
JK114	1021	30.60	-	7.60	0.1	1	2	6.65	-	0.10	-	3
JK115	1021	0.00	-	9.90	5.8	1	2	5.55	-	0.10	-	3
MW16	1021	0.00	-	9.40	2.1	1.00	2.00	2.73	-	-0.10	-	3
Min	**1018**	**0**	**-**	**0.1**	**0**	**0**	**0**	**1.63**	**-**	**-0.1**	**-**	**3**
Max	**1021**	**35**	**-**	**33.1**	**20.2**	**2**	**18**	**6.75**	**-**	**7.3**	**-**	**3**

Notes:
SWL is in meters below ground level
Pressure is in mb
Gases are in %v/v
Flow in L/h
Duration is in minutes

REPORT TABLES

Job No: E26930KB
Address: 146 Newbridge Road, Moorebank
Recorded by: GF/JDC

Date: 1/04/2014
Page: 1 of 1

Site Conditions: Sunny with some cloud cover

BH	Pressure	CH4	CH4	CO2	O2	CO	H2S	SWL	Flow Measurements			
		%v/v	%LEL	%v/v	%v/v	%v/v	%v/v	m	Peak (1)	Peak (2)	Peak (3)	Duration
MW1	1020	0.30	-	15.50	0.0	1	1	1.63	0.00	-	-	3
JK119	1020	13.40	-	14.20	0.1	1	1	6.36	4.50	3.60	1.65	3
JK102	1020	29.70	-	5.90	0.0	0	3	4.69	0.10	-	-	3
JK103	1020	31.00	-	2.30	2.2	1	1	4.12	0.00	-	-	3
JK104	1020	0.10	-	35.20	0.1	1	1	5.59	0.40	0.30	0.13	3
MW9	1020	26.10	-	33.90	0.0	1	1	5.68	0.10	-	-	3
JK107	1020	37.20	-	0.30	0.1	1	1	-	0.10	0.00	0.68	3
JK101	1020	23.80	-	12.00	0.0	0	1	5.39	0.10	-	-	3
MW7	1020	6.40	-	11.20	0.0	1	1	4.43	0.00	-	-	3
JK106	1020	17.40	-	3.20	0.1	1	2	4.76	0.10	-	-	3
JK113	No Access	-	-	-	-	-	-	-	-	-	-	3
JK110	1020	19.60	-	7.00	0.0	1	1	6.05	0.10	-	-	3
JK118	1020	16.80	-	0.80	0.1	1	177	5.10	0.10	-	-	3
JK117	1020	16.60	-	1.60	0.0	1	5	6.65	0.00	-	-	3
JK114	1020	4.70	-	4.10	5.0	1	2	6.70	0.10	-	-	3
JK115	No Access	-	-	-	-	-	-	-	-	-	-	3
MW16	1020	0.30	-	8.00	0.7	1	2	4.02	0.00	-	-	3
Min	**1020**	**0.10**	**-**	**0.3**	**0**	**0**	**1**	**1.63**	**-**	**0**	**-**	**3**
Max	**1020**	**37.2**	**-**	**35.2**	**5**	**1**	**177**	**6.7**	**-**	**3.6**	**-**	**3**

Notes:
SWL is in meters below ground level
Pressure is in mb
Gases are in %v/v
Flow in L/h
Duration is in minutes
Peak 1 - Measured using the GA5000
Peak 2 - Measured using the GFM unit
Peak 3 - Measured using Risiteck Solid State Flow unit

REPORT TABLES

Job No: E26930KB
Address: 146 Newbridge Road, Moorebank
Recorded by: GF/JDC

Date: 11/04/2014
Page: 1 of 1

Site Conditions: Storm Conditions, Cloud Cover and Rain

BH	Pressure	CH4	CH4	CO2	O2	CO	H2S	SWL	Flow Measurements			
		%v/v	%LEL	%v/v	%v/v	ppm	ppm	m	Peak (1)	Peak (2)	DP	Duration
MW1	1003	0.00	-	0.00	21.2	0	0	-	0.00	-	-	3
JK119	1003	13.30	-	13.90	0.0	3	0	-	-5.40	-	-55	3
JK102	1003	27.50	-	6.00	0.0	3	1	-	1.60	-	5	3
JK103	1003	65.40	-	2.10	0.0	6	9	-	1.40	-	4	3
JK104	1003	0.00	-	34.50	0.0	1	1	-	0.50	-	1	3
MW9	1003	23.40	-	32.80	0.0	1	0	-	0.30	-	1	3
JK107	1003	36.20	-	0.40	0.0	-	-	-	0.00	-	-	3
JK101	1003	18.90	-	7.90	0.0	1	1	-	0.60	-	2	3
MW7	1003	5.70	-	11.00	0.0	1	0	-	0.00	-	0	3
JK106	1003	15.50	-	3.40	0.0	3	0	-	0.70	-	1	3
JK113	1003	0.00	-	0.00	20.3	0	2	-	0.00	-	0	3
JK110	1003	21.70	-	7.20	0.0	3	0	-	1.10	-	2	3
JK118	1003	16.20	-	0.70	0.0	1	206	-	0.10	-	1	3
JK117	1003	14.60	-	0.60	0.0	0	1	-	0.80	-	3	3
JK114	1003	29.30	-	7.30	0.0	3	1	-	2.30	-	7	3
JK115	1003	0.00	-	0.00	12.7	3	0	-	0.00	-	0	3
MW16	1003	0.00	-	7.50	0.0	1	0	-	-0.90	-	-2	3
Min	**1003**	**0.00**	**-**	**0**	**0**	**0**	**0**	**0**	**-5.4**	**-**	**-55**	**3**
Max	**1003**	**65.4**	**-**	**34.5**	**21.2**	**6**	**206**	**0**	**2.3**	**-**	**7**	**3**

Notes:
SWL is in meters below ground level
Pressure is in hPa
Gases are in %v/v
Flow in L/h
Duration is in minutes
Peak 1 - Measured using the GFM430
DP - Differential Pressure

Appendix H

Reports on Validation of the Screening Process

Current Trial Remediation Excavation

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666
Fax (02) 9809 4095

Memorandum

To	Benedict Industries Pty Ltd (Ernest Dupere)		
cc	Ian Swane and Associates P/L (Ian Swane)		
From	John Russell	**Date**	05 Oct 2016
Subject	Validation of Screening Process	**Project No.**	71459.07

Dear Sirs

In June 2016, Douglas Partners Pty Ltd (DP) undertook soil and water sampling of the following areas within 146 Newbridge Road, Moorebank (the 'site') with reference to our Remediation Action Plan (RAP):

- Approximately 4400 m^3 of <16 mm denoted as 'screened stockpile 1' SSP1; and
- Base of the excavation (acid sulphate soil sample and dewater sample).

A copy of DP's test results are attached.

The SSP1 material had gone through the screening process as described in the RAP. The following summary has been provided by Benedict Industries Pty Ltd (Benedict) in relation to the screening process:

- *Prior to processing the material is dampened or is damp due to the nature of the material and the location it has been removed from;*
- *Whilst screening the material to remove timber and other contaminants no asbestos pieces are or have been picked/removed during the screening process;*
- *All pickers (labourers) on the conveyer wear PPE gear which includes eye, hearing, hard hats, gloves and P2 respirator masks;*
- *Since commencing screening operations on 3 March 2016 and 14 June 2016, Presna (NATA accredited environmental consultants) have been contracted to carry out airborne asbestos monitoring on site at Moorebank whilst screening operations are active;*
- *237 individual monitor samples have been tested;*
- *The airborne asbestos monitors are placed on picking platforms adjacent to pickers and inside earthmoving equipment such as excavators and wheel loaders which are working on the screening process;*
- *Of the 237 individual monitor samples, no asbestos fibres have been recorded in the samples;*
- *During the placement of the screened material, which has recently commenced, airborne asbestos monitoring has been conducted and a water cart has been used to dampen the material (if required); and*

- *Benedict will continue to monitor for the duration of the screening and placing of site materials at Moorebank.*

The following general comments are made in relation to DP's test results:

- The acid sulphate soil results indicated that one of the two samples is potential acid sulphate soil (PASS). The water sample (field filtered) collected from the ponded water at the base of excavation had relatively low concentrations of dissolved metals compared to those detected in groundwater wells in the vicinity of the excavation;
- Organic matter results on soil ranged from 18,000 mg/kg to 23,000 mg/kg suggesting on the micro to macro scale that organic matter in the screened soil is 1.8% to 2.3%;
- The foreign materials content test on soil (bulk >10L sample) ranged from 1% to 2.4% (i.e. <5% which was the nominal target set by the RAP);
- A grid-based walkover over accessible areas of the northern 'raw feed' stockpile was undertaken and four fragments of asbestos containing material (ACM) were observed. The southern 'raw feed' stockpile was inaccessible due to steep stockpile walls;
- Asbestos (ACM or fibrous asbestos (FA) and asbestos fines (AF)) was detected in five of the eight 500 ml samples and the concentration of FA and AF in one sample exceeded the NEPC (2013) residential land use criterion of 0.001% w/w; and
- PCB was recorded in all soil samples, however, at concentrations that were below the adopted remediation acceptance criteria (RAC) of 1 mg/kg.

The acid sulphate soil and water sample test results indicate that PASS may be exposed at the base of the excavation, however, it appears unlikely to be having a significantly adverse effect (i.e. mobilisation of dissolved metals) on water quality. Moreover, a significant component of the coarse material used to backfill the base of the excavation contains crushed concrete (which contains lime) that would assist to buffer any acid generation that may occur whilst the excavation remains temporarily dewatered.

The test results indicate that a component of organic matter remains in the <16 mm screened fraction following the screening process meaning that ongoing landfill gas monitoring will be required following placement of the fill back into the excavation to evaluate residual landfill gas levels. We anticipate a reasonable period of time (i.e. several months) following placement of the fill will be required for methanogenic conditions to return / re-establish.

The asbestos walkover inspection results indicate that some ACM fragments are present in the fill. The asbestos testing results on the 500 ml samples suggests that the screening process may be generating FA and AF in the screened material. Testing 500 ml soil samples for FA and AF from the 'raw feed' stockpiles would be required to confirm whether the FA and AF is already present in the fill or if it is being generated by the partial pulverisation of ACM fragments as a result of the screening process. We note that should the additional testing of screened material indicate further FA and AF, the screening operation generally, may constitute 'friable' asbestos works requiring appropriately licences contractor(s), an asbestos management plan (AMP) and associated controls.

Detectable concentrations of PCB were recorded in one soil sample during the Detailed Site Investigation (DSI) and the concentration of PCB Aroclor 1254 was 3.7 mg/kg. The fact that PCB Aroclor 1254 was detected in all samples suggests a source of PCB is present in the waste mass that has been screened. Whether the source is a spill of PCB oil affecting soil (e.g. as was detected at the one location BH220/0.1-0.2) or a small drum(s) or capacitor(s) that has been crushed resulting in leakage of PCB that was subsequently mixed through screened soil as a result of the screening process, is not known. Further testing of screened soil will provide additional data by which to assess a potential point-source (or diffuse source) of PCB.

The PCB results do suggest a relatively uniform distribution of PCB (Aroclor 1254) in the initial 4400 m^3 quantity of screened material that will be used to backfill the excavation. In this regard, the potential impacts on groundwater will warrant further consideration. Prior to the screening process, the PCB may have been confined to a small drum(s) and/or capacitor(s) which after screening may present a different risk profile with regard to potential impacts to groundwater beneath the site.

All the screened soil will be placed back in the excavation and will be below the 3 m thick engineered cap, of which the upper 1.6 m will comprise VENM, which will be placed across the site. It is understood from the client that the tested batch of screened soil will be placed above the water table thereby minimising the likelihood of migration of PCB to groundwater. The placement of the screened soil will be documented by photographic record and geotechnical earthworks records.

Limitations

Douglas Partners Pty Ltd (DP) has prepared this memorandum for this project at 146 Newbridge Road, Moorebank in accordance with DP's proposal SYD160677 dated 27 May 2016 and acceptance received from Ernest Dupere dated 27 May 2016. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Benedict Industries Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Yours faithfully
Douglas Partners Pty Ltd

John Russell
Associate

Reviewed by

J M Nash
Principal

Attachments: About this Report
Laboratory Certificate of Analysis

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

12 Ashley Street, Chatswood, NSW 2067
tel: +61 2 9910 6200

email: sydney@envirolab.com.au
envirolab.com.au

Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 147393

Client:
Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Richard Lamont

Sample log in details:

Your Reference:	**71459.07, Proposed Residential Development**
No. of samples:	13 Soils, 1 Water
Date samples received / completed instructions received	26/05/16 / 26/05/16

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	2/06/15 / 2/06/16
Date of Preliminary Report:	Not Issued

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Jacinta Hurst
Laboratory Manager

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	147393-1	147393-2	147393-3	147393-4	147393-5
Your Reference	---------- -	SP1/1	SP1/2	BD1/260516	SP1/3	SP1/4
Date Sampled	----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
TRHC6 - C9	mg/kg	<25	<25	<25	<25	<25
TRHC6 - C10	mg/kg	<25	<25	<25	<25	<25
vTPHC6 - C10 less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	103	93	98	93	80

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	147393-6	147393-7	147393-8	147393-9	147393-13
Your Reference	---------- -	SP1/5	SP1/6	SP1/7	SP1/8	TRIPSPIKE
Date Sampled	----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
TRHC6 - C9	mg/kg	<25	<25	<25	<25	[NA]
TRHC6 - C10	mg/kg	<25	<25	<25	<25	[NA]
vTPHC6 - C10 less BTEX (F1)	mg/kg	<25	<25	<25	<25	[NA]
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	96%
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	95%
Ethylbenzene	mg/kg	<1	<1	<1	<1	107%
m+p-xylene	mg/kg	<2	<2	<2	<2	105%
o-Xylene	mg/kg	<1	<1	<1	<1	95%
naphthalene	mg/kg	<1	<1	<1	<1	[NA]
Surrogate aaa-Trifluorotoluene	%	99	98	87	86	88

vTRH(C6-C10)/BTEXN in Soil		
Our Reference:	UNITS	147393-14
Your Reference	---------- -	TRIP BLANK
Date Sampled	----------	26/05/2016
Type of sample		Soil
Date extracted	-	27/05/2016
Date analysed	-	27/05/2016
Benzene	mg/kg	<0.2
Toluene	mg/kg	<0.5
Ethylbenzene	mg/kg	<1
m+p-xylene	mg/kg	<2
o-Xylene	mg/kg	<1
Surrogate aaa-Trifluorotoluene	%	104

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	147393-1	147393-2	147393-3	147393-4	147393-5
Your Reference	---------- -	SP1/1	SP1/2	BD1/260516	SP1/3	SP1/4
Date Sampled	----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	30/05/2016	30/05/2016	30/05/2016	30/05/2016	30/05/2016
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	<100	<100	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100	<100	<100	<100	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	83	81	81	80	81

svTRH (C10-C40) in Soil					
Our Reference:	UNITS	147393-6	147393-7	147393-8	147393-9
Your Reference	---------- -	SP1/5	SP1/6	SP1/7	SP1/8
Date Sampled	----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	30/05/2016	30/05/2016	30/05/2016	30/05/2016
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	<100	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100	<100	<100	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	<100	<100	<100
Surrogate o-Terphenyl	%	80	82	80	80

PAHs in Soil Our Reference: Your Reference	UNITS ----------	147393-1 SP1/1	147393-2 SP1/2	147393-3 BD1/260516	147393-4 SP1/3	147393-5 SP1/4
Date Sampled	- ----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.2	0.1	0.2	0.2	0.2
Anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.4	0.3	0.5	0.5	0.4
Pyrene	mg/kg	0.4	0.3	0.5	0.5	0.4
Benzo(a)anthracene	mg/kg	0.2	0.2	0.2	0.2	0.2
Chrysene	mg/kg	0.2	0.1	0.2	0.2	0.2
Benzo(b,j+k)fluoranthene	mg/kg	0.4	0.2	0.4	0.4	0.3
Benzo(a)pyrene	mg/kg	0.3	0.1	0.2	0.2	0.2
Indeno(1,2,3-c,d)pyrene	mg/kg	0.2	<0.1	0.1	0.1	0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.3	0.1	0.2	0.2	0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	2.7	1.4	2.6	2.5	2.2
Surrogate p-Terphenyl-d14	%	111	103	105	104	115

PAHs in Soil Our Reference: Your Reference	UNITS ----------	147393-6 SP1/5	147393-7 SP1/6	147393-8 SP1/7	147393-9 SP1/8
Date Sampled	- ----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.2	0.2	0.2	0.2
Anthracene	mg/kg	<0.1	0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.5	0.5	0.3	0.5
Pyrene	mg/kg	0.6	0.6	0.3	0.6
Benzo(a)anthracene	mg/kg	0.2	0.3	0.2	0.3
Chrysene	mg/kg	0.2	0.2	0.2	0.2
Benzo(b,j+k)fluoranthene	mg/kg	0.4	0.4	0.3	0.4
Benzo(a)pyrene	mg/kg	0.2	0.2	0.1	0.2
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	0.1	<0.1	0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.2	0.2	0.1	0.2
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	2.7	2.9	1.7	2.8
Surrogate p-Terphenyl-d14	%	104	110	106	110

Organochlorine Pesticides in soil						
Our Reference:	UNITS	147393-1	147393-2	147393-3	147393-4	147393-5
Your Reference	----------	SP1/1	SP1/2	BD1/260516	SP1/3	SP1/4
	-					
Date Sampled	----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	92	94	125	94	127

Organochlorine Pesticides in soil					
Our Reference:	UNITS	147393-6	147393-7	147393-8	147393-9
Your Reference	----------	SP1/5	SP1/6	SP1/7	SP1/8
	-				
Date Sampled	----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	114	96	92	100

Organophosphorus Pesticides Our Reference: Your Reference	UNITS ----------	147393-1 SP1/1	147393-2 SP1/2	147393-3 BD1/260516	147393-4 SP1/3	147393-5 SP1/4
Date Sampled	----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	92	94	125	94	127

Organophosphorus Pesticides Our Reference: Your Reference	UNITS ----------	147393-6 SP1/5	147393-7 SP1/6	147393-8 SP1/7	147393-9 SP1/8
Date Sampled	----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	114	96	92	100

PCBs in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- - ---------- 	147393-1 SP1/1 26/05/2016 Soil	147393-2 SP1/2 26/05/2016 Soil	147393-3 BD1/260516 26/05/2016 Soil	147393-4 SP1/3 26/05/2016 Soil	147393-5 SP1/4 26/05/2016 Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	0.5	0.6	0.4	0.6	0.9
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	92	94	125	94	127

PCBs in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- - ---------- 	147393-6 SP1/5 26/05/2016 Soil	147393-7 SP1/6 26/05/2016 Soil	147393-8 SP1/7 26/05/2016 Soil	147393-9 SP1/8 26/05/2016 Soil
Date extracted	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	0.5	0.5	0.5	0.5
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	114	96	92	100

Acid Extractable metals in soil						
Our Reference:	UNITS	147393-1	147393-2	147393-3	147393-4	147393-5
Your Reference	----------	SP1/1	SP1/2	BD1/260516	SP1/3	SP1/4
Date Sampled	- ----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Arsenic	mg/kg	6	7	5	6	6
Cadmium	mg/kg	0.9	0.6	0.6	0.6	0.7
Chromium	mg/kg	14	22	14	18	16
Copper	mg/kg	39	47	40	37	49
Lead	mg/kg	120	100	100	95	120
Mercury	mg/kg	0.1	0.1	0.1	0.1	0.1
Nickel	mg/kg	11	11	10	14	13
Zinc	mg/kg	180	220	200	200	590

Acid Extractable metals in soil					
Our Reference:	UNITS	147393-6	147393-7	147393-8	147393-9
Your Reference	----------	SP1/5	SP1/6	SP1/7	SP1/8
Date Sampled	- ----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Arsenic	mg/kg	6	6	4	7
Cadmium	mg/kg	0.7	0.8	0.6	0.6
Chromium	mg/kg	14	22	13	14
Copper	mg/kg	48	54	47	45
Lead	mg/kg	110	130	110	120
Mercury	mg/kg	0.2	0.2	<0.1	0.2
Nickel	mg/kg	10	12	9	11
Zinc	mg/kg	240	470	210	230

Misc Soil - Inorg						
Our Reference:	UNITS	147393-1	147393-2	147393-3	147393-4	147393-5
Your Reference	----------	SP1/1	SP1/2	BD1/260516	SP1/3	SP1/4
	-					
Date Sampled	----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg					
Our Reference:	UNITS	147393-6	147393-7	147393-8	147393-9
Your Reference	----------	SP1/5	SP1/6	SP1/7	SP1/8
	-				
Date Sampled	----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5

Moisture Our Reference: Your Reference	UNITS ----------	147393-1 SP1/1	147393-2 SP1/2	147393-3 BD1/260516	147393-4 SP1/3	147393-5 SP1/4
Date Sampled	- ----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Moisture	%	10	10	13	12	12

Moisture Our Reference: Your Reference	UNITS ----------	147393-6 SP1/5	147393-7 SP1/6	147393-8 SP1/7	147393-9 SP1/8
Date Sampled	- ----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Date analysed	-	27/05/2016	27/05/2016	27/05/2016	27/05/2016
Moisture	%	13	7.9	11	8.0

Misc Inorg - Soil						
Our Reference:	UNITS	147393-1	147393-2	147393-3	147393-4	147393-5
Your Reference	----------	SP1/1	SP1/2	BD1/260516	SP1/3	SP1/4
	-					
Date Sampled	----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	30/05/2016	30/05/2016	30/05/2016	30/05/2016	30/05/2016
Date analysed	-	31/05/2016	31/05/2016	31/05/2016	31/05/2016	31/05/2016
Organic Matter, Walkely Black	mg/kg	18,000	19,000	18,000	22,000	21,000

Misc Inorg - Soil					
Our Reference:	UNITS	147393-6	147393-7	147393-8	147393-9
Your Reference	----------	SP1/5	SP1/6	SP1/7	SP1/8
	-				
Date Sampled	----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	30/05/2016	30/05/2016	30/05/2016	30/05/2016
Date analysed	-	31/05/2016	31/05/2016	31/05/2016	31/05/2016
Organic Matter, Walkely Black	mg/kg	23,000	23,000	23,000	21,000

sPOCAS Our Reference: Your Reference	UNITS ---------- -	147393-10 ASS1	147393-11 ASS2
Date Sampled	----------	26/05/2016	26/05/2016
Type of sample		Soil	Soil
Date prepared	-	30/05/2016	30/05/2016
Date analysed	-	30/05/2016	30/05/2016
pH $_{kcl}$	pH units	8.3	8.6
TAA pH 6.5	moles H^+/t	<5	<5
s-TAA pH 6.5	%w/w S	<0.01	<0.01
pH $_{Ox}$	pH units	8.2	7.6
TPA pH 6.5	moles H^+/t	<5	<5
s-TPA pH 6.5	%w/w S	<0.01	<0.01
TSA pH 6.5	moles H^+/t	<5	<5
s-TSA pH 6.5	%w/w S	<0.01	<0.01
ANC_E	% $CaCO_3$	3.2	0.49
a-ANC_E	moles H^+/t	630	99
s-ANC_E	%w/w S	1.0	0.16
S_{KCl}	%w/w S	<0.005	0.02
S_P	%w/w	0.02	0.1
S_{POS}	%w/w	0.01	0.07
a-S_{POS}	moles H^+/t	9	46
Ca_{KCl}	%w/w	0.15	0.18
Ca_P	%w/w	0.35	0.40
Ca_A	%w/w	0.19	0.22
Mg_{KCl}	%w/w	0.019	0.021
Mg_P	%w/w	0.043	0.062
Mg_A	%w/w	0.025	0.041
Fineness Factor	-	1.5	1.5
a-Net Acidity	moles H^+/t	<10	<10
Liming rate	kg $CaCO_3$/t	<0.75	<0.75
a-Net Acidity without ANCE	moles H^+/t	<10	46
Liming rate without ANCE	kg $CaCO_3$/t	<0.75	3.5

Asbestos ID - soils NEPM						
Our Reference:	UNITS	147393-1	147393-2	147393-4	147393-5	147393-6
Your Reference	---------- -	SP1/1	SP1/2	SP1/3	SP1/4	SP1/5
Date Sampled	----------	26/05/2016	26/05/2016	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	31/05/2016	31/05/2016	31/05/2016	31/05/2016	31/05/2016
Sample mass tested	g	1112.91	937.35	926.62	846.92	915.14
Sample Description	-	Grey coarse-grained soil & rocks	Grey coarse-grained soil & rocks	Grey coarse-grained soil & rocks	Grey coarse-grained soil & rocks	Grey coarse-grained soil & rocks
Asbestos ID in soil (as per AS4964)	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected
Total Asbestos[#1]	g/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Asbestos ID in soil <0.1g/kg*	-	Chrysotile Amosite Crocidolite	Not applicable	Not applicable	Not applicable	Chrysotile
ACM >7mm Estimation*	g	0.0489	0.0000	0.0000	0.0000	0.0000
FA and AF Estimation*	g	0.0000	0.0000	0.0000	0.0000	0.0595
FA and AF Estimation*[#2]	%(w/w)	<0.001	<0.001	<0.001	<0.001	0.0065

Asbestos ID - soils NEPM				
Our Reference:	UNITS	147393-7	147393-8	147393-9
Your Reference	---------- -	SP1/6	SP1/7	SP1/8
Date Sampled	----------	26/05/2016	26/05/2016	26/05/2016
Type of sample		Soil	Soil	Soil
Date analysed	-	31/05/2016	31/05/2016	31/05/2016
Sample mass tested	g	1009.87	971.96	1085.67
Sample Description	-	Grey coarse-grained soil & rocks	Grey coarse-grained soil & rocks	Grey coarse-grained soil & rocks
Asbestos ID in soil (as per AS4964)	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	Chrysotile asbestos detected Organic fibres detected	Chrysotile asbestos detected Amosite asbestos detected Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected
Total Asbestos[#1]	g/kg	<0.1	0.5605	1.2369
Asbestos ID in soil <0.1g/kg*	-	Chrysotile	Chrysotile	Chrysotile Amosite
ACM >7mm Estimation*	g	0.0000	0.5448	1.3428
FA and AF Estimation*	g	0.0016	0.0000	0.0000
FA and AF Estimation*[#2]	%(w/w)	<0.001	<0.001	<0.001

HM in water - dissolved		
Our Reference:	UNITS	147393-12
Your Reference	----------	DW1
	-	
Date Sampled	----------	26/05/2016
Type of sample		Water
Date prepared	-	27/05/2016
Date analysed	-	27/05/2016
Arsenic-Dissolved	µg/L	1
Cadmium-Dissolved	µg/L	<0.1
Chromium-Dissolved	µg/L	<1
Copper-Dissolved	µg/L	<1
Lead-Dissolved	µg/L	<1
Mercury-Dissolved	µg/L	<0.05
Nickel-Dissolved	µg/L	1
Zinc-Dissolved	µg/L	9

Miscellaneous Inorganics		
Our Reference:	UNITS	147393-12
Your Reference	----------	DW1
	-	
Date Sampled	----------	26/05/2016
Type of sample		Water
Date prepared	-	27/05/2016
Date analysed	-	27/05/2016
Total Alkalinity as $CaCO_3$	mg/L	670
Acidity as $CaCO_3$	mg/L	110

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. For soil results:- 1. 'TEQ PQL' values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'TEQ zero' values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'TEQ half PQL' values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-008	Moisture content determined by heating at 105+/-5 deg C for a minimum of 12 hours.
Inorg-036	Total Organic Matter - A titrimetric method that measures the oxidisable organic content of soils. Based upon Rayment and Lyons 2011 where TOM is estimated as = TOC * 1.724.
Inorg-064	sPOCAS determined using titrimetric and ICP-AES techniques. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.
ASB-001	Asbestos ID - Identification of asbestos in soil samples using Polarised Light Microscopy and Dispersion Staining Techniques. Minimum 500mL soil sample was analysed as recommended by "National Environment Protection (Assessment of site contamination) Measure, Schedule B1 and "The Guidelines from the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia - May 2009" with a reporting limit of 0.1g/kg (0.01% w/w) as per Australian Standard AS4964-2004. Results reported denoted with * are outside our scope of NATA accreditation. **NOTE** #1 Total Asbestos g/kg was analysed and reported as per Australian Standard AS4964 (This is the sum of ACM >7mm, <7mm and FA/AF)

Method ID	Methodology Summary
	NOTE #2 The screening level of 0.001% w/w asbestos in soil for FA and AF only applies where the FA and AF are able to be quantified by gravimetric procedures. This screening level is not applicable to free fibres. Estimation = Estimated asbestos weight Results reported with "--" is equivalent to no visible asbestos identified using Polarised Light microscopy and Dispersion Staining Techniques.
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.
Metals-022 ICP-MS	Determination of various metals by ICP-MS.
Inorg-006	Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.
Inorg-005	Acidity - determined titrimetrically in accordance with APHA latest Edition, 2310-B.

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Date analysed	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
TRHC$_6$ - C$_9$	mg/kg	25	Org-016	<25	147393-1	<25 || <25	LCS-2	104%
TRHC$_6$ - C$_{10}$	mg/kg	25	Org-016	<25	147393-1	<25 || <25	LCS-2	104%
Benzene	mg/kg	0.2	Org-016	<0.2	147393-1	<0.2 || <0.2	LCS-2	95%
Toluene	mg/kg	0.5	Org-016	<0.5	147393-1	<0.5 || <0.5	LCS-2	100%
Ethylbenzene	mg/kg	1	Org-016	<1	147393-1	<1 || <1	LCS-2	105%
m+p-xylene	mg/kg	2	Org-016	<2	147393-1	<2 || <2	LCS-2	110%
o-Xylene	mg/kg	1	Org-016	<1	147393-1	<1 || <1	LCS-2	105%
naphthalene	mg/kg	1	Org-014	<1	147393-1	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%		Org-016	92	147393-1	103 || 95 || RPD: 8	LCS-2	103%

QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Date analysed	-			30/05/2016	147393-1	30/05/2016 || 30/05/2016	LCS-2	30/05/2016
TRHC$_{10}$ - C$_{14}$	mg/kg	50	Org-003	<50	147393-1	<50 || <50	LCS-2	107%
TRHC$_{15}$ - C$_{28}$	mg/kg	100	Org-003	<100	147393-1	<100 || <100	LCS-2	85%
TRHC$_{29}$ - C$_{36}$	mg/kg	100	Org-003	<100	147393-1	<100 || <100	LCS-2	123%
TRH>C$_{10}$-C$_{16}$	mg/kg	50	Org-003	<50	147393-1	<50 || <50	LCS-2	107%
TRH>C$_{16}$-C$_{34}$	mg/kg	100	Org-003	<100	147393-1	<100 || <100	LCS-2	85%
TRH>C$_{34}$-C$_{40}$	mg/kg	100	Org-003	<100	147393-1	<100 || <100	LCS-2	123%
Surrogate o-Terphenyl	%		Org-003	87	147393-1	83 || 83 || RPD: 0	LCS-2	98%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Date analysed	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Naphthalene	mg/kg	0.1	Org-012	<0.1	147393-1	<0.1 || <0.1	LCS-2	118%
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	147393-1	0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	Org-012	<0.1	147393-1	<0.1 || <0.1	LCS-2	124%
Phenanthrene	mg/kg	0.1	Org-012	<0.1	147393-1	0.2 || 0.1 || RPD: 67	LCS-2	126%
Anthracene	mg/kg	0.1	Org-012	<0.1	147393-1	0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	147393-1	0.4 || 0.3 || RPD: 29	LCS-2	127%
Pyrene	mg/kg	0.1	Org-012	<0.1	147393-1	0.4 || 0.3 || RPD: 29	LCS-2	121%
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	147393-1	0.2 || 0.1 || RPD: 67	[NR]	[NR]
Chrysene	mg/kg	0.1	Org-012	<0.1	147393-1	0.2 || 0.1 || RPD: 67	LCS-2	102%
Benzo(b,j +k)fluoranthene	mg/kg	0.2	Org-012	<0.2	147393-1	0.4 || 0.3 || RPD: 29	[NR]	[NR]

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	147393-1	0.3 || 0.1 || RPD: 100	LCS-2	127%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	147393-1	0.2 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	147393-1	0.3 || 0.1 || RPD: 100	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012	113	147393-1	111 || 100 || RPD: 10	LCS-2	106%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Date analysed	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
HCB	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	108%
gamma-BHC	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	98%
Heptachlor	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	95%
delta-BHC	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	106%
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	100%
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	106%
Dieldrin	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	108%
Endrin	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	99%
pp-DDD	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	92%
Endosulfan II	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	LCS-2	96%
Methoxychlor	mg/kg	0.1	Org-005	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%		Org-005	101	147393-1	92 || 96 || RPD: 4	LCS-2	116%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Date analysed	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	LCS-2	88%
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Diazinon	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	LCS-2	85%
Dimethoate	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	LCS-2	97%
Fenitrothion	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	LCS-2	79%
Malathion	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	LCS-2	78%
Parathion	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	LCS-2	89%
Ronnel	mg/kg	0.1	Org-008	<0.1	147393-1	<0.1 || <0.1	LCS-2	96%
Surrogate TCMX	%		Org-008	101	147393-1	92 || 96 || RPD: 4	LCS-2	97%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Date analysed	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	147393-1	0.5 || 0.4 || RPD: 22	LCS-2	116%
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	147393-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		Org-006	101	147393-1	92 || 96 || RPD: 4	LCS-2	97%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Date analysed	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-2	27/05/2016
Arsenic	mg/kg	4	Metals-020	<4	147393-1	6 || 6 || RPD: 0	LCS-2	107%
Cadmium	mg/kg	0.4	Metals-020	<0.4	147393-1	0.9 || 1 || RPD: 11	LCS-2	104%
Chromium	mg/kg	1	Metals-020	<1	147393-1	14 || 15 || RPD: 7	LCS-2	105%
Copper	mg/kg	1	Metals-020	<1	147393-1	39 || 47 || RPD: 19	LCS-2	107%
Lead	mg/kg	1	Metals-020	<1	147393-1	120 || 160 || RPD: 29	LCS-2	104%
Mercury	mg/kg	0.1	Metals-021	<0.1	147393-1	0.1 || 0.1 || RPD: 0	LCS-2	85%
Nickel	mg/kg	1	Metals-020	<1	147393-1	11 || 11 || RPD: 0	LCS-2	100%
Zinc	mg/kg	1	Metals-020	<1	147393-1	180 || 240 || RPD: 29	LCS-2	102%
QUALITY CONTROL Misc Soil - Inorg	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-1	27/05/2016
Date analysed	-			27/05/2016	147393-1	27/05/2016 || 27/05/2016	LCS-1	27/05/2016
Total Phenolics (as Phenol)	mg/kg	5	Inorg-031	<5	147393-1	<5 || <5	LCS-1	102%
QUALITY CONTROL Misc Inorg - Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			30/05/2016	147393-1	30/05/2016 || 30/05/2016	LCS-1	30/05/2016
Date analysed	-			31/05/2016	147393-1	31/05/2016 || 31/05/2016	LCS-1	31/05/2016
Organic Matter, Walkely Black	mg/kg	1000	Inorg-036	<1000	147393-1	18000 || 19000 || RPD: 5	LCS-1	98%
QUALITY CONTROL sPOCAS	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			30/05/2016	[NT]	[NT]	LCS-1	30/05/2016
Date analysed	-			30/05/2016	[NT]	[NT]	LCS-1	30/05/2016
pH $_{kcl}$	pH units		Inorg-064	[NT]	[NT]	[NT]	LCS-1	98%
TAA pH 6.5	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	LCS-1	71%
s-TAA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NR]	[NR]
pH $_{Ox}$	pH units		Inorg-064	[NT]	[NT]	[NT]	LCS-1	102%
TPA pH 6.5	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	LCS-1	74%
s-TPA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NR]	[NR]
TSA pH 6.5	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NR]	[NR]

QUALITY CONTROL sPOCAS	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
s-TSA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NR]	[NR]
ANCE	% $CaCO_3$	0.05	Inorg-064	<0.05	[NT]	[NT]	[NR]	[NR]
a-ANCE	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NR]	[NR]
s-ANCE	%w/w S	0.05	Inorg-064	<0.05	[NT]	[NT]	[NR]	[NR]
SKCl	%w/w S	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
SP	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
SPOS	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
a-SPOS	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NR]	[NR]
CaKCl	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
CaP	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
CaA	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
MgKCl	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
MgP	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
MgA	%w/w	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
SHCl	%w/w S	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
SNAS	%w/w S	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
a-SNAS	moles H^+/t	5	Inorg-064	<5	[NT]	[NT]	[NR]	[NR]
s-SNAS	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NR]	[NR]
Fineness Factor	-	1.5	Inorg-064	<1.5	[NT]	[NT]	[NR]	[NR]
a-Net Acidity	moles H^+/t	10	Inorg-064	<10	[NT]	[NT]	[NR]	[NR]
Liming rate	kg $CaCO_3$/t	0.75	Inorg-064	<0.75	[NT]	[NT]	[NR]	[NR]
a-Net Acidity without ANCE	moles H^+/t	10	Inorg-064	<10	[NT]	[NT]	[NR]	[NR]
Liming rate without ANCE	kg $CaCO_3$/t	0.75	Inorg-064	<0.75	[NT]	[NT]	[NR]	[NR]

QUALITY CONTROL HM in water - dissolved	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			27/05/2016	[NT]	[NT]	LCS-W1	27/05/2016
Date analysed	-			27/05/2016	[NT]	[NT]	LCS-W1	27/05/2016
Arsenic-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	99%
Cadmium-Dissolved	µg/L	0.1	Metals-022 ICP-MS	<0.1	[NT]	[NT]	LCS-W1	99%

QUALITY CONTROL HM in water - dissolved	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Chromium-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	93%
Copper-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	100%
Lead-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	103%
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	[NT]	[NT]	[NR]	[NR]
Nickel-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	98%
Zinc-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	98%

QUALITY CONTROL Miscellaneous Inorganics	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			27/05/2016	[NT]	[NT]	LCS-1	27/05/2016
Date analysed	-			27/05/2016	[NT]	[NT]	LCS-1	27/05/2016
Total Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	[NT]	[NT]	LCS-1	109%
Acidity as $CaCO_3$	mg/L	5	Inorg-005	<5	[NT]	[NT]	LCS-1	104%

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	147393-2	27/05/2016
Date analysed	-	[NT]	[NT]	147393-2	27/05/2016
$TRHC_6$ - C_9	mg/kg	[NT]	[NT]	147393-2	102%
$TRHC_6$ - C_{10}	mg/kg	[NT]	[NT]	147393-2	102%
Benzene	mg/kg	[NT]	[NT]	147393-2	92%
Toluene	mg/kg	[NT]	[NT]	147393-2	96%
Ethylbenzene	mg/kg	[NT]	[NT]	147393-2	104%
m+p-xylene	mg/kg	[NT]	[NT]	147393-2	108%
o-Xylene	mg/kg	[NT]	[NT]	147393-2	104%
naphthalene	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%	[NT]	[NT]	147393-2	99%

QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	147393-2	27/05/2016
Date analysed	-	[NT]	[NT]	147393-2	30/05/2016
TRHC$_{10}$ - C$_{14}$	mg/kg	[NT]	[NT]	147393-2	108%
TRHC$_{15}$ - C$_{28}$	mg/kg	[NT]	[NT]	147393-2	100%
TRHC$_{29}$ - C$_{36}$	mg/kg	[NT]	[NT]	147393-2	122%
TRH>C$_{10}$-C$_{16}$	mg/kg	[NT]	[NT]	147393-2	108%
TRH>C$_{16}$-C$_{34}$	mg/kg	[NT]	[NT]	147393-2	100%
TRH>C$_{34}$-C$_{40}$	mg/kg	[NT]	[NT]	147393-2	122%
Surrogate o-Terphenyl	%	[NT]	[NT]	147393-2	81%
QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	147393-2	27/05/2016
Date analysed	-	[NT]	[NT]	147393-2	27/05/2016
Naphthalene	mg/kg	[NT]	[NT]	147393-2	107%
Acenaphthylene	mg/kg	[NT]	[NT]	[NR]	[NR]
Acenaphthene	mg/kg	[NT]	[NT]	[NR]	[NR]
Fluorene	mg/kg	[NT]	[NT]	147393-2	110%
Phenanthrene	mg/kg	[NT]	[NT]	147393-2	107%
Anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Fluoranthene	mg/kg	[NT]	[NT]	147393-2	113%
Pyrene	mg/kg	[NT]	[NT]	147393-2	108%
Benzo(a)anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Chrysene	mg/kg	[NT]	[NT]	147393-2	85%
Benzo(b,j+k)fluoranthene	mg/kg	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	mg/kg	[NT]	[NT]	147393-2	98%
Indeno(1,2,3-c,d)pyrene	mg/kg	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%	[NT]	[NT]	147393-2	113%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	147393-2	27/05/2016
Date analysed	-	[NT]	[NT]	147393-2	27/05/2016
HCB	mg/kg	[NT]	[NT]	[NR]	[NR]
alpha-BHC	mg/kg	[NT]	[NT]	147393-2	97%
gamma-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
beta-BHC	mg/kg	[NT]	[NT]	147393-2	85%
Heptachlor	mg/kg	[NT]	[NT]	147393-2	81%
delta-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
Aldrin	mg/kg	[NT]	[NT]	147393-2	92%
Heptachlor Epoxide	mg/kg	[NT]	[NT]	147393-2	91%
gamma-Chlordane	mg/kg	[NT]	[NT]	[NR]	[NR]
alpha-chlordane	mg/kg	[NT]	[NT]	[NR]	[NR]
Endosulfan I	mg/kg	[NT]	[NT]	[NR]	[NR]
pp-DDE	mg/kg	[NT]	[NT]	147393-2	96%
Dieldrin	mg/kg	[NT]	[NT]	147393-2	98%
Endrin	mg/kg	[NT]	[NT]	147393-2	89%
pp-DDD	mg/kg	[NT]	[NT]	147393-2	83%
Endosulfan II	mg/kg	[NT]	[NT]	[NR]	[NR]
pp-DDT	mg/kg	[NT]	[NT]	[NR]	[NR]
Endrin Aldehyde	mg/kg	[NT]	[NT]	[NR]	[NR]
Endosulfan Sulphate	mg/kg	[NT]	[NT]	147393-2	85%
Methoxychlor	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCMX	%	[NT]	[NT]	147393-2	104%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	147393-2	27/05/2016
Date analysed	-	[NT]	[NT]	147393-2	27/05/2016
Azinphos-methyl (Guthion)	mg/kg	[NT]	[NT]	[NR]	[NR]
Bromophos-ethyl	mg/kg	[NT]	[NT]	[NR]	[NR]
Chlorpyriphos	mg/kg	[NT]	[NT]	147393-2	88%
Chlorpyriphos-methyl	mg/kg	[NT]	[NT]	[NR]	[NR]
Diazinon	mg/kg	[NT]	[NT]	[NR]	[NR]
Dichlorvos	mg/kg	[NT]	[NT]	147393-2	82%
Dimethoate	mg/kg	[NT]	[NT]	[NR]	[NR]
Ethion	mg/kg	[NT]	[NT]	147393-2	94%
Fenitrothion	mg/kg	[NT]	[NT]	147393-2	80%
Malathion	mg/kg	[NT]	[NT]	147393-2	72%
Parathion	mg/kg	[NT]	[NT]	147393-2	78%
Ronnel	mg/kg	[NT]	[NT]	147393-2	96%
Surrogate TCMX	%	[NT]	[NT]	147393-2	92%
QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	147393-2	27/05/2016
Date analysed	-	[NT]	[NT]	147393-2	27/05/2016
Aroclor 1016	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1221	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1232	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1242	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1248	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1254	mg/kg	[NT]	[NT]	147393-2	124%
Aroclor 1260	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%	[NT]	[NT]	147393-2	92%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	147393-2	27/05/2016
Date analysed	-	[NT]	[NT]	147393-2	27/05/2016
Arsenic	mg/kg	[NT]	[NT]	147393-2	91%
Cadmium	mg/kg	[NT]	[NT]	147393-2	95%
Chromium	mg/kg	[NT]	[NT]	147393-2	86%
Copper	mg/kg	[NT]	[NT]	147393-2	90%
Lead	mg/kg	[NT]	[NT]	147393-2	##
Mercury	mg/kg	[NT]	[NT]	147393-2	96%
Nickel	mg/kg	[NT]	[NT]	147393-2	92%
Zinc	mg/kg	[NT]	[NT]	147393-2	#

Report Comments:

METALS_S: ## Percent recovery is not possible to report due to the inhomogeneous nature of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

METALS_S: # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

Asbestos ID-Soil NEPM
This report is consistent with the reporting recommendations in the National Environment Protection (Assessment of Site Contamination) Measure, Schedule B1, May 2013.
This is reported outside our scope of NATA accreditation.

Asbestos ID was analysed by Approved Identifier:	Matt Mansfield
Asbestos ID was authorised by Approved Signatory:	Paul Ching

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NR: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

CHAIN OF CUSTODY

Douglas Partners
Geotechnics / Environment / Groundwater

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Client: Douglas Partners	**Project Number** 71459.07	**To:**	Envirolab Services
Contact Person: Richard Lamont	**Project Name:** Proposed Residential Development	**Contact Person:**	Aileen Hie
Project Mgr: JRR	**PO No.:**	**Address:**	12 Ashley Street
Sampler: RJL	**lab Quote No. :**		Chatswood NSW 2068
Address: 96 Hermitage Road West Ryde NSW 2114	**Date results required:** *standard* **Or choose:** standard / same day / 1 day / 2 day / 3 day *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*	**Phone:**	02 9910 6200
		Fax:	02 9910 6201
		Email:	ahie@envirolab.com.au
Phone: 9809 0666 **Mob:** 0434 561 888	**Report format:** esdat / PDF / Excel	**Laboratory Report No:**	
Email: richard.lamont@douglaspartners.com.au john.russell@douglaspartners.com.au	**Comments**	**Lab Comments:**	

Job No: 147393
Date Received: 26.5.16
Time Received: 11-30
Received by: PL
Temp: Cool/Ambient 15.1
Cooling: Ice/Icepack
Security: Intact/Broken/None

Sample information						Tests Required											Comments
Lab Sample ID	Field Sample ID	Depth	Date sampled	Container Type	Type of sample	heavy metals	TRH	BTEX	PAH	OCP/OPP/PCB	Phenols	asbestos AF & FA	organic matter by titration	total alkalinity & acidity	SPOCAS	Combo	Provide as much information about the sample as you can
	SP1/1	1	26-May	P;G	S	X	X	X	X	X	X	X	X			8	
	SP1/2	2	26-May	P;G	S	X	X	X	X	X	X	X	X			8	
	BD1/260516	3	26-May	P	S	X	X	X	X	X	X	X	X			8	
	SP1/3	4	26-May	P;G	S	X	X	X	X	X	X	X	X			8	
	SP1/4	5	26-May	P;G	S	X	X	X	X	X	X	X	X			8	
	SP1/5	6	26-May	P;G	S	X	X	X	X	X	X	X	X			8	
	SP1/6	7	26-May	P;G	S	X	X	X	X	X	X	X	X			8	
	SP1/7	8	26-May	P;G	S	X	X	X	X	X	X	X	X			8	
	SP1/8	9	26-May	P;G	S	X	X	X	X	X	X	X	X			8	
	ASS1	10	26-May	P	S										X		
	ASS2	11	26-May	P	W										X		
	DW1	12	26-May	P	W	X								X JYH			
	TRIP SPIKE	13	26-May	G	S			X						X			
	TRIP BLANK	14	26-May	G	S			X									

Relinquished by: Douglas Partners	**Sample Receipt**	***Lab use only:***
Hand delivered / Courier (by whom)	**Received by (Company):** EVS.	**Samples Received:** Cool or Ambient (circle one)
Condition of Sample at dispatch Cool or Ambient (circle)	**Print Name:** P. Ray	**Temperature Received at:** (if applicable)
Temperature (if Applicable):	**Date & Time:** 26.5.16 11.30	**Transported by:** Hand delivered / courier
Print Name: Richard Lamont	**Signature:**	
Date & Time: 26/05/2016		
Signature:		Page_____of _____

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666
Fax (02) 9809 4095

Memorandum

To	Benedict Industries Pty Ltd (Ernest Dupere)		Ref: 71459.R.002.Rev0
cc	Ian Swane and Associates P/L (Ian Swane)		
From	John Russell	**Date**	13 Oct 2016
Subject	Validation of Screening Process	**Project No.**	71459.07

Dear Sirs

On 20 September 2016, Douglas Partners Pty Ltd (DP) completed a site inspection and sampling at 146 Newbridge Road, Moorebank (the 'site') to undertake sampling with reference to our Remediation Action Plan (RAP), dated 19 May 2016. Based on the inspection and discussions with site staff, the activities occurring at the site are summarised as follows:

- The screening operation had generated a further approximately 2000 m^3 of <16 mm material denoted as 'screened stockpile 1' SSP1, representing an extension of the previously sampled SSP1. The screening operation had generated a further approximately 5000 m^3 stockpile of blended fraction material, including 16 – 40 mm, denoted as 'screened stockpile 2' SSP2.
- One 'raw feed' stockpile was present at the northern end of the excavation and what appears to be another 'raw feed' stockpile was present as the southern end of the excavation.
- According to the Benedict Industries Pty Ltd (Benedict) Group Operations Manager, material from SSP1 and/or SSP2 was being loaded and spread at the northern portion of the site to assist with drying the material prior to placement and compaction back in the excavation.
- The excavation was being backfilled and, according to the Benedict Group Operations Manager, the re-compacted fill was at approximately 1.6 m AHD.

During the site inspection:

- The excavation walls were inspected. The northern wall was observed to contain a comparatively high component of timber relative to the north-eastern wall.
- Soil samples were collected from SSP1 and SSP2.

A copy of DP's test results from samples collected from SSP1 and SSP2 are attached.

The following general comments are made in relation to DP's test results:

- Organic matter results on soil ranged from 15,000 mg/kg to 33,000 mg/kg suggesting on the micro to macro scale that organic matter in the screened soil is 1.5% to 3.3%;
- Many (>100) fragments of asbestos containing material (ACM) were observed in stockpiles SSP1 and SSP2;

- Asbestos (ACM or fibrous asbestos (FA) and asbestos fines (AF)) was detected in all 14 of the 500 ml samples analysed and concentration of FA and AF in five of the samples exceeded the NEPC (2013) residential land use criterion of 0.001% w/w;
- PCB was recorded in the majority of soil samples with several recording concentrations that were marginally above the adopted remediation acceptance criteria (RAC) of 1 mg/kg. All detectable concentrations were below 2 mg/kg; and
- TCLP testing indicated that a component of some of the detected metals is likely to leach from the screened soil over time and impact underlying groundwater. The TCLP testing also indicated that the leachability of the PAH and PCB present in the screened soil is low (i.e. <PQL).

The test results indicate that a component of organic matter remains in the screened material following the screening process meaning that ongoing landfill gas monitoring will be required following placement of the fill back into the excavation to evaluate residual landfill gas levels. We anticipate that methanogenic conditions will take a period of up to several months, to re-establish following re-placement of the fill.

Inspection of the stockpiles indicates that ACM fragments are present throughout the fill. The asbestos testing results on the 500 ml samples suggests that the screening process being undertaken on site may actually be generating FA and AF (as ACM is broken down in the screened material). Testing 500 ml soil samples for FA and AF from the 'raw feed' stockpiles would be required to confirm whether the FA and AF is already present in the fill, or if it is being generated by the partial pulverisation of ACM fragments as a result of the screening process.

As flagged in our previous memo dated 5 October 2016, the current results confirm that the screening operation and associated earthworks (i.e. backfilling the excavation) generally, constitutes 'friable' asbestos works requiring appropriately licenced contractor(s), an asbestos management plan (AMP) and associated controls. In this regard, DP recommends that **all works are immediately halted** until a suitable AMP is put in place and an appropriately licenced contractor(s) is appointed to undertake the remainder of the works that involve handling of the FA and AF impacted soils. Relevant notifications to SafeWork NSW must also be issued prior to the resumption of works.

In summary, the current results have triggered Section 16.5 of the RAP - *Contingencies for Unexpected Finds*. Section 16.5 of the RAP is also relevant where "significant quantities of bonded ACM or FA and AF are encountered". The recent site inspection and test results reported herein are considered to meet the aforementioned threshold of "significant quantities".

The AMP must include a process to verify timber recovered from the waste mass is free of asbestos prior to any form of re-use (e.g. recycling for mulch). Alternatively, recovered timber should be assumed to contain asbestos and be disposed of accordingly.

Further to our meeting on 30 September 2016, we understand the following from Benedict's Director and Group Operations Manager:

- No further screening of soil is to be undertaken;
- All the residual fine sand / crushed glass from across the site will be excavated, stockpiled and processed (if required) prior to being sold;

- A 22,000 m^3 stockpile of 'pond fill' (i.e. soil dredged from the ponds located at the southern portion of the site) will be screened to separate fines from clay. The clay will be retained for backfill into the excavation and the fine grained sands will be sold; and
- Two additional areas with historically elevated concentrations of landfill gas will be excavated with a view to removing some of the gas-generating fill. Additional landfill gas wells will be installed at these locations by DP to increase the resolution of landfill gas data in these areas. Following the additional landfill gas monitoring, Benedict propose to excavate targetted gas generating fill (to be determined by Benedict) and take the excavated fill to their Chipping Norton facility for disposal / processing.

In relation to the items above and in the context of the current available data, DP provides the following comments:

- Two 'raw feed' stockpiles are still present at the northern and southern end of the excavation, respectively. DP's understanding was that the 'raw feed' stockpiles were to undergo screening to a) remove a component of organic landfill gas generating material, and b) allow their backfilling and compaction under geotechnical supervision;
- Residual fine sand / crushed glass across the site also includes material that is within the trial remediation areas which is now inclusive of all areas used to spread and dry FA and AF impacted screened soil;
- The contamination status of the 'pond fill' stockpile is not known to DP as it has not been tested by DP and we can therefore make no comment on the suitability for the re-use and sale of this material. DP assumes that this stockpile has been generated under the conditions of the current licence of the facility. DP also understands that Benedict may have their own testing data on samples collected from this stockpile; and
- DP cannot provide commentary on whether excavation and transport of fill from this site to Benedict's Chipping Norton facility for disposal / processing is compliant with relevant legislation and regulations including the POEO Act. It should be assumed, in the absence of a robust programme of testing proving otherwise, that the excavated material will contain asbestos.

Figures 1 and 2 below, shows the areas within the site relevant to the items discussed above.



Figure 1: Aerial photograph showing SSP1, SSP2, 'pond fill', 'raw feed' stockpiles and the excavation (Source, NearMap flown 9 September 2016)



Figure 2: Aerial photograph showing northern portion of the site used to dry material from SSP1 and SSP2 (Source, NearMap flown 9 September 2016)

In order to provide clarification of some of the items raised above, DP requests the following information from Benedict:

- We understand that the excavation at the central portion of the site was surveyed prior to commencement of backfilling. Please request from the surveyors the calculated volume of the void such that reconciliation between the void and screened material can be made. The area of the excavation as shown on Figure 2 in the RAP is approximately 4500 m^2 and assuming an average depth of 7 m would yield a volume of 31,500 m^3. Based on estimates to date, the total

volume of screened soil that has been tested is approximately 11,500 m^3 (noting estimates of stockpiles are based on visual observation only, and not survey, and could therefore involve a high margin of error);

- A plan which clearly depicts those areas of the site that have been used for trial remediation excavation activities (e.g. stockpiling and spreading / drying of FA and AF impacted soil from SSP1 and SSP2). This plan should form the basis of the clear separation of trial remediation activities and the ongoing operational activities of the site;
- Material tracking information for all material that has been excavated and screened, specifically, components of the fill that have been segregated for off-site disposal (e.g. timber waste, metal waste, other deleterious materials such as rubber, plastics, vegetation, asbestos, bitumen, drums/containers); and
- Clarification of intention of what will be done to the 'raw feed' stockpiles identified on Figure 1. DP understands that these stockpiles are not suitable for backfilling in the excavation without undergoing screening as occurred with material which comprised stockpiles SSP1 and SSP2.

DP is of the opinion that all the residual fine sand / crushed glass from across the site that Benedict propose to excavate, stockpile and process (if required) and sell is not suitable for use for this purpose. This is because DP has not had a full time presence at the site during the trial remediation process and therefore cannot verify exactly where asbestos impacted fill from the trial remediation excavation has been stockpiled, screened or spread on areas of the site to dry. Given the potential for cross-contamination of residual fine sand / crushed glass by asbestos impacted fill, it is DP's opinion that only some of the residual fine sand / crushed glass may not have been impacted by the trial remediation activities (i.e. fine sand / crushed glass at areas where no stockpiling or vehicle movements associated with the trial remediation activities has occurred).

In working through the audit comments on the RAP, we also seek input from the geotechnical consultant on Audit Comment 47:

- *Sections 6 & 7 of the J&K (2016) report advise that excavations should be backfilled under the supervision of the geotechnical consultant (J&K). J&K should specify, in a letter to be included in the RAP, the likely frequency of these inspections and the competency of the person/s undertaking the inspection. These inspections should be undertaken by geotechnical professionals who are also experienced in identifying contamination. The RAP should require the geotechnical consultant to inspect the backfill material not only for geotechnical characteristics, but also for physical evidence of contamination that should include, but not be limited to, asbestos fragments, industrial waste (e.g. slag, ash), stained / odorous material, types and proportions of anthropogenic material present, proportion of timber and degradable material present. A detailed record of each inspection should be prepared and a copy provided to the environmental consultant for their review and inclusion in the validation report. A copy of a pro-forma inspection record should be provided in the J&K letter, so it can be included in the RAP.*

We trust that the foregoing will provide a framework for addressing the key issues that require immediate attention (i.e. implementation of an AMP and notification to SafeWork NSW) and moving forward with the trial remediation excavation(s) more generally.

Limitations

Douglas Partners Pty Ltd (DP) has prepared this memorandum for this project at 146 Newbridge Road, Moorebank in accordance with DP's proposal SYD160677 dated 27 May 2016 and acceptance received from Ernest Dupere dated 27 May 2016. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Benedict Industries Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Yours faithfully
Douglas Partners Pty Ltd

John Russell
Associate

Reviewed by

J M Nash
Principal

Attachments: About this Report
Laboratory Certificate of Analysis

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

12 Ashley Street, Chatswood, NSW 2067
tel: +61 2 9910 6200

email: sydney@envirolab.com.au
envirolab.com.au

Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 154059

Client:
Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: John Russell

Sample log in details:

Your Reference:	**71459.07, Moorebank**
No. of samples:	16 soils
Date samples received / completed instructions received	22/09/2016 / 22/09/2016

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	29/09/16 / 28/09/16
Date of Preliminary Report:	Not Issued

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025 - Testing **Tests not covered by NATA are denoted with *.**

Results Approved By:

David Springer
General Manager

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	154059-1	154059-2	154059-3	154059-4	154059-5
Your Reference	---------- -	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	24/09/2016	24/09/2016
TRHC$_6$ - C$_9$	mg/kg	<25	<25	<25	<25	<25
TRHC$_6$ - C$_{10}$	mg/kg	<25	<25	<25	<25	<25
vTPHC$_6$ - C$_{10}$ less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	95	106	103	107	112

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	154059-6	154059-7	154059-8	154059-9	154059-10
Your Reference	---------- -	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	24/09/2016	24/09/2016
TRHC$_6$ - C$_9$	mg/kg	<25	<25	<25	<25	<25
TRHC$_6$ - C$_{10}$	mg/kg	<25	<25	<25	<25	<25
vTPHC$_6$ - C$_{10}$ less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	111	108	113	112	110

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	154059-11	154059-12	154059-13	154059-14	154059-15
Your Reference	---------- -	SSP2/7	SSP2/8	SSP2/9	SSP2/10	BD1/200916
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	24/09/2016	24/09/2016
TRHC6 - C9	mg/kg	<25	<25	<25	<25	<25
TRHC6 - C10	mg/kg	<25	<25	<25	<25	<25
vTPHC6 - C10 less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	115	109	60	112	113

vTRH(C6-C10)/BTEXN in Soil		
Our Reference:	UNITS	154059-16
Your Reference	---------- -	BD2/200916
Date Sampled	----------	20/09/2016
Type of sample		Soil
Date extracted	-	23/09/2016
Date analysed	-	24/09/2016
TRHC6 - C9	mg/kg	<25
TRHC6 - C10	mg/kg	<25
vTPHC6 - C10 less BTEX (F1)	mg/kg	<25
Benzene	mg/kg	<0.2
Toluene	mg/kg	<0.5
Ethylbenzene	mg/kg	<1
m+p-xylene	mg/kg	<2
o-Xylene	mg/kg	<1
naphthalene	mg/kg	<1
Surrogate aaa-Trifluorotoluene	%	108

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	154059-1	154059-2	154059-3	154059-4	154059-5
Your Reference	---------- -	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	24/09/2016	24/09/2016
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	<100	<100	<100	110
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100	<100	<100	<100	110
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	81	88	84	85	86

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	154059-6	154059-7	154059-8	154059-9	154059-10
Your Reference	---------- -	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	24/09/2016	24/09/2016
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	<100	<100	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	110	<100	<100	<100	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	84	77	88	83	75

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	154059-11	154059-12	154059-13	154059-14	154059-15
Your Reference	----------	SSP2/7	SSP2/8	SSP2/9	SSP2/10	BD1/200916
	-					
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	26/09/2016	26/09/2016
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	<100	<100	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100	<100	<100	<100	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	76	83	76	80	77

svTRH (C10-C40) in Soil		
Our Reference:	UNITS	154059-16
Your Reference	----------	BD2/200916
	-	
Date Sampled	----------	20/09/2016
Type of sample		Soil
Date extracted	-	23/09/2016
Date analysed	-	26/09/2016
TRHC$_{10}$ - C$_{14}$	mg/kg	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	120
TRH>C$_{10}$-C$_{16}$	mg/kg	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	160
TRH>C$_{34}$-C$_{40}$	mg/kg	<100
Surrogate o-Terphenyl	%	86

PAHs in Soil Our Reference: Your Reference	UNITS ----------	154059-1 SSP1/9	154059-2 SSP1/10	154059-3 SSP1/11	154059-4 SSP1/12	154059-5 SSP2/1
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	0.2	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
Phenanthrene	mg/kg	0.3	0.1	0.2	2.0	0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	0.6	<0.1
Fluoranthene	mg/kg	0.4	0.3	0.3	2.0	0.3
Pyrene	mg/kg	0.4	0.3	0.4	1.8	0.4
Benzo(a)anthracene	mg/kg	0.2	0.1	0.1	0.7	0.2
Chrysene	mg/kg	0.2	0.1	0.2	0.6	0.2
Benzo(b,j+k)fluoranthene	mg/kg	0.3	0.2	0.3	0.8	0.4
Benzo(a)pyrene	mg/kg	0.1	0.1	0.2	0.4	0.2
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	0.1	0.3	0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	0.1	0.1	0.2	0.2
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	0.6	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	0.6	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	0.6	<0.5
Total Positive PAHs	mg/kg	1.9	1.5	1.8	9.8	2.1
Surrogate p-Terphenyl-d14	%	89	97	94	97	92

PAHs in Soil Our Reference: Your Reference	UNITS ----------	154059-6 SSP2/2	154059-7 SSP2/3	154059-8 SSP2/4	154059-9 SSP2/5	154059-10 SSP2/6
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.9	1.9	0.1	<0.1	0.1
Anthracene	mg/kg	0.2	0.4	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	1.9	2.6	0.3	0.2	0.3
Pyrene	mg/kg	1.8	2.6	0.3	0.2	0.3
Benzo(a)anthracene	mg/kg	0.8	0.9	0.1	<0.1	0.1
Chrysene	mg/kg	0.8	0.9	0.1	0.1	0.1
Benzo(b,j+k)fluoranthene	mg/kg	1	1	0.2	<0.2	0.3
Benzo(a)pyrene	mg/kg	0.72	0.75	0.1	0.09	0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	0.4	0.4	0.1	<0.1	0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.4	0.5	0.1	<0.1	0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	1	1.1	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	1	1.1	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	1	1.1	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	9.1	12	1.6	0.61	1.7
Surrogate p-Terphenyl-d14	%	92	92	100	60	96

PAHs in Soil Our Reference: Your Reference	UNITS ----------	154059-11 SSP2/7	154059-12 SSP2/8	154059-13 SSP2/9	154059-14 SSP2/10	154059-15 BD1/200916
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.1	0.1	<0.1	0.6	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
Fluoranthene	mg/kg	0.3	0.3	0.2	0.9	0.1
Pyrene	mg/kg	0.3	0.3	0.2	0.8	0.1
Benzo(a)anthracene	mg/kg	0.1	0.1	<0.1	0.3	<0.1
Chrysene	mg/kg	0.1	0.2	<0.1	0.3	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	0.3	0.3	<0.2	0.5	<0.2
Benzo(a)pyrene	mg/kg	0.1	0.1	0.06	0.3	0.06
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	0.1	<0.1	0.2	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.1	0.1	<0.1	0.2	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	1.6	1.8	0.41	4.3	0.35
Surrogate p-Terphenyl-d14	%	90	92	92	92	106

PAHs in Soil		
Our Reference:	UNITS	154059-16
Your Reference	----------	BD2/200916
	-	
Date Sampled	----------	20/09/2016
Type of sample		Soil
Date extracted	-	23/09/2016
Date analysed	-	23/09/2016
Naphthalene	mg/kg	<0.1
Acenaphthylene	mg/kg	<0.1
Acenaphthene	mg/kg	<0.1
Fluorene	mg/kg	<0.1
Phenanthrene	mg/kg	0.1
Anthracene	mg/kg	<0.1
Fluoranthene	mg/kg	0.4
Pyrene	mg/kg	0.5
Benzo(a)anthracene	mg/kg	0.2
Chrysene	mg/kg	0.2
Benzo(b,j+k)fluoranthene	mg/kg	0.3
Benzo(a)pyrene	mg/kg	0.2
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1
Benzo(g,h,i)perylene	mg/kg	0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5
Total Positive PAHs	mg/kg	2.1
Surrogate p-Terphenyl-d14	%	94

Organochlorine Pesticides in soil						
Our Reference:	UNITS	154059-1	154059-2	154059-3	154059-4	154059-5
Your Reference	----------	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
	-					
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	98	98	115	98	100

Organochlorine Pesticides in soil						
Our Reference:	UNITS	154059-6	154059-7	154059-8	154059-9	154059-10
Your Reference	----------	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
	-					
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	96	96	96	96	98

Organochlorine Pesticides in soil						
Our Reference:	UNITS	154059-11	154059-12	154059-13	154059-14	154059-15
Your Reference	----------	SSP2/7	SSP2/8	SSP2/9	SSP2/10	BD1/200916
	-					
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	96	98	126	94	98

Organochlorine Pesticides in soil		
Our Reference:	UNITS	154059-16
Your Reference	----------	BD2/200916
	-	
Date Sampled	----------	20/09/2016
Type of sample		Soil
Date extracted	-	23/09/2016
Date analysed	-	23/09/2016
HCB	mg/kg	<0.1
alpha-BHC	mg/kg	<0.1
gamma-BHC	mg/kg	<0.1
beta-BHC	mg/kg	<0.1
Heptachlor	mg/kg	<0.1
delta-BHC	mg/kg	<0.1
Aldrin	mg/kg	<0.1
Heptachlor Epoxide	mg/kg	<0.1
gamma-Chlordane	mg/kg	<0.1
alpha-chlordane	mg/kg	<0.1
Endosulfan I	mg/kg	<0.1
pp-DDE	mg/kg	<0.1
Dieldrin	mg/kg	<0.1
Endrin	mg/kg	<0.1
pp-DDD	mg/kg	<0.1
Endosulfan II	mg/kg	<0.1
pp-DDT	mg/kg	<0.1
Endrin Aldehyde	mg/kg	<0.1
Endosulfan Sulphate	mg/kg	<0.1
Methoxychlor	mg/kg	<0.1
Surrogate TCMX	%	127

Organophosphorus Pesticides Our Reference: Your Reference	UNITS ----------	154059-1 SSP1/9	154059-2 SSP1/10	154059-3 SSP1/11	154059-4 SSP1/12	154059-5 SSP2/1
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	98	98	115	98	100

Organophosphorus Pesticides Our Reference: Your Reference	UNITS ----------	154059-6 SSP2/2	154059-7 SSP2/3	154059-8 SSP2/4	154059-9 SSP2/5	154059-10 SSP2/6
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	96	96	96	96	98

Organophosphorus Pesticides						
Our Reference:	UNITS	154059-11	154059-12	154059-13	154059-14	154059-15
Your Reference	----------	SSP2/7	SSP2/8	SSP2/9	SSP2/10	BD1/200916
	-					
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	96	98	126	94	98

Organophosphorus Pesticides		
Our Reference:	UNITS	154059-16
Your Reference	----------	BD2/200916
	-	
Date Sampled	----------	20/09/2016
Type of sample		Soil
Date extracted	-	23/09/2016
Date analysed	-	23/09/2016
Azinphos-methyl (Guthion)	mg/kg	<0.1
Bromophos-ethyl	mg/kg	<0.1
Chlorpyriphos	mg/kg	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1
Diazinon	mg/kg	<0.1
Dichlorvos	mg/kg	<0.1
Dimethoate	mg/kg	<0.1
Ethion	mg/kg	<0.1
Fenitrothion	mg/kg	<0.1
Malathion	mg/kg	<0.1
Parathion	mg/kg	<0.1
Ronnel	mg/kg	<0.1
Surrogate TCMX	%	127

PCBs in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- - ---------- 	154059-2 SSP1/10 20/09/2016 Soil	154059-3 SSP1/11 20/09/2016 Soil	154059-9 SSP2/5 20/09/2016 Soil	154059-10 SSP2/6 20/09/2016 Soil	154059-12 SSP2/8 20/09/2016 Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.2
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.2
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.2
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.2
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.2
Aroclor 1254	mg/kg	0.6	0.3	0.6	0.8	<0.2
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.2
Surrogate TCLMX	%	98	115	96	98	98

PCBs in Soil Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- - ---------- 	154059-13 SSP2/9 20/09/2016 Soil	154059-14 SSP2/10 20/09/2016 Soil	154059-16 BD2/200916 20/09/2016 Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	0.4	1.2	0.7
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1
Surrogate TCLMX	%	126	94	127

Acid Extractable metals in soil						
Our Reference:	UNITS	154059-1	154059-2	154059-3	154059-4	154059-5
Your Reference	---------- -	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	26/09/2016	26/09/2016	26/09/2016	26/09/2016	26/09/2016
Arsenic	mg/kg	9	8	9	9	9
Cadmium	mg/kg	0.6	0.7	<0.4	0.8	0.7
Chromium	mg/kg	14	19	16	17	16
Copper	mg/kg	34	51	41	62	52
Lead	mg/kg	93	140	100	150	130
Mercury	mg/kg	<0.1	0.2	0.2	0.1	0.2
Nickel	mg/kg	7	12	13	13	11
Zinc	mg/kg	170	270	210	360	340

Acid Extractable metals in soil						
Our Reference:	UNITS	154059-6	154059-7	154059-8	154059-9	154059-10
Your Reference	---------- -	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	26/09/2016	26/09/2016	26/09/2016	26/09/2016	26/09/2016
Arsenic	mg/kg	11	11	8	7	5
Cadmium	mg/kg	1	1	0.7	0.7	<0.4
Chromium	mg/kg	24	28	16	15	13
Copper	mg/kg	58	120	55	95	48
Lead	mg/kg	190	590	140	120	93
Mercury	mg/kg	0.2	0.2	0.2	0.1	<0.1
Nickel	mg/kg	13	17	20	9	10
Zinc	mg/kg	350	430	290	210	180

Acid Extractable metals in soil						
Our Reference:	UNITS	154059-11	154059-12	154059-13	154059-14	154059-15
Your Reference	---------- -	SSP2/7	SSP2/8	SSP2/9	SSP2/10	BD1/200916
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	26/09/2016	26/09/2016	26/09/2016	26/09/2016	26/09/2016
Arsenic	mg/kg	7	5	39	6	7
Cadmium	mg/kg	0.5	<0.4	0.7	0.6	2
Chromium	mg/kg	18	12	14	14	23
Copper	mg/kg	52	29	51	44	45
Lead	mg/kg	110	63	110	110	90
Mercury	mg/kg	0.1	<0.1	0.2	0.1	<0.1
Nickel	mg/kg	12	7	11	9	26
Zinc	mg/kg	210	190	270	220	330

Acid Extractable metals in soil			
Our Reference:	UNITS	154059-16	154059-17
Your Reference	----------	BD2/200916	SSP1/9 - [TRIPLICATE]
	-		
Date Sampled	----------	20/09/2016	20/09/2016
Type of sample		Soil	Soil
Date prepared	-	23/09/2016	23/09/2016
Date analysed	-	26/09/2016	26/09/2016
Arsenic	mg/kg	9	14
Cadmium	mg/kg	0.8	0.8
Chromium	mg/kg	22	18
Copper	mg/kg	56	59
Lead	mg/kg	130	110
Mercury	mg/kg	0.1	<0.1
Nickel	mg/kg	11	8
Zinc	mg/kg	250	190

Misc Soil - Inorg						
Our Reference:	UNITS	154059-1	154059-2	154059-3	154059-4	154059-5
Your Reference	----------	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
	-					
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg						
Our Reference:	UNITS	154059-6	154059-7	154059-8	154059-9	154059-10
Your Reference	----------	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
	-					
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg						
Our Reference:	UNITS	154059-11	154059-12	154059-13	154059-14	154059-15
Your Reference	----------	SSP2/7	SSP2/8	SSP2/9	SSP2/10	BD1/200916
	-					
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg		
Our Reference:	UNITS	154059-16
Your Reference	----------	BD2/200916
	-	
Date Sampled	----------	20/09/2016
Type of sample		Soil
Date prepared	-	23/09/2016
Date analysed	-	27/09/2016
Total Phenolics (as Phenol)	mg/kg	<5

Moisture						
Our Reference:	UNITS	154059-1	154059-2	154059-3	154059-4	154059-5
Your Reference	----------	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
	-					
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	24/09/2016	24/09/2016
Moisture	%	18	14	15	17	5.9

Moisture						
Our Reference:	UNITS	154059-6	154059-7	154059-8	154059-9	154059-10
Your Reference	----------	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
	-					
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	24/09/2016	24/09/2016
Moisture	%	9.1	18	5.3	9.1	6.5

Moisture						
Our Reference:	UNITS	154059-11	154059-12	154059-13	154059-14	154059-15
Your Reference	----------	SSP2/7	SSP2/8	SSP2/9	SSP2/10	BD1/200916
	-					
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	24/09/2016	24/09/2016	24/09/2016	24/09/2016	24/09/2016
Moisture	%	9.0	14	16	14	14

Moisture		
Our Reference:	UNITS	154059-16
Your Reference	----------	BD2/200916
	-	
Date Sampled	----------	20/09/2016
Type of sample		Soil
Date prepared	-	23/09/2016
Date analysed	-	24/09/2016
Moisture	%	8.1

Misc Inorg - Soil						
Our Reference:	UNITS	154059-1	154059-2	154059-3	154059-4	154059-5
Your Reference	---------- -	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Date analysed	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Organic Matter, Walkely Black	mg/kg	32,000	22,000	20,000	33,000	22,000

Misc Inorg - Soil						
Our Reference:	UNITS	154059-6	154059-7	154059-8	154059-9	154059-10
Your Reference	---------- -	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Date analysed	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Organic Matter, Walkely Black	mg/kg	29,000	30,000	25,000	22,000	16,000

Misc Inorg - Soil						
Our Reference:	UNITS	154059-11	154059-12	154059-13	154059-14	154059-15
Your Reference	---------- -	SSP2/7	SSP2/8	SSP2/9	SSP2/10	BD1/200916
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Date analysed	-	27/09/2016	27/09/2016	27/09/2016	27/09/2016	27/09/2016
Organic Matter, Walkely Black	mg/kg	20,000	16,000	18,000	20,000	19,000

Misc Inorg - Soil		
Our Reference:	UNITS	154059-16
Your Reference	---------- -	BD2/200916
Date Sampled	----------	20/09/2016
Type of sample		Soil
Date prepared	-	27/09/2016
Date analysed	-	27/09/2016
Organic Matter, Walkely Black	mg/kg	25,000

Asbestos ID - soils NEPM						
Our Reference:	UNITS	154059-1	154059-2	154059-3	154059-4	154059-5
Your Reference	---------- -	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	27-28/09/2016	27-28/09/2016	27-28/09/2016	27-28/09/2016	27-28/09/2016
Sample mass tested	g	916.01	996.11	1015.76	884.47	1217.33
Sample Description	-	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil (as per AS4964)	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	Chrysotile asbestos detected Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	Chrysotile asbestos detected Amosite asbestos detected Crocidolite asbestos detected Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected
Total Asbestos[#1]	g/kg	<0.1	<0.1	0.1174	<0.1	0.6516
Asbestos ID in soil <0.1g/kg*	-	Chrysotile	Chrysotile	Not applicable	Chrysotile Amosite	Not applicable
ACM >7mm Estimation*	g	0.0000	0.0000	0.1183	0.0000	0.7343
FA and AF Estimation*	g	0.0025	0.0190	0.0010	0.0051	0.0590
FA and AF Estimation*[#2]	%(w/w)	<0.001	0.0019	<0.001	<0.001	0.0048

Asbestos ID - soils NEPM						
Our Reference:	UNITS	154059-6	154059-7	154059-8	154059-9	154059-10
Your Reference	---------- -	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	27-28/09/2016	27-28/09/2016	27-28/09/2016	27-28/09/2016	27-28/09/2016
Sample mass tested	g	1155.1	908.23	1130.16	1000.79	994.25
Sample Description	-	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil (as per AS4964)	-	Chrysotile asbestos detected Amosite asbestos detected Crocidolite asbestos detected Organic fibres detected	Chrysotile asbestos detected Amosite asbestos detected Crocidolite asbestos detected Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	Chrysotile asbestos detected Amosite asbestos detected Crocidolite asbestos detected Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected
Total Asbestos[#1]	g/kg	0.8930	10.4556	<0.1	0.1764	<0.1
Asbestos ID in soil <0.1g/kg*	-	Not applicable	Not applicable	Chrysotile Amosite	Not applicable	Chrysotile
ACM >7mm Estimation*	g	0.8290	9.1191	0.0000	0.1685	0.0000
FA and AF Estimation*	g	0.2025	0.3770	0.0045	0.0081	0.0048
FA and AF Estimation*[#2]	%(w/w)	0.0175	0.0415	<0.001	<0.001	<0.001

Asbestos ID - soils NEPM					
Our Reference:	UNITS	154059-11	154059-12	154059-13	154059-14
Your Reference	---------- -	SSP2/7	SSP2/8	SSP2/9	SSP2/10
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil
Date analysed	-	27-28/09/2016	27-28/09/2016	27-28/09/2016	27-28/09/2016
Sample mass tested	g	1196.82	1136.86	1037.47	968.64
Sample Description	-	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil (as per AS4964)	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected
Total Asbestos[#1]	g/kg	<0.1	<0.1	<0.1	<0.1
Asbestos ID in soil <0.1g/kg*	-	Chrysotile Crocidolite	Chrysotile	Chrysotile Amosite	Chrysotile
ACM >7mm Estimation*	g	0.0000	0.0000	0.0000	0.0000
FA and AF Estimation*	g	0.0047	0.0005	0.0296	0.0050
FA and AF Estimation*[#2]	%(w/w)	<0.001	<0.001	0.0029	<0.001

Total PCBs in Soil						
Our Reference:	UNITS	154059-1	154059-4	154059-5	154059-6	154059-7
Your Reference	----------	SSP1/9	SSP1/12	SSP2/1	SSP2/2	SSP2/3
	-					
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016	23/09/2016	23/09/2016
Total PCB (Arochlor 1016-1260)	mg/kg	1.5	1.8	1.3	1.4	0.8
Surrogate TCLMX	%	98	98	100	96	96

Total PCBs in Soil				
Our Reference:	UNITS	154059-8	154059-11	154059-15
Your Reference	----------	SSP2/4	SSP2/7	BD1/200916
	-			
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil
Date extracted	-	23/09/2016	23/09/2016	23/09/2016
Date analysed	-	23/09/2016	23/09/2016	23/09/2016
Total PCB (Arochlor 1016-1260)	mg/kg	0.8	0.6	0.8
Surrogate TCLMX	%	96	96	98

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. For soil results:- 1. 'TEQ PQL' values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'TEQ zero' values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'TEQ half PQL' values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-008	Moisture content determined by heating at 105+/-5 deg C for a minimum of 12 hours.
Inorg-036	Total Organic Matter - A titrimetric method that measures the oxidisable organic content of soils. Based upon Rayment and Lyons 2011 where TOM is estimated as = TOC * 1.724.
ASB-001	Asbestos ID - Identification of asbestos in soil samples using Polarised Light Microscopy and Dispersion Staining Techniques. Minimum 500mL soil sample was analysed as recommended by "National Environment Protection (Assessment of site contamination) Measure, Schedule B1 and "The Guidelines from the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia - May 2009" with a reporting limit of 0.1g/kg (0.01% w/w) as per Australian Standard AS4964-2004. Results reported denoted with * are outside our scope of NATA accreditation. **NOTE** #1 Total Asbestos g/kg was analysed and reported as per Australian Standard AS4964 (This is the sum of ACM >7mm, <7mm and FA/AF) **NOTE** #2 The screening level of 0.001% w/w asbestos in soil for FA and AF only applies where the FA and AF are able to be quantified by gravimetric procedures. This screening level is not applicable to free fibres.

Method ID	Methodology Summary
	Estimation = Estimated asbestos weight Results reported with "--" is equivalent to no visible asbestos identified using Polarised Light microscopy and Dispersion Staining Techniques.
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Date analysed	-			24/09/2016	154059-1	24/09/2016 || 24/09/2016	LCS-8	24/09/2016
TRHC$_6$ - C$_9$	mg/kg	25	Org-016	<25	154059-1	<25 || <25	LCS-8	123%
TRHC$_6$ - C$_{10}$	mg/kg	25	Org-016	<25	154059-1	<25 || <25	LCS-8	123%
Benzene	mg/kg	0.2	Org-016	<0.2	154059-1	<0.2 || <0.2	LCS-8	118%
Toluene	mg/kg	0.5	Org-016	<0.5	154059-1	<0.5 || <0.5	LCS-8	119%
Ethylbenzene	mg/kg	1	Org-016	<1	154059-1	<1 || <1	LCS-8	124%
m+p-xylene	mg/kg	2	Org-016	<2	154059-1	<2 || <2	LCS-8	126%
o-Xylene	mg/kg	1	Org-016	<1	154059-1	<1 || <1	LCS-8	126%
naphthalene	mg/kg	1	Org-014	<1	154059-1	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%		Org-016	109	154059-1	95 || 110 || RPD: 15	LCS-8	116%

QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Date analysed	-			26/09/2016	154059-1	24/09/2016 || 24/09/2016	LCS-8	26/09/2016
TRHC$_{10}$ - C$_{14}$	mg/kg	50	Org-003	<50	154059-1	<50 || <50	LCS-8	126%
TRHC$_{15}$ - C$_{28}$	mg/kg	100	Org-003	<100	154059-1	<100 || <100	LCS-8	126%
TRHC$_{29}$ - C$_{36}$	mg/kg	100	Org-003	<100	154059-1	<100 || <100	LCS-8	129%
TRH>C$_{10}$-C$_{16}$	mg/kg	50	Org-003	<50	154059-1	<50 || <50	LCS-8	126%
TRH>C$_{16}$-C$_{34}$	mg/kg	100	Org-003	<100	154059-1	<100 || <100	LCS-8	126%
TRH>C$_{34}$-C$_{40}$	mg/kg	100	Org-003	<100	154059-1	<100 || <100	LCS-8	129%
Surrogate o-Terphenyl	%		Org-003	80	154059-1	81 || 78 || RPD: 4	LCS-8	97%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Date analysed	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Naphthalene	mg/kg	0.1	Org-012	<0.1	154059-1	<0.1 || <0.1	LCS-8	104%
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	Org-012	<0.1	154059-1	<0.1 || <0.1	LCS-8	106%
Phenanthrene	mg/kg	0.1	Org-012	<0.1	154059-1	0.3 || 0.1 || RPD: 100	LCS-8	127%
Anthracene	mg/kg	0.1	Org-012	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	154059-1	0.4 || 0.2 || RPD: 67	LCS-8	110%
Pyrene	mg/kg	0.1	Org-012	<0.1	154059-1	0.4 || 0.2 || RPD: 67	LCS-8	111%
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	154059-1	0.2 || <0.1	[NR]	[NR]
Chrysene	mg/kg	0.1	Org-012	<0.1	154059-1	0.2 || 0.1 || RPD: 67	[NR]	[NR]
Benzo(b,j+k) fluoranthene	mg/kg	0.2	Org-012	<0.2	154059-1	0.3 || <0.2	[NR]	[NR]

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	154059-1	0.1 || 0.06 || RPD: 50	LCS-8	111%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012	97	154059-1	89 || 94 || RPD: 5	LCS-8	111%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Date analysed	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
HCB	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	117%
gamma-BHC	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	90%
Heptachlor	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	98%
delta-BHC	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	95%
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	94%
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	89%
Dieldrin	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	96%
Endrin	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	98%
pp-DDD	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	91%
Endosulfan II	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	LCS-8	88%
Methoxychlor	mg/kg	0.1	Org-005	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%		Org-005	121	154059-1	98 || 98 || RPD: 0	LCS-8	119%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Date analysed	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	LCS-8	94%
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Diazinon	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	LCS-8	96%
Dimethoate	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	LCS-8	96%
Fenitrothion	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	LCS-8	110%
Malathion	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	LCS-8	74%
Parathion	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	LCS-8	109%
Ronnel	mg/kg	0.1	Org-008	<0.1	154059-1	<0.1 || <0.1	LCS-8	101%
Surrogate TCMX	%		Org-008	121	154059-1	98 || 98 || RPD: 0	LCS-8	98%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/09/2016	[NT]	[NT]	LCS-8	23/09/2016
Date analysed	-			23/09/2016	[NT]	[NT]	LCS-8	23/09/2016
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	LCS-8	96%
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%		Org-006	121	[NT]	[NT]	LCS-8	98%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Date analysed	-			26/09/2016	154059-1	26/09/2016 || 26/09/2016	LCS-8	26/09/2016
Arsenic	mg/kg	4	Metals-020	<4	154059-1	9 || 7 || RPD: 25	LCS-8	110%
Cadmium	mg/kg	0.4	Metals-020	<0.4	154059-1	0.6 || 0.9 || RPD: 40	LCS-8	106%
Chromium	mg/kg	1	Metals-020	<1	154059-1	14 || 16 || RPD: 13	LCS-8	107%
Copper	mg/kg	1	Metals-020	<1	154059-1	34 || 56 || RPD: 49	LCS-8	109%
Lead	mg/kg	1	Metals-020	<1	154059-1	93 || 170 || RPD: 59	LCS-8	104%
Mercury	mg/kg	0.1	Metals-021	<0.1	154059-1	<0.1 || 0.1	LCS-8	92%
Nickel	mg/kg	1	Metals-020	<1	154059-1	7 || 14 || RPD: 67	LCS-8	101%
Zinc	mg/kg	1	Metals-020	<1	154059-1	170 || 290 || RPD: 52	LCS-8	103%

QUALITY CONTROL Misc Soil - Inorg	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD
Date prepared	-			27/09/2016	154059-1	23/09/2016 || 23/09/2016
Date analysed	-			27/09/2016	154059-1	27/09/2016 || 27/09/2016
Total Phenolics (as Phenol)	mg/kg	5	Inorg-031	<5	154059-1	<5 || <5

QUALITY CONTROL Misc Inorg - Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD
Date prepared	-			27/09/2016	154059-1	27/09/2016 || 27/09/2016
Date analysed	-			27/09/2016	154059-1	27/09/2016 || 27/09/2016
Organic Matter, Walkely Black	mg/kg	1000	Inorg-036	<1000	154059-1	32000 || 29000 || RPD: 10

QUALITY CONTROL Total PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Date analysed	-			23/09/2016	154059-1	23/09/2016 || 23/09/2016	LCS-8	23/09/2016
Total PCB (Arochlor 1016-1260)	mg/kg	0.6	Org-006	<0.6	154059-1	1.5 || 0.7 || RPD: 73	LCS-8	103%
Surrogate TCLMX	%		Org-006	121	154059-1	98 || 98 || RPD: 0	LCS-8	96%

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
Date analysed	-	154059-11	24/09/2016 || 24/09/2016	154059-2	24/09/2016
$TRHC_6 - C_9$	mg/kg	154059-11	<25 || <25	154059-2	114%
$TRHC_6 - C_{10}$	mg/kg	154059-11	<25 || <25	154059-2	114%

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Benzene	mg/kg	154059-11	<0.2 || <0.2	154059-2	103%
Toluene	mg/kg	154059-11	<0.5 || <0.5	154059-2	101%
Ethylbenzene	mg/kg	154059-11	<1 || <1	154059-2	113%
m+p-xylene	mg/kg	154059-11	<2 || <2	154059-2	127%
o-Xylene	mg/kg	154059-11	<1 || <1	154059-2	128%
naphthalene	mg/kg	154059-11	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%	154059-11	115 || 111 || RPD: 4	154059-2	106%
QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
Date analysed	-	154059-11	24/09/2016 || 24/09/2016	154059-2	24/09/2016
TRH C_{10} - C_{14}	mg/kg	154059-11	<50 || <50	154059-2	118%
TRH C_{15} - C_{28}	mg/kg	154059-11	<100 || <100	154059-2	108%
TRH C_{29} - C_{36}	mg/kg	154059-11	<100 || <100	154059-2	119%
TRH >C_{10}-C_{16}	mg/kg	154059-11	<50 || <50	154059-2	118%
TRH >C_{16}-C_{34}	mg/kg	154059-11	<100 || <100	154059-2	108%
TRH >C_{34}-C_{40}	mg/kg	154059-11	<100 || <100	154059-2	119%
Surrogate o-Terphenyl	%	154059-11	76 || 77 || RPD: 1	154059-2	88%
QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
Date analysed	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
Naphthalene	mg/kg	154059-11	<0.1 || <0.1	154059-2	107%
Acenaphthylene	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	154059-11	<0.1 || <0.1	154059-2	116%
Phenanthrene	mg/kg	154059-11	0.1 || <0.1	154059-2	129%
Anthracene	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	154059-11	0.3 || 0.2 || RPD: 40	154059-2	111%
Pyrene	mg/kg	154059-11	0.3 || 0.2 || RPD: 40	154059-2	108%
Benzo(a)anthracene	mg/kg	154059-11	0.1 || 0.1 || RPD: 0	[NR]	[NR]
Chrysene	mg/kg	154059-11	0.1 || 0.1 || RPD: 0	[NR]	[NR]
Benzo(b,j+k)fluoranthene	mg/kg	154059-11	0.3 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	154059-11	0.1 || 0.1 || RPD: 0	154059-2	123%
Indeno(1,2,3-c,d)pyrene	mg/kg	154059-11	0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	154059-11	0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d14	%	154059-11	90 || 95 || RPD: 5	154059-2	104%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
Date analysed	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
HCB	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	154059-11	<0.1 || <0.1	154059-2	119%
gamma-BHC	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	154059-11	<0.1 || <0.1	154059-2	92%
Heptachlor	mg/kg	154059-11	<0.1 || <0.1	154059-2	99%
delta-BHC	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	154059-11	<0.1 || <0.1	154059-2	89%
Heptachlor Epoxide	mg/kg	154059-11	<0.1 || <0.1	154059-2	93%
gamma-Chlordane	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	154059-11	<0.1 || <0.1	154059-2	89%
Dieldrin	mg/kg	154059-11	<0.1 || <0.1	154059-2	96%
Endrin	mg/kg	154059-11	<0.1 || <0.1	154059-2	98%
pp-DDD	mg/kg	154059-11	<0.1 || <0.1	154059-2	92%
Endosulfan II	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	154059-11	<0.1 || <0.1	154059-2	93%
Methoxychlor	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%	154059-11	96 || 98 || RPD: 2	154059-2	118%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
Date analysed	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
Azinphos-methyl (Guthion)	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Bromophos-ethyl	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	154059-11	<0.1 || <0.1	154059-2	88%
Chlorpyriphos-methyl	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Diazinon	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Dichlorvos	mg/kg	154059-11	<0.1 || <0.1	154059-2	92%
Dimethoate	mg/kg	154059-11	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	154059-11	<0.1 || <0.1	154059-2	97%
Fenitrothion	mg/kg	154059-11	<0.1 || <0.1	154059-2	110%
Malathion	mg/kg	154059-11	<0.1 || <0.1	154059-2	77%
Parathion	mg/kg	154059-11	<0.1 || <0.1	154059-2	115%
Ronnel	mg/kg	154059-11	<0.1 || <0.1	154059-2	101%
Surrogate TCMX	%	154059-11	96 || 98 || RPD: 2	154059-2	96%

QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	154059-2	23/09/2016
Date analysed	-	[NT]	[NT]	154059-2	23/09/2016
Aroclor 1016	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1221	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1232	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1242	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1248	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1254	mg/kg	[NT]	[NT]	154059-2	103%
Aroclor 1260	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%	[NT]	[NT]	154059-2	96%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	154059-11	23/09/2016 || 23/09/2016	154059-2	23/09/2016
Date analysed	-	154059-11	26/09/2016 || 26/09/2016	154059-2	26/09/2016
Arsenic	mg/kg	154059-11	7 || 6 || RPD: 15	154059-2	101%
Cadmium	mg/kg	154059-11	0.5 || 0.7 || RPD: 33	154059-2	98%
Chromium	mg/kg	154059-11	18 || 16 || RPD: 12	154059-2	102%
Copper	mg/kg	154059-11	52 || 49 || RPD: 6	154059-2	116%
Lead	mg/kg	154059-11	110 || 120 || RPD: 9	154059-2	105%
Mercury	mg/kg	154059-11	0.1 || 0.1 || RPD: 0	154059-2	99%
Nickel	mg/kg	154059-11	12 || 12 || RPD: 0	154059-2	98%
Zinc	mg/kg	154059-11	210 || 240 || RPD: 13	154059-2	#

QUALITY CONTROL Misc Soil - Inorg	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	154059-11	23/09/2016 || 23/09/2016	154059-2	27/09/2016
Date analysed	-	154059-11	27/09/2016 || 27/09/2016	154059-2	27/09/2016
Total Phenolics (as Phenol)	mg/kg	154059-11	<5 || <5	154059-2	98%
QUALITY CONTROL Total PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD		
Date extracted	-	154059-11	23/09/2016 || 23/09/2016		
Date analysed	-	154059-11	23/09/2016 || 23/09/2016		
Total PCB (Arochlor 1016-1260)	mg/kg	154059-11	0.6 || 0.8 || RPD: 29		
Surrogate TCLMX	%	154059-11	96 || 98 || RPD: 2		
QUALITY CONTROL Misc Soil - Inorg	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	LCS-1	27/09/2016
Date analysed	-	[NT]	[NT]	LCS-1	27/09/2016
Total Phenolics (as Phenol)	mg/kg	[NT]	[NT]	LCS-1	103%
QUALITY CONTROL Misc Inorg - Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	154059-12	27/09/2016 || 27/09/2016	LCS-1	27/09/2016
Date analysed	-	154059-12	27/09/2016 || 27/09/2016	LCS-1	27/09/2016
Organic Matter, Walkely Black	mg/kg	154059-12	16000 || 15000 || RPD: 6	LCS-1	96%

Report Comments:

Acid Extractable Metals in Soil: The laboratory RPD acceptance criteria has been exceeded for 154059-1 for Pb, Ni and Zn. Therefore a triplicate result has been issued as laboratory sample number 154059-17.

METALS_S: # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

PCB_S:
PQL has been raised due to interference from analytes(other than those being tested) in the sample/s.

Asbestos-ID in soil: NEPM
This report is consistent with the reporting recommendations in the National Environment Protection (Assessment of Site Contamination) Measure, Schedule B1, May 2013. This is reported outside our scope of NATA accreditation.

Asbestos ID was analysed by Approved Identifier:	Matt Mansfield
Asbestos ID was authorised by Approved Signatory:	Matt Mansfield

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NR: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

CHAIN OF CUSTODY

Douglas Partners
Geotechnics / Environment / Groundwater

Client:	Douglas Partners	Project Number: 71459.07	To: Envirolab Services
Contact Person:	John Russell	Project Name: Moorebank	Contact Person: Aileen Hie
Project Mgr:	JRR	PO No.:	Address: 12 Ashley Street
		lab Quote No. :	Chatswood NSW 2068
Address:	96 Hermitage Road West Ryde NSW 2114	Date results required: Or choose: standard *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*	Phone: 02 9910 6200 Fax: 02 9910 6201
Phone:	9809 0666 Mob: 0422 000 434	Report format: esdat / PDF / Excel	Email: ahie@envirolab.com.au
Email:	john.russell@douglaspartners.com.au	Comments:	Laboratory Report No:
			Lab Comments:

Sample information						Tests Required										Comments
Lab Sample ID	Field Sample ID	Depth	Date sampled	Container Type	Type of sample	metals	TRH/BTEX	PAH	OCP/OPP/PCB	Phenols	asbestos FA/AF	organic matter by titration				Combo	Provide as much information about the sample as you can
1	SSP1/9		20/09/2016	P/G	soil	X	X	X	X	X	X	X				8	
2	SSP1/10		20/09/2016	P/G	soil	X	X	X	X	X	X	X				8	
3	SSP1/11		20/09/2016	P/G	soil	X	X	X	X	X	X	X				8	
4	SSP1/12		20/09/2016	P/G	soil	X	X	X	X	X	X	X				8	
5	SSP2/1		20/09/2016	P/G	soil	X	X	X	X	X	X	X				8	
6	SSP2/2		20/09/2016	P/G	soil	X	X	X	X	X	X	X				8	
7	SSP2/3		20/09/2016	P/G	soil	X	X	X	X	X	X	X				8	
8	SSP2/4		20/09/2016	P/G	soil	X	X	X	X	X	X	X				8	
9	SSP2/5		20/09/2016	P/G	soil	X	X	X	X	X	X	X				8	
10	SSP2/6		20/09/2016	P/G	soil	X	X	X	X	X	X	X				8	
11	SSP2/7		20/09/2016	P/G	soil	X	X	X	X	X	X	X				8	
12	SSP2/8		20/09/2016	P/G	soil	X	X	X	X	X	X	X				8	
13	SSP2/9		20/09/2016	P/G	soil	X	X	X	X	X	X	X				8	
14	SSP2/10		20/09/2016	P/G	soil	X	X	X	X	X	X	X				8	
15	BD1/200916		20/09/2016	P/G	soil	X	X	X	X	X	X	X				8	
16	BD2/200916		20/09/2016	P/G	soil	X	X	X	X	X	X	X				8	

Relinquished by: Douglas Partners	Sample Receipt	*Lab use only:*
Courier (by whom)	Received by (Company): ENS	Samples Received: Cool or Ambient (circle one)
Condition of Sample at dispatch Cool or Ambient (circle)	Print Name: Dennis Frost	Temperature Received at: (if applicable)
Temperature (if Applicable):	Date & Time: 22/09/16 @ 13:00	Transported by: Hand delivered / courier
Print Name: John Russell	Signature:	
Date & Time: 22/09/16		
Signature:		

ENVIROLAB

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

No: 154059
Date Received: 22/09/16
Time Received: 13:00
Received by: D.F
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

SAMPLE RECEIPT ADVICE

Client Details	
Client	Douglas Partners Pty Ltd
Attention	John Russell

Sample Login Details	
Your Reference	71459.07, Moorebank
Envirolab Reference	**154059**
Date Sample Received	22/09/2016
Date Instructions Received	22/09/2016
Date Results Expected to be Reported	**29/09/2015**

Sample Condition	
Samples received in appropriate condition for analysis	YES
No. of Samples Provided	16 soils
Turnaround Time Requested	Standard
Temperature on receipt (°C)	12.6
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments
Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	Phone: 02 9910 6200
Fax: 02 9910 6201	Fax: 02 9910 6201
Email: ahie@envirolabservices.com.au	Email: jhurst@envirolabservices.com.au

Sample and Testing Details on following page

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

Sample Id	*vTRH(C6-C10)/BTEXN in Soil*	*svTRH (C10-C40) in Soil*	*PAHs in Soil*	*Organochlorine Pesticides in soil*	*Organophosphorus Pesticides*	*PCBs in Soil*	*Acid Extractable metals in soil*	*Total Phenolics (as Phenol)*	*Organic Matter, Walkely Black*	*Asbestos ID - soils NEPM*
SSP1/9	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP1/10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP1/11	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP1/12	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/7	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/9	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SSP2/10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BD1/200916	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BD1/200916	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

12 Ashley Street, Chatswood, NSW 2067
tel: +61 2 9910 6200

email: sydney@envirolab.com.au
envirolab.com.au

Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 154059-A

Client:
Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: John Russell

Sample log in details:

Your Reference:	**71459.07, Moorebank**
No. of samples:	Additional Testing on 16 Soils
Date samples received / completed instructions received	22/09/2016 / 30/09/16

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	10/10/16 / 10/10/16
Date of Preliminary Report:	Not Issued

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025 - Testing **Tests not covered by NATA are denoted with *.**

Results Approved By:

David Springer
General Manager

Metals in TCLP USEPA1311						
Our Reference:	UNITS	154059-A-1	154059-A-2	154059-A-3	154059-A-4	154059-A-5
Your Reference	---------- -	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	04/10/2016	04/10/2016	04/10/2016	04/10/2016	04/10/2016
Date analysed	-	04/10/2016	04/10/2016	04/10/2016	04/10/2016	04/10/2016
pH of soil for fluid# determ.	pH units	6.6	6.7	6.4	6.4	6.7
pH of soil TCLP (after HCl)	pH units	1.6	1.6	1.5	1.5	1.6
Extraction fluid used	-	1	1	1	1	1
pH of final Leachate	pH units	5.1	5.2	5.2	5.2	5.2
Arsenic in TCLP	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium in TCLP	mg/L	0.01	0.01	<0.01	0.01	0.01
Chromium in TCLP	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Copper in TCLP	mg/L	0.04	0.04	0.04	0.05	0.04
Lead in TCLP	mg/L	0.2	0.2	0.2	0.2	0.2
Mercury in TCLP	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Nickel in TCLP	mg/L	0.03	0.04	0.04	0.05	0.05
Zinc in TCLP	mg/L	2.9	3.1	2.5	3.8	3.6

Metals in TCLP USEPA1311						
Our Reference:	UNITS	154059-A-6	154059-A-7	154059-A-8	154059-A-9	154059-A-10
Your Reference	---------- -	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	04/10/2016	04/10/2016	04/10/2016	04/10/2016	04/10/2016
Date analysed	-	04/10/2016	04/10/2016	04/10/2016	04/10/2016	04/10/2016
pH of soil for fluid# determ.	pH units	6.5	6.4	6.6	6.6	6.6
pH of soil TCLP (after HCl)	pH units	1.6	1.5	1.6	1.6	1.6
Extraction fluid used	-	1	1	1	1	1
pH of final Leachate	pH units	5.3	5.3	5.6	5.2	5.1
Arsenic in TCLP	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium in TCLP	mg/L	0.01	0.01	0.01	0.01	<0.01
Chromium in TCLP	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Copper in TCLP	mg/L	0.04	0.04	0.04	0.03	0.03
Lead in TCLP	mg/L	0.3	0.2	0.1	0.09	0.07
Mercury in TCLP	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Nickel in TCLP	mg/L	0.04	0.04	0.05	0.04	0.03
Zinc in TCLP	mg/L	3.1	4.0	5.4	2.6	1.5

Metals in TCLP USEPA1311						
Our Reference:	UNITS	154059-A-11	154059-A-12	154059-A-13	154059-A-14	154059-A-15
Your Reference	----------	SSP2/7	SSP2/8	SSP2/9	SSP2/10	BD1/200916
	-					
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	04/10/2016	04/10/2016	04/10/2016	04/10/2016	04/10/2016
Date analysed	-	04/10/2016	04/10/2016	04/10/2016	04/10/2016	04/10/2016
pH of soil for fluid# determ.	pH units	6.6	6.6	6.5	6.7	6.6
pH of soil TCLP (after HCl)	pH units	1.6	1.5	1.5	1.5	1.5
Extraction fluid used	-	1	1	1	1	1
pH of final Leachate	pH units	5.4	5.2	5.2	5.3	5.2
Arsenic in TCLP	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium in TCLP	mg/L	0.01	<0.01	<0.01	<0.01	<0.01
Chromium in TCLP	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Copper in TCLP	mg/L	0.04	0.03	0.04	0.05	0.05
Lead in TCLP	mg/L	0.1	0.08	0.1	0.2	0.2
Mercury in TCLP	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Nickel in TCLP	mg/L	0.04	0.03	0.04	0.04	0.05
Zinc in TCLP	mg/L	2.9	1.5	2.3	2.2	2.7

Metals in TCLP USEPA1311		
Our Reference:	UNITS	154059-A-16
Your Reference	----------	BD2/200916
	-	
Date Sampled	----------	20/09/2016
Type of sample		Soil
Date extracted	-	04/10/2016
Date analysed	-	04/10/2016
pH of soil for fluid# determ.	pH units	6.8
pH of soil TCLP (after HCl)	pH units	1.6
Extraction fluid used	-	1
pH of final Leachate	pH units	5.3
Arsenic in TCLP	mg/L	<0.05
Cadmium in TCLP	mg/L	<0.01
Chromium in TCLP	mg/L	<0.01
Copper in TCLP	mg/L	0.03
Lead in TCLP	mg/L	0.2
Mercury in TCLP	mg/L	<0.0005
Nickel in TCLP	mg/L	0.04
Zinc in TCLP	mg/L	3.6

PAHs in TCLP (USEPA 1311)						
Our Reference:	UNITS	154059-A-1	154059-A-2	154059-A-3	154059-A-4	154059-A-5
Your Reference	---------- -	SSP1/9	SSP1/10	SSP1/11	SSP1/12	SSP2/1
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Date analysed	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Naphthalene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Acenaphthylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Acenaphthene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Fluorene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Phenanthrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Fluoranthene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Pyrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(a)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chrysene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(bjk)fluoranthene in TCLP	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Benzo(a)pyrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Dibenzo(a,h)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(g,h,i)perylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Total +ve PAH's	mg/L	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE
Surrogate p-Terphenyl-d14	%	123	100	115	119	116

PAHs in TCLP (USEPA 1311)						
Our Reference:	UNITS	154059-A-6	154059-A-7	154059-A-8	154059-A-9	154059-A-10
Your Reference	----------	SSP2/2	SSP2/3	SSP2/4	SSP2/5	SSP2/6
	-					
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Date analysed	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Naphthalene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Acenaphthylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Acenaphthene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Fluorene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Phenanthrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Fluoranthene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Pyrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(a)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chrysene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(bjk)fluoranthene in TCLP	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Benzo(a)pyrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Dibenzo(a,h)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(g,h,i)perylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Total +ve PAH's	mg/L	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE
Surrogate p-Terphenyl-d14	%	118	107	126	124	130

PAHs in TCLP (USEPA 1311)						
Our Reference:	UNITS	154059-A-11	154059-A-12	154059-A-13	154059-A-14	154059-A-15
Your Reference	---------- -	SSP2/7	SSP2/8	SSP2/9	SSP2/10	BD1/200916
Date Sampled	----------	20/09/2016	20/09/2016	20/09/2016	20/09/2016	20/09/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Date analysed	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Naphthalene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Acenaphthylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Acenaphthene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Fluorene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Phenanthrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Fluoranthene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Pyrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(a)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chrysene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(bjk)fluoranthene in TCLP	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Benzo(a)pyrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Dibenzo(a,h)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(g,h,i)perylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Total +ve PAH's	mg/L	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE	NIL (+)VE
Surrogate p-Terphenyl-d14	%	124	104	106	108	104

PAHs in TCLP (USEPA 1311)		
Our Reference:	UNITS	154059-A-16
Your Reference	----------	BD2/200916
	-	
Date Sampled	----------	20/09/2016
Type of sample		Soil
Date extracted	-	05/10/2016
Date analysed	-	05/10/2016
Naphthalene in TCLP	mg/L	<0.001
Acenaphthylene in TCLP	mg/L	<0.001
Acenaphthene in TCLP	mg/L	<0.001
Fluorene in TCLP	mg/L	<0.001
Phenanthrene in TCLP	mg/L	<0.001
Anthracene in TCLP	mg/L	<0.001
Fluoranthene in TCLP	mg/L	<0.001
Pyrene in TCLP	mg/L	<0.001
Benzo(a)anthracene in TCLP	mg/L	<0.001
Chrysene in TCLP	mg/L	<0.001
Benzo(bjk)fluoranthene in TCLP	mg/L	<0.002
Benzo(a)pyrene in TCLP	mg/L	<0.001
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	<0.001
Dibenzo(a,h)anthracene in TCLP	mg/L	<0.001
Benzo(g,h,i)perylene in TCLP	mg/L	<0.001
Total +ve PAH's	mg/L	NIL (+)VE
Surrogate p-Terphenyl-d14	%	126

PCBs in TCLP Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- - ----------	154059-A-1 SSP1/9 20/09/2016 Soil	154059-A-2 SSP1/10 20/09/2016 Soil	154059-A-3 SSP1/11 20/09/2016 Soil	154059-A-4 SSP1/12 20/09/2016 Soil	154059-A-5 SSP2/1 20/09/2016 Soil
Date extracted	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Date analysed	-	06/10/2016	06/10/2016	06/10/2016	06/10/2016	06/10/2016
Aroclor 1016	µg/L	<2	<2	<2	<2	<2
Aroclor 1221	µg/L	<2	<2	<2	<2	<2
Aroclor 1232	µg/L	<2	<2	<2	<2	<2
Aroclor 1242	µg/L	<2	<2	<2	<2	<2
Aroclor 1248	µg/L	<2	<2	<2	<2	<2
Aroclor 1254	µg/L	<2	<2	<2	<2	<2
Aroclor 1260	µg/L	<2	<2	<2	<2	<2
Surrogate TCLMX	%	134	128	135	138	129

PCBs in TCLP Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- - ----------	154059-A-6 SSP2/2 20/09/2016 Soil	154059-A-7 SSP2/3 20/09/2016 Soil	154059-A-8 SSP2/4 20/09/2016 Soil	154059-A-9 SSP2/5 20/09/2016 Soil	154059-A-10 SSP2/6 20/09/2016 Soil
Date extracted	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Date analysed	-	06/10/2016	06/10/2016	06/10/2016	06/10/2016	06/10/2016
Aroclor 1016	µg/L	<2	<2	<2	<2	<2
Aroclor 1221	µg/L	<2	<2	<2	<2	<2
Aroclor 1232	µg/L	<2	<2	<2	<2	<2
Aroclor 1242	µg/L	<2	<2	<2	<2	<2
Aroclor 1248	µg/L	<2	<2	<2	<2	<2
Aroclor 1254	µg/L	<2	<2	<2	<2	<2
Aroclor 1260	µg/L	<2	<2	<2	<2	<2
Surrogate TCLMX	%	130	126	129	137	132

PCBs in TCLP Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- - ----------	154059-A-11 SSP2/7 20/09/2016 Soil	154059-A-12 SSP2/8 20/09/2016 Soil	154059-A-13 SSP2/9 20/09/2016 Soil	154059-A-14 SSP2/10 20/09/2016 Soil	154059-A-15 BD1/200916 20/09/2016 Soil
Date extracted	-	05/10/2016	05/10/2016	05/10/2016	05/10/2016	05/10/2016
Date analysed	-	06/10/2016	06/10/2016	06/10/2016	06/10/2016	06/10/2016
Aroclor 1016	µg/L	<2	<2	<2	<2	<2
Aroclor 1221	µg/L	<2	<2	<2	<2	<2
Aroclor 1232	µg/L	<2	<2	<2	<2	<2
Aroclor 1242	µg/L	<2	<2	<2	<2	<2
Aroclor 1248	µg/L	<2	<2	<2	<2	<2
Aroclor 1254	µg/L	<2	<2	<2	<2	<2
Aroclor 1260	µg/L	<2	<2	<2	<2	<2
Surrogate TCLMX	%	118	126	123	135	137

PCBs in TCLP		
Our Reference:	UNITS	154059-A-16
Your Reference	----------	BD2/200916
	-	
Date Sampled	----------	20/09/2016
Type of sample		Soil
Date extracted	-	05/10/2016
Date analysed	-	06/10/2016
Aroclor 1016	µg/L	<2
Aroclor 1221	µg/L	<2
Aroclor 1232	µg/L	<2
Aroclor 1242	µg/L	<2
Aroclor 1248	µg/L	<2
Aroclor 1254	µg/L	<2
Aroclor 1260	µg/L	<2
Surrogate TCLMX	%	133

Method ID	Methodology Summary
Inorg-004	Toxicity Characteristic Leaching Procedure (TCLP) using in house method INORG-004.
EXTRACT.7	Toxicity Characteristic Leaching Procedure (TCLP).
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Org-012	Leachates are extracted with Dichloromethane and analysed by GC-MS.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.

QUALITY CONTROL Metals in TCLP USEPA1311	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			04/10/2016	154059-A-1	04/10/2016 || 04/10/2016	LCS-W1	04/10/2016
Date analysed	-			04/10/2016	154059-A-1	04/10/2016 || 04/10/2016	LCS-W1	04/10/2016
Arsenic in TCLP	mg/L	0.05	Metals-020 ICP-AES	<0.05	154059-A-1	<0.05 || <0.05	LCS-W1	116%
Cadmium in TCLP	mg/L	0.01	Metals-020 ICP-AES	<0.01	154059-A-1	0.01 || 0.01 || RPD: 0	LCS-W1	109%
Chromium in TCLP	mg/L	0.01	Metals-020 ICP-AES	<0.01	154059-A-1	<0.01 || <0.01	LCS-W1	108%
Copper in TCLP	mg/L	0.01	Metals-020 ICP-AES	<0.01	154059-A-1	0.04 || 0.04 || RPD: 0	LCS-W1	115%
Lead in TCLP	mg/L	0.03	Metals-020 ICP-AES	<0.03	154059-A-1	0.2 || 0.2 || RPD: 0	LCS-W1	107%
Mercury in TCLP	mg/L	0.0005	Metals-021 CV-AAS	<0.0005	154059-A-1	<0.0005 || <0.0005	LCS-W1	116%
Nickel in TCLP	mg/L	0.02	Metals-020 ICP-AES	<0.02	154059-A-1	0.03 || 0.03 || RPD: 0	LCS-W1	106%
Zinc in TCLP	mg/L	0.02	Metals-020 ICP-AES	<0.02	154059-A-1	2.9 || 2.8 || RPD: 4	LCS-W1	117%

QUALITY CONTROL PAHs in TCLP (USEPA 1311)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			05/10/2016	[NT]	[NT]	LCS-W1	05/10/2016
Date analysed	-			05/10/2016	[NT]	[NT]	LCS-W1	05/10/2016
Naphthalene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W1	78%
Acenaphthylene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Acenaphthene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Fluorene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W1	94%
Phenanthrene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W1	108%
Anthracene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Fluoranthene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W1	90%
Pyrene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W1	90%
Benzo(a)anthracene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Chrysene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Benzo(bjk)fluoranthene in TCLP	mg/L	0.002	Org-012	<0.002	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	LCS-W1	90%
Indeno(1,2,3-c,d)pyrene -TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene in TCLP	mg/L	0.001	Org-012	<0.001	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012	126	[NT]	[NT]	LCS-W1	97%

QUALITY CONTROL PCBs in TCLP	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			05/10/2016	[NT]	[NT]	LCS-W1	05/10/2016
Date analysed	-			06/10/2016	[NT]	[NT]	LCS-W1	06/10/2016
Aroclor 1016	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Aroclor 1221	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Aroclor 1232	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Aroclor 1242	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Aroclor 1248	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Aroclor 1254	µg/L	2	Org-006	<2	[NT]	[NT]	LCS-W1	82%
Aroclor 1260	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%		Org-006	71	[NT]	[NT]	LCS-W1	123%

QUALITY CONTROL Metals in TCLP USEPA1311	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	154059-A-13	04/10/2016 || 04/10/2016	154059-A-2	04/10/2016
Date analysed	-	154059-A-13	04/10/2016 || 04/10/2016	154059-A-2	04/10/2016
Arsenic in TCLP	mg/L	154059-A-13	<0.05 || <0.05	154059-A-2	113%
Cadmium in TCLP	mg/L	154059-A-13	<0.01 || <0.01	154059-A-2	101%
Chromium in TCLP	mg/L	154059-A-13	<0.01 || <0.01	154059-A-2	101%
Copper in TCLP	mg/L	154059-A-13	0.04 || 0.04 || RPD: 0	154059-A-2	110%
Lead in TCLP	mg/L	154059-A-13	0.1 || 0.1 || RPD: 0	154059-A-2	100%
Mercury in TCLP	mg/L	154059-A-13	<0.0005 || <0.0005	154059-A-2	122%
Nickel in TCLP	mg/L	154059-A-13	0.04 || 0.04 || RPD: 0	154059-A-2	98%
Zinc in TCLP	mg/L	154059-A-13	2.3 || 2.4 || RPD: 4	154059-A-2	102%

Report Comments:

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NR: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Aileen Hie

From: John Russell <John.Russell@douglaspartners.com.au>
Sent: Friday, 30 September 2016 10:59 AM
To: Ken Nguyen
Cc: Samplereceipt
Subject: RE: Results for Registration 154059 71459.07, Moorebank

Ken, 1-16

Can we please get the following additional testing done:

- TCLP for metals, PAH and PCB on all samples.

Envirolab Ref. 154059A
Due: 10/10/16
Std +1A.

Thanks,

John Russell | Associate
Douglas Partners Pty Ltd | ABN 75 053 980 117 | www.douglaspartners.com.au
96 Hermitage Road West Ryde NSW 2114 | PO Box 472 West Ryde NSW 1685
P: 02 9809 0666 | F: 02 9809 4095 | M: 0422 000 434 | E: John.Russell@douglaspartners.com.au

FINANCIAL REVIEW
CLIENT CHO
FINALIST

This email is confidential. If you are not the intended recipient, please notify us immediately and be aware that any disclosure, copying, distribution or use of the contents of this information is prohibited. Please note that the company does not make any commitment through emails not confirmed by fax or letter.

From: Ken Nguyen [mailto:KNguyen@envirolab.com.au]
Sent: Wednesday, 28 September 2016 6:56 PM
To: John Russell
Subject: Results for Registration 154059 71459.07, Moorebank

Please refer to attached for:
a copy of the Certificate of Analysis
a copy of the COC
an excel file containing the results

Please note that a hard copy will not be posted.

Enquiries should be made directly to:
sydney@envirolab.com.au

Regards

Envirolab Services
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
www.envirolabservices.com.au

Regards

Ken Nguyen | Chemist | Envirolab Services Pty Ltd

12 Ashley Street, Chatswood, NSW 2067
tel: +61 2 9910 6200

email: sydney@envirolab.com.au
envirolab.com.au

Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 158762

Client:
Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: John Russell

Sample log in details:

Your Reference:	**71459.07, Stockpile Sampling**
No. of samples:	12 soils
Date samples received / completed instructions received	08/12/2016 / 08/12/2016

This report replaces R00 due to the addition of report comments.

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	12/12/16 / 12/12/16
Date of Preliminary Report:	Not Issued

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025 - Testing **Tests not covered by NATA are denoted with *.**

Results Approved By:

David Springer
General Manager

RTA276 ENM* Foreign Material						
Our Reference:	UNITS	158762-1	158762-2	158762-3	158762-4	158762-5
Your Reference	----------	SSP1-B1	SSP1-B2	SSP2-1	SSP2-2	SSP2-3
Type of sample	- ----------	material	material	material	material	material
Date prepared	-	12/12/2016	12/12/2016	12/12/2016	12/12/2016	12/12/2016
Date analysed	-	12/12/2016	12/12/2016	12/12/2016	12/12/2016	12/12/2016
Sample Mass Tested	g	6,800	5,900	6,900	7,400	6,400
Foreign Material	%	1.3#	0.90#	0.74#	0.33#	0.95#

RTA276 ENM* Foreign Material						
Our Reference:	UNITS	158762-6	158762-7	158762-8	158762-9	158762-10
Your Reference	----------	SSP2-4	SSP2-5	SSP2-6	SSP2-7	SSP2-8
Type of sample	- ----------	material	material	material	material	material
Date prepared	-	12/12/2016	12/12/2016	12/12/2016	12/12/2016	12/12/2016
Date analysed	-	12/12/2016	12/12/2016	12/12/2016	12/12/2016	12/12/2016
Sample Mass Tested	g	5,700	6,700	6,300	7,100	5,400
Foreign Material	%	0.35#	0.36#	0.72#	0.31#	0.73#

RTA276 ENM* Foreign Material			
Our Reference:	UNITS	158762-11	158762-12
Your Reference	----------	SSP2-9	SSP2-10
Type of sample	- ----------	material	material
Date prepared	-	12/12/2016	12/12/2016
Date analysed	-	12/12/2016	12/12/2016
Sample Mass Tested	g	6,100	6,800
Foreign Material	%	0.54#	0.45#

Method ID	Methodology Summary
RTA276	RTA 276 - Modified to Environmental Operations (Waste) - 2005 General Exemption under Part 6, Clause 51A.
Inorg-080 ENM	This method is based on RTA T276 and as per NSW DECC Resource Recovery Exemption Guidelines and correspondence. It includes rubber, plastic, bitumen, paper, cloth, paint and wood (Note wood is construction timber only, naturally occuring wood/twigs/roots are excluded). RTA T276 requires at least 6kg of sample for this test.

Report Comments:

Foreign Material: #Indicates asbestos found, see below:

SSP1-B1(158762-1) Asphalt (including bitumen)plastic, timber.
57g Asbestos detected.

SSP1-B2(158762-2) plastic, timber and cloth
42g Asbestos detected.

SSP2-1(158762-3) plastic, timber and cloth
26g Asbestos detected.

SSP1-B2(158762-4) plastic, timber and cloth
55g Asbestos detected.

SSP2-3(158762-5) plastic, timber and cloth
19g Asbestos detected.

SSP2-4(158762-6) plastic, timber.
34g Asbestos detected.

SSP2-5(158762-7) plastic, timber and cloth
67g Asbestos detected.

SSP2-6(158762-8) plastic, timber,Asphalt (including bitumen)
12g Asbestos detected.

SSP7-7(158762-9) plastic, timber and cloth

SSP2-8(158762-10) plastic, timber and cloth
10g Asbestos detected.

SSP2-9(158762-11) plastic, timber.
34g Asbestos detected.

SSP2-10(158762-12) plastic, timber, cloth, Asphalt (including bitumen)
13g Asbestos detected.

Asbestos ID was analysed by Approved Identifier: Not applicable for this job
Asbestos ID was authorised by Approved Signatory: Not applicable for this job

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

CHAIN OF CUSTODY

Douglas Partners
Geotechnics | Environment | Groundwater

Client: Douglas Partners	Project Number 71459.07	To:	Envirolab Services
Contact Person: John Russell	Project Name: Stockpile Sampling	Contact Person:	Aileen Hie
Project Mgr: John Russell	PO No.:	Address:	12 Ashley Street
	lab Quote No. :		Chatswood NSW 2068
Address: 96 Hermitage Road West Ryde NSW 2114	Date results required: Standard Or choose: 24h *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*	Phone:	02 9910 6200
		Fax:	02 9910 6201
Phone: 9809 0666 Mob: 0422 000 434	Report format: esdat / PDF / Excel	Email:	ahie@envirolab.com.au
Email: John.Russell @douglaspartners.com.au Chris.Bagia @douglaspartners.com.au	Comments: Samples already held by Envirolab	Laboratory Report No:	
		Lab Comments:	

Sample information | **Tests Required** | **Comments**

Lab Sample ID	Field Sample ID	Depth	Date sampled	Container Type	Type of sample	Foreign Materials (Aggregates)										Combo	Provide as much information about the sample as you can
1	SSP1-B1	-	23/09/2016	BULKBAG	S	X											
2	SSP1-B2	-	23/09/2016	BULKBAG	S	X											
3	SSP2-1	-	23/09/2016	BULKBAG	S	X											
4	SSP2-2	-	23/09/2016	BULKBAG	S	X											
5	SSP2-3	-	23/09/2016	BULKBAG	S	X											
6	SSP2-4	-	23/09/2016	BULKBAG	S	X											
7	SSP2-5	-	23/09/2016	BULKBAG	S	X											
8	SSP2-6	-	23/09/2016	BULKBAG	S	X											
9	SSP2-7	-	23/09/2016	BULKBAG	S	X											
10	SSP2-8	-	23/09/2016	BULKBAG	S	X											
11	SSP2-9	-	23/09/2016	BULKBAG	S	X											
12	SSP2-10	-	23/09/2016	BULKBAG	S	X											

ENVIROLAB

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 158762
Date Received: 8/12/16
Time Received: 16:00
Received by: SZ
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Relinquished by: Douglas Partners	Sample Receipt	*Lab use only:*
Hand delivered / Courier (by whom)	Received by (Company): ENS	Samples Received: Cool or Ambient (circle one)
Condition of Sample at dispatch Cool or Ambient (circle)	Print Name: Kevin Wong	Temperature Received at: (if applicable)
Temperature (if Applicable):	Date & Time: 8/12/16 15:00	Transported by: Hand delivered / courier
Print Name: Christopher Bagia	Signature: SZ	
Date & Time:		
Signature:		

Appendix I

J&K (2016b)

J&K (2017)

EMAIL

JK Geotechnics
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

PO Box 976, North Ryde BC NSW 1670
115 Wicks Rd, Macquarie Park NSW 2113
Tel: 02 9888 5000 Fax: 02 9888 5003
www.jkgeotechnics.com.au

To: **Ern Dupere**

Of: **Benedict**

Email: **ern@benedict.com.au**

Ref No: **26903Zemail3** **Date:** **22 August 2016**

From: **Agi Zenon**

Cc: **John.Russell@douglas.com.au**

Re: **Response to RAP Comments**

We refer to the geotechnical comments made by Dr Ian Swane in his review of the RAP (prepared by Douglas Partners) and comment as follows:

Item 13 (Section 11: Geotechnical Improvement)

Rereading our report in light of the comments has indicated that the intent of our recommendations is not clear.

As stated in Section 7.4.3 *"Site Classification of Footings"* of our report, following the recommended geotechnical site improvement/remediation works, we expect that differential movements across individual residential lots will be no higher than those associated with a 'Class H1' or possibly 'Class H2' site.

The final design classification will depend on the nature and composition of the 'engineered fill' earthworks.

Although crushed sandstone has been recommended for the engineered fill, material breakdown can sometimes occur, which affects shrink-swell properties. The further geotechnical investigation is required following completion of the engineered fill, to confirm whether material breakdown has occurred to the extent that the site classification has increased from the predicted 'H1' to 'H2'. This further investigation would be limited to the upper 2m to 2.5m of the engineered fill.

The further geotechnical investigation will also allow sampling for laboratory CBR testing of the upper engineered fill to confirm the parameters for final pavement design.

Item 27 (New Section 15.4: Remediation Acceptance Criteria – Geotechnical)

The following are the acceptance criteria for the geotechnical operations which are required on the site:

(i) Proof-roll the base of the proposed 'backfill' areas in accordance with the criteria indicated in AS2798 (Section 5.5: Test Rolling).

(ii) 'Backfill' to be carried out as follows:

- The excavated material can be used as backfill subject to approval by the geotechnical engineer prior to, and on completion of, sorting to remove deleterious matter and to remove particle sizes greater than 75mm. The approved material can then be placed in layers not greater than 200mm loose thickness and compacted to a density between 95% and 97% of SMDD. If clayey materials are used, the compacted moisture content should be within 2% of SOMC. Compaction may be carried out in thicker layers using larger particle sizes, subject to confirmation that the required density can be achieved through the full layer thickness. Over compaction should be avoided as this would result in too much of a contrast between the 'existing fill' and the 'backfill' with associated large differential settlements over short horizontal distances. Similarly, under-compaction is undesirable as the creep settlement within the 'backfill' will increase and may also result in larger differential settlements.
- Particular care is required to achieve edge compaction where access for rollers is difficult. Benching the sides of the excavation will facilitate edge compaction.
- The backfill must be subjected to Level 1 testing, carried out at the frequency indicated in AS32798 for the volume of fill involved. The Geotechnical Testing Authority should be engaged directly on behalf of the client and not as part of the earthworks contractor.

(iii) High Energy Impact Compaction (HEIC) acceptance criteria, based on initial field trials:

Settlement: average compaction settlement 3mm or less.

Uniformity: Soil response based on Continuous Impact Response technology (medium or better).

(iv) 'Engineered Fill' to be carried out as follows:

- The site should be backfilled using select material to achieve the design surface grades, with an 'engineered fill' blanket being no less than 3m thick. The 'engineered fill' should comprise a well graded granular material (such as ripped or crushed sandstone), which is free of deleterious substances, and has a maximum particle size of 75mm. The fill should be compacted in layers of not greater than 200mm loose thickness, to a minimum density of 98% SMDD. Compaction may be carried out in thicker layers using larger particle sizes, subject to confirmation that the required density can be achieved through the full layer thickness.

- Level 1 density testing should be carried out at the frequency indicated in AS3798 to confirm that the above specifications have been achieved. Preferably the Geotechnical Technical Authority should be engaged directly on behalf of the client and not as part of the earthworks contract.

Item 11 (Section 11: Geotechnical Site Improvements)

a) The value of 1.8% creep settlement rate which was adopted is based on information available in the literature, taking into account the age of the fill. Douglas Partners in their report dated November 2015, adopted a similar creep settlement rate value of 2%.

b) Based on the borehole logs which were presented in our report, materials in sufficient quantity were not identified, to indicate that degradation of waste, material collapse or liquidation would be an issue. Also, the infiltration of surface water would be minimal if at all, due to the presence of the 3m thick 'engineered fill' capping layer.

c) The surcharge value of 70kPa was estimated by assessing the volume and load spread of existing stockpiles on site as shown on the survey plan and examination of a number of historical aerial photographs.

d) The effects of creep settlements from two types of fill (ie. existing fill and backfill) settling at different rates, could not be modelled directly by a computer analysis. In order to model the differential settlements across the site, we estimated the creep settlement of the two fills at regular time intervals using the relationship presented in our report. For each time interval, we then adopted a modulus value for each of the fills which would result in the same settlement as that estimated for the creep. These moduli were then used in a computer analysis. The differential settlements between the two fills were then estimated at each time interval, taking the 'bridging effect' of the 'engineered fill' capping layer into account. The maximum differential settlement across an individual lot was selected on this basis.

   The reference in our report to parameters being adjusted until the settlements were with 10% of those expected, refers to expected settlements based on analysis and adjustment of parameters in order to model the differential settlements between two fills in different stages of their settlement cycles as indicated above.

e) The section shown in Figure 3 is the 'existing fill' and 'engineered fill' capping layer. Although the 'backfill' areas are not shown, they were analysed. Figure 3 will be updated to show the 'backfill' areas.

f) We note that the prediction of creep settlements for both the 'existing fill' and the 'backfill' adopted the same methodology as that used by Douglas Partners in their report dated November 2015. The total settlement was different as we considered any elastic or consolidation settlements to have already occurred due to the applied stockpile loads and that the stockpile

loads will in effect be replaced by the ‘engineered fill’ capping layer, thus not increasing the overall applied loads.

We can revise the relevant sections of our report to more clearly reflect the actual analyses carried out and the intent of the provided recommendations.

Should you require further information please do not hesitate to contact the undersigned.

Regards
For and on behalf of
JK GEOTECHNICS



Agi Zenon
Principal I Geotechnical Engineer

REPORT

TO
BENEDICT INDUSTRIES PTY LTD

ON
GEOTECHNICAL EVALUATION

FOR
PROPOSED RESIDENTIAL SUBDIVISION

AT
146 NEWBRIDGE ROAD, MOOREBANK, NSW

22 March 2017
Ref: 26930Zrpt Rev5

JK Geotechnics
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

PO Box 976, North Ryde BC NSW 1670
Tel: 02 9888 5000 Fax: 02 9888 5003
www.jkgeotechnics.com.au

Jeffery & Katauskas Pty Ltd, trading as JK Geotechnics ABN 17 003 550 801

Date: 22 March 2017
Report No: 26930Zrpt
Revision No: 5

Report prepared by:



Agi Zenon
Principal I Geotechnical Engineer

For and on behalf of
JK GEOTECHNICS
PO Box 976
NORTH RYDE BC NSW 1670

© Document Copyright of JK Geotechnics.

This Report (which includes all attachments and annexures) has been prepared by JK Geotechnics (JKG) for its Client, and is intended for the use only by that Client.

This Report has been prepared pursuant to a contract between JKG and its Client and is therefore subject to:

a) JKG's proposal in respect of the work covered by the Report;

b) the limitations defined in the Client's brief to JKG;

c) the terms of contract between JK and the Client, including terms limiting the liability of JKG.

If the Client, or any person, provides a copy of this Report to any third party, such third party must not rely on this Report, except with the express written consent of JKG which, if given, will be deemed to be upon the same terms, conditions, restrictions and limitations as apply by virtue of (a), (b), and (c) above.

Any third party who seeks to rely on this Report without the express written consent of JKG does so entirely at their own risk and to the fullest extent permitted by law, JKG accepts no liability whatsoever, in respect of any loss or damage suffered by any such third party.

At the Company's discretion, JKG may send a paper copy of this report for confirmation. In the event of any discrepancy between paper and electronic versions, the paper version is to take precedence. The USER shall ascertain the accuracy and the suitability of this information for the purpose intended; reasonable effort is made at the time of assembling this information to ensure its integrity. The recipient is not authorised to modify the content of the information supplied without the prior written consent of JKG.

TABLE OF CONTENTS

1 INTRODUCTION 1

2 BACKGROUND 1

3 SITE DESCRIPTION 1

4 EVALUATION METHODOLOGY 2
- 4.1 JKG Investigation 2
- 4.2 DP Investigation 3
- 4.3 Landpac High Energy Impact Compaction 3

5 INVESTIGATION RESULTS 4
- 5.1 Subsurface Conditions 4
- 5.2 Results of HEIC 5

6 COMPUTER MODELLING AND ANALYSES 6
- 6.1 Settlement of Deep Fill 7
  - 6.1.1 Sources of Settlement 7
  - 6.1.2 Total and Different Settlement 9
- 6.2 Geotechnical Model 10
- 6.3 Applied Loads 10
- 6.4 Model Parameters and Stages 11
- 6.5 Analyses Results 12

7 COMMENTS AND RECOMMENDATIONS 13
- 7.1 Geotechnical Issue 13
- 7.2 Site Improvement 13
- 7.3 Batter Slopes 15
- 7.4 Proposed Subdivision Works 16
  - 7.4.1 Buried Services and Detailed Excavations 16
  - 7.4.2 Pavements 16
  - 7.4.3 Site Classification and Footings 17
- 7.5 Further Geotechnical Investigation 17
- 7.6 Further Geotechnical Input 18

8 GENERAL COMMENTS 18

STS TABLE A: MOISTURE CONTENT, ATTERBERG LIMITS & LINEAR SHRINKAGE TEST REPORT
STS TABLE B: FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT
STS TABLE C: PARTICLE SIZE DISTRIBUTION TEST REPORT
BOREHOLE LOGS JK1 TO JK16
CONE PENETROMETER TEST RESULTS (2, 8 AND 14)
FIGURE 1: BOREHOLE LOCATION PLAN
FIGURE 2: FILL DEPTH CONTOUR PLAN
REPORT EXPLANATION NOTES
APPENDIX A: AERIAL PHOTOGRAPHS BETWEEN 1991 AND 2015
APPENDIX B: DOUGLAS PARTNERS TEST LOCATIONS AND TEST RESULTS (PROJECT 30410, DATED 30 MAY 2002)
APPENDIX C: LANDPAC HEIC REPORT
APPENDIX D: NUMERICAL ANALYSES OUTPUT

1 INTRODUCTION

This report presents the results of a geotechnical evaluation of 146 Newbridge Road, Moorebank for residual subdivision purposes. This evaluation has been carried out for Benedict Industries Pty Ltd and supersedes our earlier report (Ref 26930Zrpt Rev3) dated 22 April 2016.

We understand that the site has been rezoned from rural to medium density residential (R3). We have been provided with preliminary unreferenced civil drawings prepared by John Daly & Associates including sewer and road plans and long sections.

The purpose of the evaluation was to obtain geotechnical information on subsurface conditions as a basis for remediation/improvement options, footings, pavements and buried services.

2 BACKGROUND

A study of aerial photographs indicates that the site was previously a low lying bushland area prone to flooding. The photographs since 1943 indicate that the area was used for grazing and was occupied at various stages by small isolated sheds. We understand that between about 1980 and 1990, the site levels were raised using 'non putrefiable' waste. From 1991 to 2016, the site had been used as a sand washing and inert waste processing facility which included some buildings, sheds and a weighbridge. Aerial photographs between 1991 and 2015 (copies presented in Appendix A) indicate that many stockpiles occupied different portions of the site at various times.

3 SITE DESCRIPTION

The site is located in the relatively flat alluvial topography associated with the Georges River. The site itself has an irregular plan shape, covers an area of approximately 9.5 hectares, and has a northern frontage onto Newbridge Road.

At the time of the investigation, the site was occupied by numerous stockpiles. The stockpiles were of varying size and mainly consisted of sand, but also gravel and glass. The provided survey plan (Ref 32825, dated 22/08/13) prepared by Matthew Freeburn, shows that the stockpiles at the time of the survey were up to 16m high. A fibro house and shed were located over the north-eastern portion of the site adjacent to Newbridge Road. Over the centre of the site were two, two storey metal sheds, several containers, and a weighbridge with an adjacent office.

The site appeared to have been built up from natural, with the access road ramping up off Newbridge Road, and batters along the southern, eastern and western site boundaries sloping at between approximately 25° and 40° down to the neighbouring ground.

The Georges River is located a short distance to the east and Governor Macquarie Drive is located a short distance to the west. Immediately beyond the western site boundary is a creek containing standing water. A lake or dam is located immediately to the south. Vacant land is located to the east.

4 EVALUATION METHODOLOGY

Our geotechnical evaluation of the site has been based on investigations carried out by us (JKG) and complemented by work carried out by EIS, Douglas Partners (DP) and Landpac, all working for Benedicts.

4.1 JKG Investigation

The fieldwork for the subsurface investigation was carried out between 18 and 25 October 2012, and comprised the auger drilling of 16 boreholes (JK1 to JK16) to depths between 7.95m and 12m, using our truck mounted JK350 and JK500, and our track mounted JK305 rigs. In addition, three Electrical Friction Cone Penetrometer (EFCP) tests (2, 8 and 14) were carried out at the JK2, JK8 and JK14 locations, to depths between 5.55m and 22.27m. The test locations, as indicated on attached Figure 1, were set out using hand held GPS instrumentation, and are therefore approximate. The surface reduced levels (RLs) at the test locations, were estimated by interpolation between spot heights and ground contours shown on the provided survey plan, and are therefore also approximate. The survey datum is the Australian Height Datum (AHD).

The nature and composition of the subsoils were assessed by logging the materials recovered during drilling and by interpretation of the EFCP test results. The strength/density of the subsoils was assessed from the Standard Penetration Test (SPT) 'N' number augmented by hand penetrometer readings on clayey samples recovered from the SPT split tube sampler, and by interpretation of the EFCP test results. Groundwater observations were made during, on completion, and a short period after completion of drilling individual boreholes. Standpipes or monitoring wells were installed into JK1, JK7, JK9 and JK16, and allowed longer term groundwater monitoring.

Our geotechnical engineers were present full time on site during the fieldwork and set out the test locations, nominated sampling and testing, and logged the subsurface profile. The borehole logs and EFCP test results are attached to this report together with a glossary of logging terms and symbols used.

Selected soil samples were recovered from the boreholes and submitted to a NATA registered laboratory (Soil Test Services Pty Ltd) for moisture content, Atterberg Limits, linear shrinkage, Standard compaction, four-day soaked CBR testing, and particle size distribution testing. The test results are summarised in attached STS Tables A to C.

4.2 DP Investigation

The fieldwork for the subsurface investigation was undertaken in September 2015 and included Cone Penetration Tests (same as the JKG EFCP test) at 10 locations (CPT301 to CPT310) to maximum depths of approximately 20m. Most of the CPTs encountered obstructions in the filling at shallow depths. When an obstruction was encountered, the test location was generally moved slightly and repeated. In total, there were 28 attempts to penetrate the filling at 10 locations. Only two CPTs penetrated through the filling and tested the underlying material, which is a 7% success rate.

The depths to groundwater were recorded upon extraction of the CPT rods.

The test locations and test results are presented in Appendix B.

4.3 Landpac High Energy Impact Compaction

It was fairly obvious and was also recommended in our earlier report dated 17 December 2013, that some form of structural remediation of the site would be required.

To this end, a trial of high energy impact compaction (HEIC) was carried out on the site by Landpac. Two trial areas were selected, referred to as Area A near Newbridge Road where the filling was relatively shallow, and Area B near the south-western corner of the site where the filling was significantly deeper.

Trial Areas A and B were subjected to 40 passes of a three sided roller. The methodology and evaluation of results is presented in the Landpac report included in Appendix C.

DP carried out CPTs in the test areas following completion of the HEIC in an attempt to assess the depth of improvement. These tests were of limited use due to premature refusal.

5 INVESTIGATION RESULTS

5.1 Subsurface Conditions

The 1:100,000 geological map of Penrith indicates that the site is underlain by fluvial deposits possibly over Ashfield Shales. Reference should be made to the attached borehole logs and EFCP logs for detailed subsurface conditions at specific locations. A summary of the subsurface conditions as encountered is presented below:

- Asphaltic concrete (AC) paving 150mm and 160mm thick was encountered at the surface of JK3 and JK7, respectively. A concrete pavement 50mm thick was encountered at the surface of JK6.
- Fill underlies the site to depths between 0.5m and 11.5m. A plan showing contours of fill depth is presented in Figure 2. These contours are not dissimilar to the contours determined by DP following inclusion of their investigation results. The fill varied erratically in composition (silty sand, silty clay, sandy clay, clayey sand, gravel, etc) and density (from poorly to well compacted), and contained inclusions of gravel and concrete, brick, plastic, ash, metal and timber fragments. The compaction of the fill generally appeared to reduce with depth.
- Natural silty and sandy clays underlay the fill. These clays were generally of high plasticity and varied in strength from stiff to hard. However, soft clays were also encountered.
- Sand deposits often underlay the clays and were loose to dense. However, very dense sand and very loose sand was also encountered.
- Based on the EFCP refusals at JK2 and JK8, bedrock has been inferred at depths of 17.2m and 22.3m, respectively.
- A few hours to several days following completion of drilling individual boreholes, groundwater levels were measured at depths between 1.5m (JK1) and 5.6m (JK9). The groundwater surface varied between RL0.5m (JK1) and RL2.7m (JK7). The groundwater surface appeared to slope down towards the north-east.
- The laboratory Atterberg Limits and particle size distribution tests confirmed the field classification of the soils. The plastic limit and linear shrinkage test results indicated that the sampled silty clays generally had a moderate shrink-swell reactivity.

- Four day soaked CBR values of 5% and 8% are indicated, based on the samples being compacted to 98% Standard Maximum Dry Density (SMDD) and within 2% of Standard Optimum Moisture Content (SOMC).

5.2 Results of HEIC

The results of the HEIC trial indicated that after 40 passes of HEIC, the near surface profile appeared to have been compacted in both areas based on the low to medium results of the 'continuous impact response'. Landpac's report is included in Appendix C.

The measured settlements (obtained by GPS methods) indicate an average settlement of 63mm for Area A and 60mm for Area B. The range of settlement, however, indicated that the settlement for Area A ranged from less than 20mm to 200mm with some minor areas up to 300mm. Area B had a similar range of settlement. The difference in settlements was often over a short distance and was not 'uniform' across the trial area.

HEIC is generally effective for a depth of about 1m to 2m for clayey material which appears to make up most of the filling material. Therefore, it could be expected that HEIC has created a compacted layer of approximately 1m to 2m thick across the trial area. However, the filling beneath the 'compacted layer' is expected to have not been noticeably affected by the HEIC. This was confirmed to a certain extent by the post HEIC CPT attempted by DP.

Landpac concluded that the HEIC provided a relatively uniform subgrade over the trial areas, except for one localised area in Area A.

6 COMPUTER MODELLING AND ANALYSES

Finite element (FE) analyses were carried out in an attempt to estimate the settlements which will affect the buildings and structures associated with the proposed subdivision as a result of the existing fill and the proposed remediation/improvement operations.

During discussions with the project civil and structural engineers, it was agreed that a blanket 3m deep of engineered fill is required across the entire site to allow for the laying of buried services and the installation of shallow piles in ‘stable’ material.

Further, methane ‘hotspots’ have been detected by the project environmentalists and these are being treated by excavating down into or through the fill to remove organics (generally buried timber) to the extent that methane is no longer an issue.

We have recommend that excavations be backfilled under our direction. Details on the backfill methodology for both the excavations and the blanket are provided in Section 7 below.

In the following sections of this report, we have distinguished the different fills by referring to the original fill as ‘existing fill’. The fill used to backfill excavations following the removal of organic material as ‘backfill’ and the 3m blanket of fill to be placed over the site as ‘engineered fill’.

The FE analyses were carried out using a two dimensional (2D) computer program PLAXIS. A typical long section through the site was prepared from the results of the survey, subsurface investigation results and the latest civil drawings, and staged 2D modelling was completed as detailed in Section 6.4 below. The estimated total settlements and differential settlements are reported in Section 6.5 below.

6.1 Settlement of Deep Fill

6.1.1 Sources of Settlement

The sources that contribute to the total long term settlement of deep fills include consolidation, creep, inundation (also known as hydro-consolidation or collapse) and elastic settlements. In the case of landfill, total settlement may also include decomposition. These different sources are discussed below.

Consolidation

Consolidation settlements result from the self-weight of the fill, and any subsequent surcharge loads, and occur in fine grained soils due to dissipation of excess pore pressures. This settlement will effectively be complete a relatively short period following fill placement and/or surcharge application.

Creep Settlement

Creep settlement is a long term settlement which occurs over the life of the fill, even under constant stress (surcharge load) and moisture content. Creep settlements occur due to the gradual rearrangement of the soil particles as a result of failure of their contact points both in granular and clayey soils. The magnitude of creep settlements is a function of the composition, thickness, compaction, and stress history of the fill.

Although they continue over the long term, creep settlements reduce with time relative to a log cycle of time, as follows:

$$\textit{Creep settlement} = \alpha \times \textit{fill thickness (m)} \times \log\left(\frac{t_2}{t_1}\right)$$

Where α = *creep settlement rate*

Time $t_2 > t_1$

Based on available literature, the creep settlement rate (α) for landfill material is in the order of 1% to 15% of the fill thickness per log cycle of time. However, based on the age of the subject landfill of about 30 years, the surcharge to which it has been subjected during the operation of the washing and processing facility over the last about 20 years, and the nature of fill encountered during the investigations, we have adopted a creep settlement rate for the 'existing fill' of 3% of the fill thickness per log cycle of time. The creep settlement rate was reduced by 40 percent to 1.8% to take into account the effect of surcharge, as suggested in the literature. This 1.8% creep settlement rate is consistent with the 2% creep settlement rate adopted by DP in their estimation of fill settlement.

For compacted clay fill, the literature indicates that creep settlement rate is generally in the range of 0.2% to 0.5% of the fill thickness per log cycle of time. Therefore, on this basis and considering the nature of the proposed ‘backfill’ and ‘engineered fill’, we have adopted a creep settlement rate for these more recent fills to be in the order of 0.5% of fill thickness over a log cycle of time.

Inundation Settlement

Additional settlement of deep fill can occur when the fill is inundated from a rise in the groundwater table. Given the site setting and the period of about 30 years since the fill was placed, inundation settlement is not considered to be applicable.

Elastic Settlement

The proposed ‘engineered fill’ surcharge and the proposed subdivision loads would cause the ‘existing fill’ and ‘backfill’ to settle elastically (ie. shortly after the load is applied).

Decomposition Settlement

Settlement due to decomposition of organics present in subsoils can occur.

Although significant organics were removed from the ‘existing fill’ in the methane hotspot areas, we consider that it is those very organics causing the high methane. In the overall ‘existing fill’, we have assumed an organic content of about 5% (ie. higher than the organics measured by DP (the project environmentalist) in the ‘existing fill’ after selection and blending for use as ‘backfill’. As the organics are expected to be spread throughout the ‘existing fill’ mass and given their age, we do not expect that they will be significant relative to the ongoing creep settlement of the ‘existing fill’ nor are they expected to affect likely differential settlements. Further, we anticipate that the creep settlement recommended for landfills includes an element of decomposition.

The presence of organics has therefore been ignored in our analyses.

6.1.2 Total and Different Settlement

Based on the aerial photographs, we have estimated that the average load applied to the 'existing fill' over the last 20 years by the stockpiles associated with the washing and processing operations to be about 70kPa.

The loads imposed by the proposed 3m thick 'engineered fill' and the proposed subdivision have been estimated to be 60kPa and 5kPa, respectively.

Based on the above, therefore, the surcharge (ie. past and future) on the 'existing fill' for the purposes of our analyses has been assumed to be constant, other than for the construction period. The construction period includes the period during which the stockpiles are removed, the 'engineered fill' is placed, and the subdivision (including buildings and structures) completed. During the construction period, the surcharge load is reduced and gradually reapplied. This will have the effect of stiffening the 'existing fill' or reducing the magnitude of total settlement (due to rebound), but has been ignored in the analyses.

The proposed 'backfill' will be placed immediately prior to the construction period.

It can thus be seen from the above that the total settlement which occurs in the 'existing fill' will be due to the assumed constant surcharge load, with the period of interest being from the end of the construction period, say, year 2019 and, say, a 50 year life of the buildings (ie. to the year 2069). With respect to the age of the 'existing fill', 2019 corresponds to t_1=28, and 2069 corresponds to t_2=78 in the equation presented in Section 6.1.1 above.

The total settlement which will occur in the 'backfill' will be due to the same loads and time period described above, but at a different stage of the time cycle relative to the age of the 'backfill'. The year 2019 will correspond with t_1=0.5, and year 2069 will correspond with t_2=50.

Settlement of the natural soils underlying the 'existing fill' will be minor as the settlement would have taken place not long after the surcharge due to the stockpiles was placed and the surcharge has remained, for all intense and purposes, constant since and going forward. However, for the sake of completeness, we have taken elastic settlement of the natural sand and creep settlement of the natural clay into account. There will be some minor elastic settlement of the 'engineered fill' due to the self-weight and subdivision surcharge. However, given the relatively light subdivision load, the shallow depth of the 'engineered fill' and the relatively high compacted density of the engineered

fill, the resulting settlements are insignificant relative to the creep settlement of the underlying 'existing fill' and 'backfill'.

6.2 Geotechnical Model

In order to assess the total and differential settlement at the surface of the subdivision site, a geotechnical model was prepared. A long section through the site (refer Figure 3, Appendix D) presents a summary of the geotechnical model assumed, based on borehole and CPT information. This geotechnical model was used in our numerical analysis.

The model divides the subsurface profile into a number of soil units. Geotechnical parameters were selected for each unit based on the borehole and CPT information, available literature and case studies.

Groundwater has been included in our analysis and was assumed to be between RL0.5m to RL3.0m along the length of the analysed section. This is based on the standing water levels encountered during our investigation.

6.3 Applied Loads

As stated above, we have used the aerial photographs to roughly estimate that a surcharge load of 70kPa was applied at the surface of the landfill for a period of 20 years due to the presence of the stockpiles during the operational life of the site.

The surcharge of 60kPa due to the 'engineered fill' was then applied following by a residential surcharge of 5kPa for a period of 50 years.

6.4 Model Parameters and Stages

In our selection of parameters, consideration was given to the inherent uncertainty associated with natural, non-engineered materials and anisotropy. In this regard, we consider that conservative geotechnical parameters have been adopted. The adopted geotechnical parameters for each geotechnical unit are presented in the following table:

Parameters	Engineering Fill (crushed sandstone)	Engineering Fill (clayey material)	Backfill	Existing Fill	Natural Clay	Natural Sand
Unsaturated Unit Weight (kN/m^3)	22	18	20	16	18	18
Saturated Unit Weight (kN/m^3)	24	20	20	18	18	20
Cohesion (c') (kPa)	0.3	3	0	0	19	0
Internal Angle of Friction (ϕ) (°)	35	28	30	28	28	33
Modified Swelling Index (κ^*)	–	–	0.017	$6x5x10^{3-}$	0.02	–
Modified Compression Index (λ^*)	–	–	0.06	0.047	0.07	–
Modified Creep Index (μ^*)	–	–	$1.3x10^{-3}$	$3.7x10^{-3}$	$0.6x10^{-3}$	–
Modulus (E_{50}) (MPa)	50	30	–	–	–	60
Modulus (E_{oed}) (MPa)	–	–	–	–	–	60
Unload/Reload Modulus (E_{ur}) (MPa)	–	–	–	–	–	240
Poisson's Ratio (v)	0.25	0.3	–	–	–	–
Unload/Reload Poisson's Ratio (V_{ur})	–		–	–	–	0.2

The geotechnical units 'existing fill', 'backfill' and 'natural clay' were modelled using the soft soil creep constitutive model to predict the time dependent behaviour. The 'engineering fill' units were modelled using the Mohr-Coulomb model and the 'natural sand' was modelled using the hardening soil model.

The initial stress field has been modelled by the adoption of K_o values relating horizontal and vertical stresses for specific units. K_o within the natural sand and clay profile has been calculated on the basis of the relationship $K_o = 1–\sin\Phi$.

The model was run through a number of stages in an attempt to simulate the stress history followed by the remediation and construction procedure. The stages are presented below:

1 Initial phase.
2 Place ‘existing fill’ and leave for 10 years.
3 Apply 70kPa surcharge for 20 years.
4 Replace ‘existing fill’ with ‘backfill’ locally.
5 Place 1.4m thick ‘engineered fill’ capping layer comprising clayey material.
6 Place 1.6m thick ‘engineered fill’ capping layer comprising crushed sandstone.
7 Apply 5kPa residential surcharge.

Our analyses also addressed the situation of up to 1m of the ‘engineered fill’ being stripped locally as part of forming the final building platform. Although such stripping did not have a measurable effect on the analyses results, there may be impacts with respect to shrink-swell as the underlying compacted engineered fill consisting of clayey material will be closer to surface (refer Sections 7.2 and 7.4.3 below).

6.5 Analyses Results

A printout showing the predicted settlements from our FE analyses is presented in Figure 4, Appendix D. The maximum settlement of about 60mm after 50 years occurs in the area of deeper ‘existing fill’, to the north of the area which was excavated and backfilled for environmental reasons. Over the remainder of the site, the total settlement varies between about 10mm (over the north) and 40mm (towards the south) depending on the depth of ‘existing fill’.

However, a maximum differential settlement over a distance of 30m of about 40mm is indicated. This differential settlement occurs in an area which straddles the ‘existing fill’-‘backfill’ interface.

The above differential settlement will probably occur as a tilt and is consistent with differential movements associated with a ‘Class H1’ site in accordance with AS2870–2011.

We note that a 60 tonne weighbridge on site was operational for many years and was supported by concrete pad footings founded in the ‘existing fill’. The weighbridge was calibrated every year and apparently no problems due to differential settlement have been experienced, bearing in mind that weighbridges are sensitive to such movement.

Given the above, we consider that our settlement predictions are probably conservative (ie. higher than will likely be experienced). However, we recommend that the predicted settlements be adopted for design.

7 COMMENTS AND RECOMMENDATIONS

7.1 Geotechnical Issue

The principal geotechnical issue associated with the proposed residential subdivision of the subject site is the presence of uncontrolled fill ('existing fill') to significant depth. As a result, the site currently would classify as 'Class P' in accordance with AS2870.

However, given that the site has effectively been preloaded over many years by the extensive stockpiles, our numerical analyses have indicated that the site can be improved to the extent that the proposed residential buildings and associated infrastructure will be subjected to differential settlements which can be accommodated using engineering principles.

7.2 Site Improvement

In order to achieve the conditions modelled in our analyses so as to control the long term settlements of the site and maintain them within acceptable limits, the following process is recommended:

- All existing buildings, structures and pavements must be demolished and, together with all existing stockpiles, removed from site.
- The excavation of 'hotspots' must be completed as required by the environmentalist and the lateral extent and depth recorded by survey. These excavations must then be backfilled using well compacted fill. Prior to backfilling, the base of the excavations must be proof-rolled. It will probably be necessary in areas to form a stable platform and this can be achieved by punching cobble sized fragments into the subgrade.
- The excavated material can be used as backfill subject to approval by the geotechnical engineer prior to, and on completion of, sorting to remove deleterious matter and to remove particle sizes greater than 75mm. The approved material can then be placed in layers not greater than 200mm loose thickness and compacted to a target density between 95% and 97% of SMDD. If clayey materials are used, the compacted moisture content should be within 2% of SOMC. Compaction may be carried out in thicker layers using larger particle sizes, subject to confirmation that the required density can be achieved through the full layer

thickness. Extensive over compaction is undesirable as this would result in too much of a contrast between the 'existing fill' and the 'backfill' with associated large differential settlements over short horizontal distances. Similarly, under-compaction is undesirable as the creep settlement within the 'backfill' will increase and also result in larger differential settlements.

- Particular care is required to achieve edge compaction of the backfill in areas where access for rollers is difficult. Benching the sides of the excavation will facilitate edge compaction. The backfill must be subjected to Level 1 testing, carried out at the frequency indicated in AS32798 for the volume of fill involved.
- The entire site should be excavated down to 3m below design bulk subgrade level.
- The exposed subgrade should then be subjected to HEIC. The purpose of HEIC is to improve the density of the upper fill materials, particularly those areas of inferior compaction, and to provide a relatively uniform platform onto which to place the 'engineered fill'.
- A specification for HEIC should be prepared based on the results of an initial trial. The HEIC must be accompanied by survey levelling and possibly testing. The extent of testing and survey levelling will depend on the performance of HEIC at specific locations.
- Once the entire site area has been successfully subjected to HEIC, the site should be backfilled using select material to achieve the design bulk surface grades, with an 'engineered fill' blanket being no less than 3m thick. The upper 'engineered fill' should comprise a well graded granular material (such as crushed sandstone), which is free of deleterious substances, and has a maximum particle size of 75mm. Site won clayey material which has been certified by the project environmentalist as being suitable for the intended purpose may also be used as engineered fill over the lower capping, subject to approval by the geotechnical engineer. The clayey fill should be compacted in layers of not greater than 200mm loose thickness to a density strictly between 98% and 102% SMDD and within 2% of SOMC. The granular fill should be compacted in layers of not greater than 200mm loose thickness, to a minimum density of 98% SMDD. Compaction may be carried out in thicker layers using larger particle sizes, subject to confirmation that the required density can be achieved through the full layer thickness.
- Level 1 density testing of the 'engineered fill' should be carried out at the frequency indicated in AS3798 to confirm that the above specifications have been achieved. Preferably the Geotechnical Technical Authority should be engaged directly on behalf of the client and not as part of the earthworks contract.

The earthworks recommendations provided above should be complemented to reference to AS3798 and will need to be integrated with any environmental remediation which may be required.

As stated in Section 6.4 above, detailed local excavations into the upper 'engineered fill' will be carried out in areas to form level building platforms. This may expose such areas to shrink-swell movements as the clays will be within the shrink-swell zone.

In order to limit shrink-swell, it must be ensured that the final building platforms are underlain by at least 1.5m of 'engineered fill' comprising granular material. Particular care is therefore required to ensure that the areas of detailed excavation are clearly demarcated so as to allow the required material making up the 'engineered fill' to be used.

7.3 Batter Slopes

The existing batters along the southern, eastern and western site boundaries should be cleared of vegetation and 'tidied up' so that even side slopes no steeper than 1 Vertical (V) in 1.5 Horizontal (H) are achieved. The batters to the proposed 'engineered fill' embankments should also be no steeper than 1V on 1.5H. Batter slopes higher than a total of, say 3m, should incorporate a horizontal bench at least 2m wide. The batters should be protected from erosion by providing a rapidly growing vegetation cover or by structural means (eg. stone pitching, shotcreting, etc). A drain should be constructed at the crest of the batters to collect surface water runoff and direct it to the base of the embankment in a controlled manner.

Alternatively, the batters may be supported by engineered retaining walls or engineered embankment slopes.

7.4 Proposed Subdivision Works

Once the improvement/remediation detailed in Section 7.2 above has been completed, we would consider that the site is suitable for subdivision works.

7.4.1 Buried Services and Detailed Excavations

The proposed buried services should be flexible to the extent that the predicted differential settlements can be accommodated, and should be laid in trenches which are underlain by at least 1m of 'engineered fill'. If deeper services are required, the trenches may encounter difficult excavation conditions, and provision will need to be made for removal of concrete, boulders, timber, etc and for the provision of adequate service support in the form of deeper 'engineered fill', etc. If such a situation exists, further geotechnical advice should be sought.

The backfill of trenches requires particular attention so as to maintain the properties of the 'engineered fill'. A similar specification to that proposed engineered fill must be adopted, except that the maximum particle size and the maximum loose thickness of the material placed must reflect the likely smaller compaction equipment which will be used.

Detailed excavations into the 'engineered fill' up to 1m to form individual building platforms will not have a measurable effect on the predicted total and differential settlements, however, there may be other impacts as detailed in Section 7.4.3 below.

7.4.2 Pavements

The design of the proposed pavements will depend on the nature and composition of the fill materials imported to site for the 'engineered fill'. However, where ripped or crushed sandstone is used as the upper 'engineered fill', design CBR values for the proposed roads should be tentatively assumed as 15%. Once the 'engineered fill' has been completed, additional sampling should be carried out and four day CBR tests completed to obtain final pavement design parameters.

The proposed pavement subbase and basecourse layers should avoid the use of cemented materials, given the anticipated differential settlements which may cause the cemented layers to crack, with the cracks propagating to the surface.

7.4.3 Site Classification and Footings

We note that currently a 'Class P' classification is applicable with very difficult founding conditions, which will require extensive footing designs. However, following the geotechnical site improvement/remediation works detailed above, we consider that differential movements across individual residential lots will be no higher than those associated with a 'Class H1' site. The 'Class H1' will apply in the area of, and adjacent to, the deeper 'existing fill', to the north of the area which was excavated and backfilled for environmental reasons. 'Class M' sites will apply to the area radiating out from the above with 'Class S' over the extreme north, where the 'existing fill' is shallowest.

The above assumes that each individual building platform is underlain by at least 1.5m of 'engineered fill' comprising granular material. Should the proposed 'engineered fill' which comprises clayey material be present within 1.5m of the individual building platform surface, the clayey material will be subject to shrink-swell movements which will adversely affect the above site classifications.

On this basis, conventional high level footings are appropriate. We note that the design classification will, to some extent, depend on the nature and composition of the engineered fill, and will have to be confirmed following completion of the earthworks. For design purposes, we recommend that a 'Class H1-D' be tentatively adopted throughout.

The use of piles as settlement reduces and to reduce issues associated with buried services being surcharged or undermining high level footings, are acceptable, provided they are founded no deeper than 1m above the 'existing fill'.

7.5 Further Geotechnical Investigation

Further geotechnical investigations are required once the site remediation has been completed. The geotechnical investigation should target the upper 2m of the site (ie. the 'engineered fill') to confirm its nature and composition for site classification purposes as well as the pavement design CBR values.

7.6 Further Geotechnical Input

The following summarises the further geotechnical input which is required and which has been detailed in the preceding sections of this report:

- Survey of the lateral extent and depth of 'backfill' excavations.
- Preparation of a specification for HEIC the remainder of the site.
- Ongoing levelling, survey and possible testing for the HEIC.
- Level 1 density testing of 'backfill' and 'engineered fill'.
- Geotechnical investigation of the 'engineered fill' to confirm the site classification and subgrade CBR values.

8 GENERAL COMMENTS

The recommendations presented in this report include specific issues to be addressed during the construction phase of the project. In the event that any of the construction phase recommendations presented in this report are not implemented, the general recommendations may become inapplicable and JK Geotechnics accept no responsibility whatsoever for the performance of the structure where recommendations are not implemented in full and properly tested, inspected and documented.

Occasionally, the subsurface conditions between the completed boreholes may be found to be different (or may be interpreted to be different) from those expected. Variation can also occur with groundwater conditions, especially after climatic changes. If such differences appear to exist, we recommend that you immediately contact this office.

This report provides advice on geotechnical aspects for the proposed civil and structural design. As part of the documentation stage of this project, Contract Documents and Specifications may be prepared based on our report. However, there may be design features we are not aware of or have not commented on for a variety of reasons. The designers should satisfy themselves that all the necessary advice has been obtained. If required, we could be commissioned to review the geotechnical aspects of contract documents to confirm the intent of our recommendations has been correctly implemented.

This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose. If there is any change in the proposed development described in this report then all recommendations should be reviewed. Copyright in this report is the property of JK Geotechnics. We have used a degree of care, skill and diligence normally exercised by consulting engineers in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report. The report shall not be reproduced except in full.

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, BC 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001

SOIL TEST SERVICES
ABN 43 002 145 173

TABLE A
MOISTURE CONTENT, ATTERBERG LIMITS AND LINEAR SHRINKAGE TEST REPORT

Client: JK Geotechnics
Project: Proposed Residential Development
Location: 146 Newbridge Road, Moorebank, NSW

Ref No: 26930Z
Report: A
Report Date: 18/11/2013

AS 1289	TEST METHOD	2.1.1	3.1.2	3.2.1	3.3.1	3.4.1
BOREHOLE NUMBER	DEPTH m	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTICITY INDEX %	LINEAR SHRINKAGE %
JK1	3.00-3.45	N/A	60	18	42	15.0
JK3	5.50-6.00	27.0				
JK4	4.50-4.95	26.8	67	21	46	15.0
JK6	4.50-4.95	14.0	51	15	36	15.0
JK9	3.00-3.45	19.1	64	26	38	12.0
JK15	7.50-7.95	33.8				
JK16	7.50-7.95	29.0				

Notes:

- The test sample for liquid and plastic limit was air-dried & dry-sieved
- The linear shrinkage mould was 125mm
- Refer to appropriate notes for soil descriptions
- Date of receipt of sample: 04/11/2013
- N/A denotes not applicable

All services provided by STS are subject to our standard terms and conditions. A copy is available on request.

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, Bc 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001

SOIL TEST SERVICES
ABN 43 002 145 173

TABLE B
FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

Client: JK Geotechnics
Project: Proposed Residential Development
Location: 146 Newbridge Road, Moorebank, NSW

Ref No: 26930Z
Report: B
Report Date: 18/11/2013
Page 1 of 1

BOREHOLE NUMBER	JK2	JK8	JK14
DEPTH (m)	0.50 - 1.30	0.00 - 0.50	0.50 - 1.00
Surcharge (kg)	9.0	9.0	9.0
Maximum Dry Density (t/m^3)	1.57 STD	1.90 STD	1.83 STD
Optimum Moisture Content (%)	24.9	13.9	14.0
Moulded Dry Density (t/m^3)	1.54	1.86	1.79
Sample Density Ratio (%)	98	98	98
Sample Moisture Ratio (%)	98	100	101
Moisture Contents			
Insitu (%)	20.7	18.3	12.3
Moulded (%)	24.5	13.8	14.2
After soaking and			
After Test, Top 30mm(%)	32.5	17.7	17.4
Remaining Depth (%)	27.1	14.5	16.4
Material Retained on 19mm Sieve (%)	0	7*	10*
Swell (%)	1.0	1.0	0.5
C.B.R. value: @5.0mm penetration	5	5	8

NOTES:

- Refer to appropriate Borehole logs for soil descriptions
- Test Methods :
  - (a) Soaked C.B.R. : AS 1289 6.1.1
  - (b) Standard Compaction : AS 1289 5.1.1
  - (c) Moisture Content : AS 1289 2.1.1
- Date of receipt of sample: 04/11/2013
- * Denotes not used in test sample

NATA
NATA Accredited Laboratory Number:1327

Accredited for compliance with ISO/IEC 17025.
This document shall not be reproduced except in full.

Authorised Signature / Date
(A. Tatikonda) 18/11/13

All services provided by STS are subject to our standard terms and conditions. A copy is available on request.

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, Bc 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001
Email: dtreweek@jkgroup.net.au

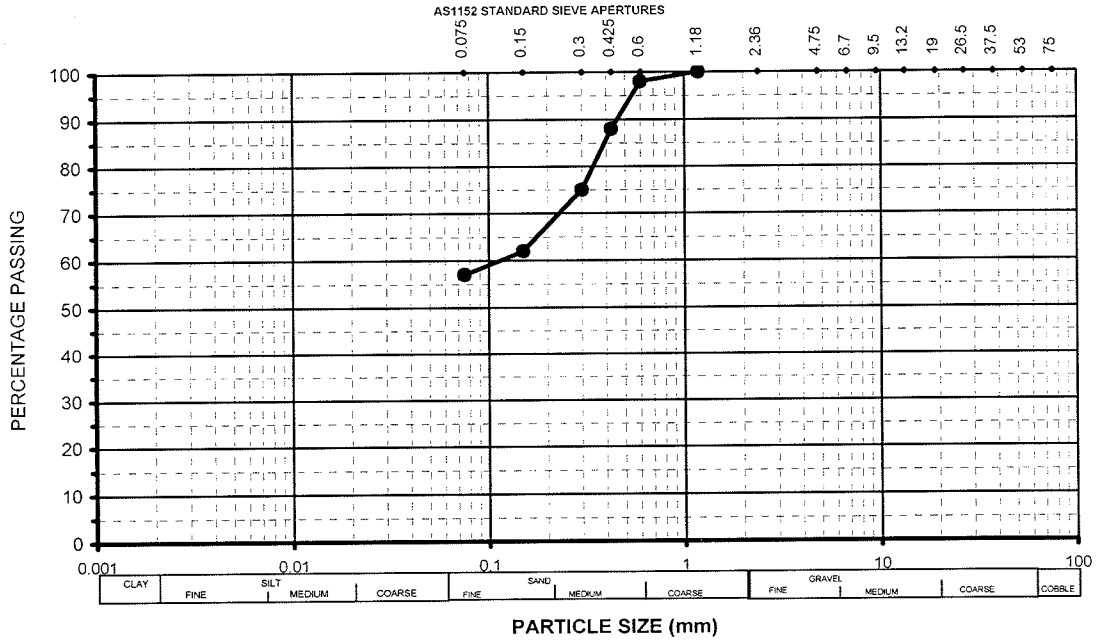
SOIL TEST SERVICES
ABN 43 002 145 173

TABLE C
PARTICLE SIZE DISTRIBUTION TEST REPORT

Client: JK Geotechnics
Project: Proposed Residential Development
Location: 146 Newbridge Road, Moorebank, NSW

Ref No: 26930Z
Report No: C
Report Date: 18/11/2003
Page 1 of 2

Borehole No:JK1
Depth (m): 6.00-6.45



SIEVE ANALYSIS RESULTS

SIEVE SIZE	% PASSING
1.18 mm	100
600 um	98
425 um	88
300 um	75
150 um	62
75 um	57

Test Method: AS1289.3.6.1 Dry Sieve(washed)

• Notes:

• Please refer to appropriate notes for soil descriptions

NATA
NATA Accredited Laboratory
Number:1327

Approved Signatory / Date
18/11/13
(A. Tatikonda)

Accredited for compliance with ISO/IEC 17025.
This document shall not be reproduced except in full.
All services provided by STS are subject to our standard terms and conditions. A copy is available on request.

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, Bc 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001
Email: dtreweek@jkgroup.net.au

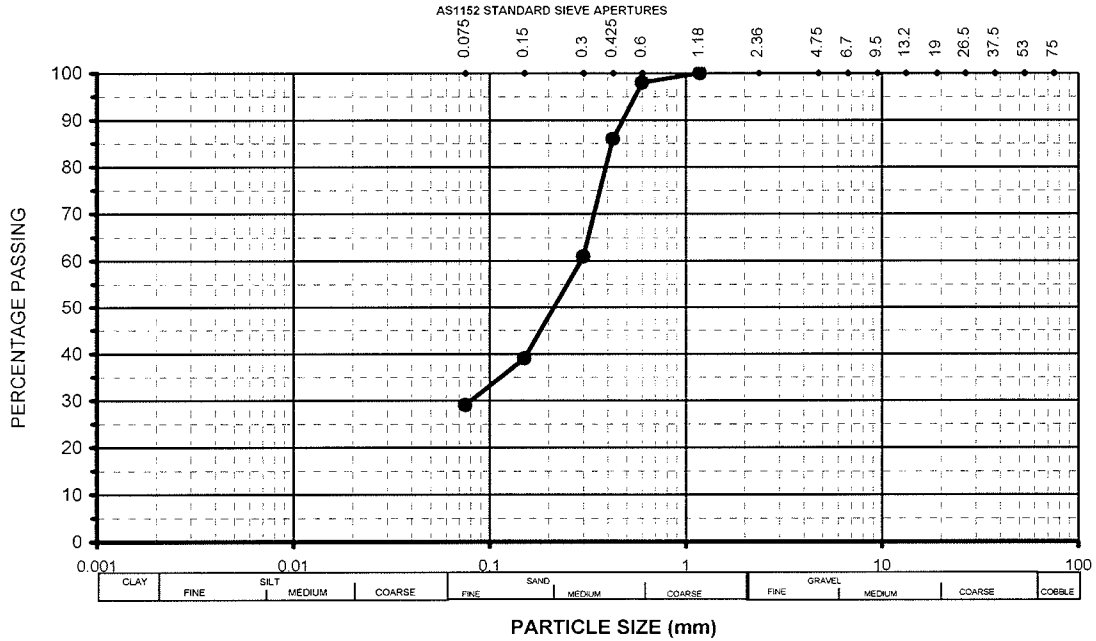
SOIL TEST SERVICES
ABN 43 002 145 173

TABLE C
PARTICLE SIZE DISTRIBUTION TEST REPORT

Client: JK Geotechnics
Project: Proposed Residential Development
Location: 146 Newbridge Road, Moorebank, NSW

Ref No: 26930Z
Report No: C
Report Date: 18/11/2003
Page 2 of 2

Borehole No:JK9
Depth (m): 6.00-6.45



SIEVE ANALYSIS RESULTS

SIEVE SIZE	% PASSING
1.18 mm	100
600 um	98
425 um	86
300 um	61
150 um	39
75 um	29

Test Method: AS1289.3.6.1 Dry Sieve(washed)

• Notes:

• Please refer to appropriate notes for soil descriptions

NATA
NATA Accredited Laboratory
Number:1327

Approved Signatory / Date
18/11/13
(A. Tatikonda)

Accredited for compliance with ISO/IEC 17025.
This document shall not be reproduced except in full.
All services provided by STS are subject to our standard terms and conditions. A copy is available on request.

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK1
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~2.0 m
Date: 22/10/13 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
					N = 8 5,4,4	1	1			FILL: Silty sandy clay, low plasticity, red brown, with fine grained ironstone gravel, trace of concrete fragments, ash and root fibres.	MC<PL			GRASS COVER APPEARS POORLY COMPACTED
▼ ON 25/10/13					N=0 0,0,0	0	2			FILL: Silty clay, mediium plasticity, brown and ligth grey, with timber fragments, trace of fine to medium grained sand.	MC>PL		40 40 40	
					N = 11 4,4,7	-1	3		CH	SILTY CLAY: high plasticity, light grey, trace of fine to medium grained ironstone gravel.	MC>PL	St	150 170 180	
					N = 15 4,7,8	-2	4			as above, but trace of fine to medium grained sand.		VSt	330 350 350	
▼ ON COMPLETION & AFTER 24 HRS						-3	5		CL	SANDY CLAY: low plasticity, light grey.				
					N = 22 9,12,10	-4	6		SM	SILTY SAND: fine to medium grained, light grey and brown.	W	MD		

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK1
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~2.0 m
Date: 22/10/13 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
					N = 21 5,10,11	-6	8			SILTY SAND: fine to medium grained, light grey and brown.	W	MD		
						-7	9			END OF BOREHOLE AT 9.00 m				50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED TO 7.5m DEPTH. MACHINE SLOTTED FROM 7.5m TO 1.5m DEPTH, CASING FROM 1.5m TO SURFACE, 2mm SAND FILTER PACK FROM 7.5m TO 1.0m, BENTONITE SEAL FROM 1.0m TO 0.5m, BACKFILLED WITH SAND AND CUTTINGS FINISHED AS MONUMENT.
						-8	10							
						-9	11							
						-10	12							
						-11	13							

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK2
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~2.5 m
Date: 21/10/13 **Datum:** AHD
Plant Type: JK350 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										FILL: Silty sand, fine to medium grained, brown, with fine to coarse grained igneous gravel and clay nodules.	D			GRASS COVER
					N = 7 2,3,4	2	1		CL	SILTY CLAY: medium plasticity, orange brown, trace of root fibres.	MC>PL	VSt	250 270 300	
					N = 13 4,6,7	1	2		CH	SILTY CLAY: high plasticity, ligth grey, trace of fine to medium grained ironstone gravel and root fibres.			350 350 350	
ON COMPLETION					N = 35 7,17,18	0	3		SC	CLAYEY SAND: fine to medium grained, light grey.	D	D		
					N = 57 6,27,30	-1	4		SP	SAND: fine to medium grained, light brown.	W	VD		
					N = 44 6,22,22	-2	5					D		
						-3	6							
						-4								

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK2
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~2.5 m
Date: 21/10/13 **Datum:** AHD
Plant Type: JK350 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
									SM	SILTY SAND: fine to medium grained, light grey and light brown.	W	VD		
				■	N = 50 7,20,30	-5								
							8			END OF BOREHOLE AT 7.95 m				
						-6								
							9							
						-7								
							10							
						-8								
							11							
						-9								
							12							
						-10								
							13							
						-11								

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK3
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~4.0 m
Date: 21/10/13 **Datum:** AHD
Plant Type: JK350 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										ASPHALTIC CONCRETE: 160mm.t				
										FILL: Silty sandy gravel, fine to medium grained igneous, dark grey, fine to medium grained sand.	D	-		APPEARS MODERATELY COMPACTED
					N = 14 8,7,7	3	1			FILL: Silty sand, fine to medium grained, brown, with fine to medium grained ironstone gravel, concrete and brick fragments, trace of ash.				
ON COMPLETION					N = 15 1,2,13	2	2			FILL: Silty sand, fine to medium grained brown, with fine to medium grained sandstone gravel, trace of plastic and fibre glass.				
					SPT 2/ 0mm REFUSAL	1	3			FILL: Silty clay, medium plasticity, dark grey, with fine to coarse grained sandstone gravel, trace of fine to medium grained sand.	MC>>PL			
						0	4		CL	SILTY CLAY: medium plasticity, dark grey, trace of fine to medium grained sand.	MC>>PL	S		
					N = 2 1,1,1	-1	5						40 40 30	
						-2	6					VS		

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK3
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~4.0 m
Date: 21/10/13 **Datum:** AHD
Plant Type: JK350 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	■			■					CH	SILTY CLAY: high plasticity, brown.	MC>PL	St	150 120 140	
						-4	8			END OF BOREHOLE AT 8.00 m				
						-5	9							
						-6	10							
						-7	11							
						-8	12							
						-9	13							

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK4
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~6.5 m
Date: 23/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION										FILL: Silty sand, fine to medium grained, brown, trace of fine to coarse grained igneous gravel.	D			APPEARS MODERATELY AND WELL COMPACTED
					N = 24 7,12,12	6	1			FILL: Silty sand, fine to medium grained, brown, trace of fine to medium grained ironstone gravel and clay fines.				
					N = 5 2,3,2	5	2			FILL: Silty clay, medium plasticity, brown, with fine to medium grained sand, trace of fine to emdium grained sandstone gravel and root fibres.	MC>PL		320 120 120	
					N = 2 2,1,1	4	3		CL	SILTY SANDY CLAY: low plasticity, dark grey.	MC>PL	S	40 40 50	
					N = 14 4,6,8	3	4		CH	SILTY CLAY: high plasticity, light grey and brown.		St	160 160 190	
					N = 14 5,7,7	2	5		CL	SILTY CLAY: medium plasticity, light grey.			120 120 150	
						1	6							
						0								

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK4
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~6.5 m
Date: 23/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										SILTY CLAY: medium plasticity, light grey.	MC>PL	VSt		
				■	N = 15 7,7,8	-1							340 350 340	
							8			END OF BOREHOLE AT 7.95 m				
						-2	9							
						-3	10							
						-4	11							
						-5	12							
						-6	13							
						-7								

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ DWG13632.GDW 17/12/2013 10:35 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK5
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.0 m
Date: 18/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										FILL: Silty sand, fine to medium grained, brown, with fine to mediun grained quartz gravel and concrete and glass fragments.	D			APPEARS POORLY TO MODERATELY COMPACTED
					N = 16 4,4,12					FILL: Silty clay, medium plasticity, brown, with fine to medium grained sand, concrete and brick fragments.	MC>PL		200 200 150	
					SPT 5/ 20mm REFUSAL	6	1			FILL: Silty clayey sand, fine to coarse grained, dark brown, with concrete and metal fragments.				
					SPT 19/ 150mm REFUSAL	5	2			FILL: Silty clay, medium plasticity, brown, with fine to medium grained quartz and ironstone gravel, and timber, slag and brick fragments.			100 120 100	
ON COMPLETION						4	3			FILL: Silty gravelly sand, fine to medium grained, light grey and brown, fine to coars grianed concrete and brick fragments.	W			
					N = 7 1,2,5	3	4			FILL: Silty sandy clay, low plasticity, light grey and orange brown.	MC>PL		150 150 150	
AFTER 6.5 HRS						2	5			FILL: Silty sandy clay, low plasticity, dark brown, with fine to medum grained ironstone gravel and concrete fragments.			100 100 100	
					N = 13 0,5,8	1	6		ML	CLAYEY SILT: low plasticity, light grey.	MC<PL	VSt - H	300 400 300	

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK5
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.0 m
Date: 18/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
									CL	SILTY CLAY: medium plasticity, light grey and orange brown.	MC>PL	VSt - H		
	■			■	N = 10 3,4,6									
						-1	8			END OF BOREHOLE AT 7.95 m				
						-2	9							
						-3	10							
						-4	11							
						-5	12							
						-6	13							

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK6
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~6.8 m
Date: 23/10/13 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** G.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
									-	CONCRETE: 50mm.t				
										FILL: Gravelly clayey sand, fine to medium grained, brown, fine to coarse grained igneous, trace of ash, slag, glass and metal fragments.	M	-		APPEARS MODERATELY TO POORLY COMPACTED
											MC>PL			
					N = 12 6,6,6	6	1			FILL: Silty clay, high plasticity, light grey, grey and brown, trace of fine to medium grained ironstone, sandstone and shale gravel.			300 250 120	
										FILL: Clayey sand, fine to medium grained, grey, light grey and brown, trace of timber, fine to medium grained sandstone gravel and ash.	M			
					N = 9 7,6,3	5	2							
						4	3							
					N = 6 4,3,3					FILL: Silty clay, high plasticity, grey brown and orange brown, trace of fine to medium grained ironstone gravel and ash.	MC>PL		100 110 90	
						3	4		CH	SILTY CLAY: high plasticity, grey mottled red brown.	MC>PL	H		
					N = 19 6,8,11	2	5						500 550 580	
										SILTY CLAY: high plasticity, light grey mottled orange brown, trace of fine grained sand.		VSt - H		
					N = 17 5,7,10	1	6						350 410 440	
ON COMPLETION						0			SM	SILTY SAND: fine to medium grained, grey.	W	(MD)		

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK6
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~6.8 m
Date: 23/10/13 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** G.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										SILTY SAND: fine to medium grained, grey.	W	(MD)		
				■	N = 26 8,11,15	-1								
							8			END OF BOREHOLE AT 7.95 m				
						-2	9							
						-3	10							
						-4	11							
						-5	12							
						-6	13							
						-7								

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK7
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.2 m
Date: 23/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										ASPHALTIC CONCRETE: 150mm.t				
						7			-	FILL: Silty clay, medium plasticity, brown, with fine to medium grained ironstone gravel, fine grained sand, trace of root fibres.	MC>PL	-		APPEARS WELL COMPACTED
					N = 44 27,22,22		1							
						6				FILL: Silty sandy clay, low plasticity, brown, fine to medium grained sand, with fine to medium grained sandstone and igneous gravel, concrete, timber and brick fragments.			100 100 100	
					N > 10 8,10/ 100mm REFUSAL		2							
						5				FILL: Clayey sandy gravel, fine to coarse grained sized concrete, grey, fine to medium grained sand, trace of timber fragments.	D			
					N = 16 8,7,9		3							
						4				FILL: Gravelly sandy clay, low plasticity, brown, fine to medium grained sand, with concrete fragments.	MC>PL			TOO GRAVELLY FOR HP TESTING
ON COMPLETION & AFTER 2 HRS					N = 5 4,2,3		4							APPEARS POORLY COMPACTED
						3								
							5			as above, but with plastic and metal fragments and fabric.				
						2			CH	SILTY CLAY: high plasticity, light grey and brown.	MC>PL	S	40 40 50	
					N=0 0,0,0		6							
						1								

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:33 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK7
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.2 m
Date: 23/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
						0			CH	SILTY CLAY: high plasticity, light grey and brown. *(continued)*	MC>PL	VSt		
				■	N = 14 4,6,8								250 280 280	
						-1	8							
							9			END OF BOREHOLE AT 9.00 m				50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED TO 8.6m DEPTH. MACHINE SLOTTED FROM 8.6m TO 2.6m, CASING 2.6m TO SURFACE, 2mm SAND FILTER PACK FROM 8.6m TO 1.5m, BENTONITE SEAL BETWEEN 1.5m & 0.5m, BACKFILLED WITH SAND AND CUTTINGS, FINISHED AS MONUMENT
						-2								
							10							
						-3								
							11							
						-4								
							12							
						-5								
							13							
						-6								

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:33 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK8
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.0 m
Date: 21/10/13 **Datum:** AHD
Plant Type: JK350 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
									-	FILL: Silty sand, fine to medium grained, brown, with glass, plastic, metal, timber and concrete fragments.	D			APPEARS WELL COMPACTED
										FILL: Silty sandy gravel, fine to medium grained sized glass, brown, fine to medium grained sand.	W			
					N = 24 5,10,14	6	1			FILL: Silty sand, fine to medium grained, light brown and dark brown, trace of fine to coarse grained sandstone gravel.	(D)			
						5	2							
ON COMPLETION					N > 16 1,5,11/ 100mm REFUSAL	4	3			FILL: Sandy gravelly clay, low plasticity, brown and dark brown, fine to medium grained sandstone and concrete gravel, trace of glass fragments.	MC>PL			TOO GRAVELLY FOR HP TESTING
						3	4							APPEARS MODERATELY COMPACTED
					N = 6 2,3,3	2	5			FILL: Sandy clay, medium plasticity, brown, fine to medium grained sand, trace of ironstone gravel and root fibres.			120 140 150	
					N = 22 10,11,11	1	6		SM	SILTY SAND: fine to medium grained, light grey, with clay fines.	W	MD		

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:33 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK8
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.0 m
Date: 21/10/13 **Datum:** AHD
Plant Type: JK350 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										SILTY SAND: fine to medium grained, light grey, with clay fines.	W	MD		
				■	N = 43 4,20,23							D		
						-1	8			END OF BOREHOLE AT 7.95 m				
						-2	9							
						-3	10							
						-4	11							
						-5	12							
						-6	13							

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:33 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK9
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~6.8 m
Date: 23/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
						6	0		-	FILL: Silty sand, fine to medium grained, brown, trace of fine to medium grained igneous gravel.	D			APPEARS MODERATELY TO WELL COMPACTED
					N = 12 9,6,6		1			FILL: Silty sandy clay, low plasticity, brown, fine to medium grained sand, with fine to medium grained sandstone, ironstone and igneous gravel.	MC>PL		220 210 200	
					N = 7 6,3,4	5	2			as above, but with timber fragments.			210 220 210	
					N = 8 3,4,4	4	3		CH	SILTY CLAY: high plasticity, brown mottled dark brown.	MC>PL	VSt	300 300 300	
					N = 20 4,9,11	3	4			SILTY CLAY: high plasticity, light grey and red brown.	MC<PL	H	580 290 >600	
					N = 20 8,8,12	2	5		CL	SANDY CLAY: low plasticity, ligth grey, fine to coarse grained sand.	MC>PL	(St)		
						1	6		SM	SILTY CLAYEY SAND: fine to coarse grained, ligth grey and brown, with clay fines.	M	MD		
						0								

ON COMPLETION 23/10/13 AFTER 4 HRS

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:33 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK9
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~6.8 m
Date: 23/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										SILTY CLAYEY SAND: fine to coarse grained, ligth grey and brown, with clay fines.	W	MD		
				■	N = 14 1,4,10	-1	8			SILTY SAND: fine to medium grained, light grey.				
						-2	9			END OF BOREHOLE AT 9.00 m				CLASS 18 PVC STANDPIPE INSTALLED TO 8.4m DEPTH. SLOTTED BETWEEN 2.4m AND 8.4m, CASING 2.4m TO SURFACE, BACKFILLED WITH 2mm FILTER SAND, BENTONITE SEAL BETWEEN 1.5m & 0.5m, MONUMENT COMPLETED AT SURFACE
						-3	10							
						-4	11							
						-5	12							
						-6	13							
						-7								

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:33 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK10
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.0 m
Date: 18/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
					SPT 10/ 20mm REFUSAL	6	1			FILL: Silty gravelly sand, fine to medium grained, brown, fine to medium grained quartz and bitumen gravel, crushed concrete and brick fragments.	D			
					SPT 17/ 100mm REFUSAL	5	2			FILL: Clayey sand, fine to coarse grained, yellow brown, with fine to medium grained quartz gravel. FILL: Silty sandy gravel, fine to medium grained sandstone, dark brown, fine to medium grained sand, with concrete and brick fragments, timber, metal and plastic fragments.				
					N = 7 4,5,2	4	3			FILL: Silty sand, fine to coarse grained, grey, trace of fine to coarse grained sandtone gravel and timber fragments.				
					N = 4 2,2,2	3	4			FILL; Silty clay, medium plasticity, orange brown, with fine to medium grained sand, concrete and brick fragments.	MC>PL		50 50 80	APPEARS POORLY COMPACTED
AFTER 4 HRS					N = 13 3,8,5	2	5			FILL: Sandy clay, low plasticity, dark grey, fine to medium grained sand, with timber, concrete and brick fragments and plastic bags.				TOO GRAVELLY FOR HP TESTING
						1	6							

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK10
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.0 m
Date: 18/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
					N = 9 3,6,3	-1	8			FILL: Sandy clay, low plasticity, dark grey, fine to medium grained sand, with timber, concrete and brick fragments and plastic bags.	MC>PL			TOO GRAVELLY FOR HP TESTING
						-2	9						50 50 80	
						-3	10							APPEARS POORLY COMPACTED
						-4	11						50 50 80	
						-5	12		SM	SILTY SAND: fine to coarse grained, light brown, trace of clay fines.	W	-		ALLUVIAL
						-6	13			END OF BOREHOLE AT 12.00 m				

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK11
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.0 m
Date: 23/10/13 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** G.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										FILL: Gravelly clayey sand, fine to medium grained, dark brown and grey, fine to coarse grained igneous, trace of glass, steel and ash fragments.	M			
											MC>PL			
				■	N = 20 10,10,10					FILL: Silty clay, medium to high plasticity, brown and grey, trace of fine to medium grained ironstone and shale gravel.			220 100 190	
						6	1			FILL: Sandy clay, low plasticity, brown and grey, trace of fine to medium grained sandstone, ironstone and shale gravel and ash.	MC<PL			
				■	N = 8 7,4,4								100 120 90	APPEARS WELL TO POORLY COMPACTED
						5	2							
				■	SPT 10/ 50mm REFUSAL	4	3							
										FILL: Clayey gravelly sand, fine to medium grained, brown and light brown, fine to medium grained ironstone and concrete fragments.	M			
						3	4							
				■	SPT 5/ 0mm REFUSAL									
						2	5		CH	SILTY CLAY: high plasticity, light grey.	MC>PL	H		
▼ ON COMPLETION				■	N = 19 8,9,10	1	6						500 580 550	
									SM	SILTY SAND: fine to medium grained, grey.	W	MD		

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK11
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.0 m
Date: 23/10/13 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** G.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										SILTY SAND: fine to medium grained, grey.	W	MD		
				■	N = 22 10,10,12									
						-1	8			END OF BOREHOLE AT 7.95 m				
						-2	9							
						-3	10							
						-4	11							
						-5	12							
						-6	13							

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK12
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.0 m
Date: 18/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
ON COMPLETION & AFTER 2 HRS					SPT 13/ 50mm REFUSAL	6	1			FILL: Silty gravelly sand, fine to coarse grained, grey, with fine to medium grained igneous gravel and concrete and glass fragments.	D			
					SPT 6/ 50mm REFUSAL	5	2			as above, but with metal and brick fragments, trace of clay fines.				
					N = 11 11,7,4	4	3			FILL: Silty clay, medium plasticity, brown, with fine to medium grained ironstone gravel, trace of brick and timber fragments and ash.	MC>PL		100 100 100	APPEARS WELL TO POORLY COMPACTED
					N = 2 1,1,1	3	4			FILL: Silty sand, fine to coarse grained, dark grey, with fine to medium grained igneous gravel and slag.	W			
					N = 26 3,10,16	2	5							
						1	6		CH	SILTY CLAY: high plasticity, orange brown mottled light grey.	MC<PL	H	450 480 520	

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK12
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.0 m
Date: 18/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
									SC	CLAYEY SAND: fine to medium grained, light grey and orange brown.	W	MD		
					N = 11 7,6,5									
						-1	8			END OF BOREHOLE AT 7.95 m				
						-2	9							
						-3	10							
						-4	11							
						-5	12							
						-6	13							

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK13
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.0 m
Date: 22/10/13 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										FILL: Silty sand, fine to medium grained, light brown.	D			
										FILL: Silty sand, fine to medium grained, brown.				
				■	N > 32 15,32/ 150mm REFUSAL					FILL: Sandy clay, low plasticity, brown, fine to medium grained sand, with fine to medium grained igneous gravel, brick and glass fragments, trace of ash.	MC>PL			SLIGHT HYDROCARBON ODOUR TOO GRAVELLY FOR HP TESTING
				■	N = 29 9,19,10	6	1			FILL: Sandy clayey gravel, fine to coarse grained sized brick and concrete gravel.	D			
						5	2			as above, but with timber fragments, trace of plastic and metal fragments.				APPEARS WELL COMPACTED
				■	N = 29 5,1,28	4	3							
▼ ON COMPLETION						3	4				W			
				■	N = 16 4,8,8					FILL: Silty gravel, fine to coarse grained sied brick ad concrete gravel, trace of fine to medium grained igneous gravel and tile fragments.				
						2	5							
				■	N = 2 3,1,1	1	6		SC	SILTY CLAYEY SAND: fine to medium grained, light grey and brown.	W	VL		
									CL	SILTY SANDY CLAY: low plasticity, orange brown and light grey, fine grained sand.	MC>PL	VSt		

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK13
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~7.0 m
Date: 22/10/13 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										SILTY SANDY CLAY: low plasticity, orange brown and light grey.	MC>PL	VSt		
				■	N = 12 2,6,6								250 250 250	
						-1	8			END OF BOREHOLE AT 7.95 m				
						-2	9							
						-3	10							
						-4	11							
						-5	12							
						-6	13							

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK14
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~6.0 m
Date: 18/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										FILL:Silty sand, fine to medium grained, dark grey, with fine to medium grained igneous gravel, concrete and timber fragments.	D			
										FILL: Silty sandy clay, low plasticity, dark brown, with fine to medium grained igneous gravel, concrete, glass and timber fragments.	MC<PL			NO SPT DUE TO OBSTRUCTION IN FILL
						5	1			FILL: Silty clay, medium plasticity, brown, trace of fine to medium grained sand, fine grained igneous gravel and timber fragments.	MC>PL			
					N = 3 1,1,2								100 100 120	
						4	2							
					N > 12 15,12/ 150mm REFUSAL	3	3			FILL: Gravel, fine to coarse grained sized bricks.	D			APPEARS POORLY COMPACTED
										FILL: Gravelly clay, low plasticity, brown, fine to coarse grained sand, concrete and brick fragments.	MC>PL			
						2	4							TOO GRAVELLY FOR HP TESTING
					N = 7 2,4,3									
						1	5							
ON COMPLETION					N = 3 17,1,2	0	6			FILL: Silty sand, fine to medium grained, light grey.	W			
										FILL: Silty sand, fine to medium grained, dark grey, with timber fragments.				

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK14
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~6.0 m
Date: 18/10/13 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
					SPT 10/ 10mm REFUSAL	-2	8			FILL: Silty sand, fine to medium grained, dark grey, with timber fragments.	W			
						-3	9			as above, but with metal fragments.				
						-4	10		CL	SILTY CLAY: low plasticity, dark grey, with fine grained sand.	MC>PL	F	50 50 50	
						-5	11							
						-6	12					St	100 120 100	
						-7	13			END OF BOREHOLE AT 12.00 m				

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK15
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~8.5 m
Date: 22/10/13 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
						8				FILL: Silty sand, fine to medium grained, brown, with fine to medium grained quartz gravel, concrete, glass and tile fragments and slag.	D			
					N = 40 15,18,22		1			FILL: Clayey sand, fine to coarse grained, brown, with fine to medium grained quartz and ironstone gravel, tile fragments, trace of ash.				
						7				FILL: Gravelly clayey sand, fine to coarse grained, dark grey (black), with fin eto medium grained sandstone and ironstone gravel, concrete, tile and plastic fragments, trace of timber.				APPEARS MODERATELY TO POORLY COMPACTED
					N = 11 7,5,6		2							
						6								
					N = 8 2,2,6		3			FILL: Silty clayey sand, fine to medium grained, fine to medium grained, brown, with fine to medium grained quartz gravel, concrete and timber fragments, trace of ash.				
						5								
							4			FILL: Silty sand, fine to medium grained, brown grey, trace of fine to medium grained quartz gravel.				
					N = 5 4,2,3	4								
▶							5				W			
▼ ON COMPLETION						3				FILL: Silty sand, fine to medium grained, grey.				
							6							
					N = 3 1,1,2									POSSIBLY NATURAL
						2								

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK15
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~8.5 m
Date: 22/10/13 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	■					1			CH	SILTY CLAY: high plasticity, dark grey.	MC>PL	VS		
				■	N=0 0,0,0									
						0	8			END OF BOREHOLE AT 7.95 m				
						-1	9							
						-2	10							
						-3	11							
						-4	12							
						-5	13							

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK16
1 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~5.0 m
Date: 22/10/13 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
					SPT 20/ 150mm REFUSAL	4	1			FILL: Silty sand, fine to medium grained, brown, with fine to medium grained igneous gravel, concrete and brick fragments, trace of slag.	D			APPEARS POORLY COMPACTED
					N = 7 4,3,4	3	2			as above, but with fine to medium grained sandstone gravel, trace of ash.				
▼					N = 4 1,2,2	2	3			FILL: Clayey sand, fine to coarse grained, brown, with fine to medium grained quartz and ironstone gravel, trace of glass fragments and slag.	W			
▼ ON 25/10/13						1	4		SM	SILTY SAND: fine to medium grained, dark brown, with clay fines.	W	VL		
▼ AFTER 4 HRS					N = 2 1,1,1	0	5							
▼ ON COMPLETION					N = 2 1,1,1	-1	6							

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
JK16
2 / 2

BOREHOLE LOG

Client: BENEDICT INDUSTRIES PTY LTD
Project: PROPOSED RESIDENTIAL DEVELOPMENT
Location: 146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z **Method:** SPIRAL AUGER **R.L. Surface:** ~5.0 m
Date: 22/10/13 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** D.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	■			■	N=0 0,0,0	-3	8		CL	SILTY CLAY: medium plasticity, grey, with fine to medium grained sand.	MC>>PL	VS		TOO SOFT FOR HP TESTING
						-4	9			END OF BOREHOLE AT 9.00 m				CLASS 18 PVC STANDPIPE INSTALLED TO 8.4m DEPTH. SLOTTED BETWEEN 2.4m AND 8.4m, CASING 2.4m TO SURFACE, BACKFILLED WITH 2mm FILTER SAND AND CUTTINGS TO SURFACE, BENTONITE SEAL BETWEEN 2m & 1m, MONUMENT COMPLETED AT SURFACE
						-5	10							
						-6	11							
						-7	12							
						-8	13							

JK_LIB_CURRENT - V7.1.GLB Log J & K AUGERHOLE - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:32 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

JK Geotechnics

GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

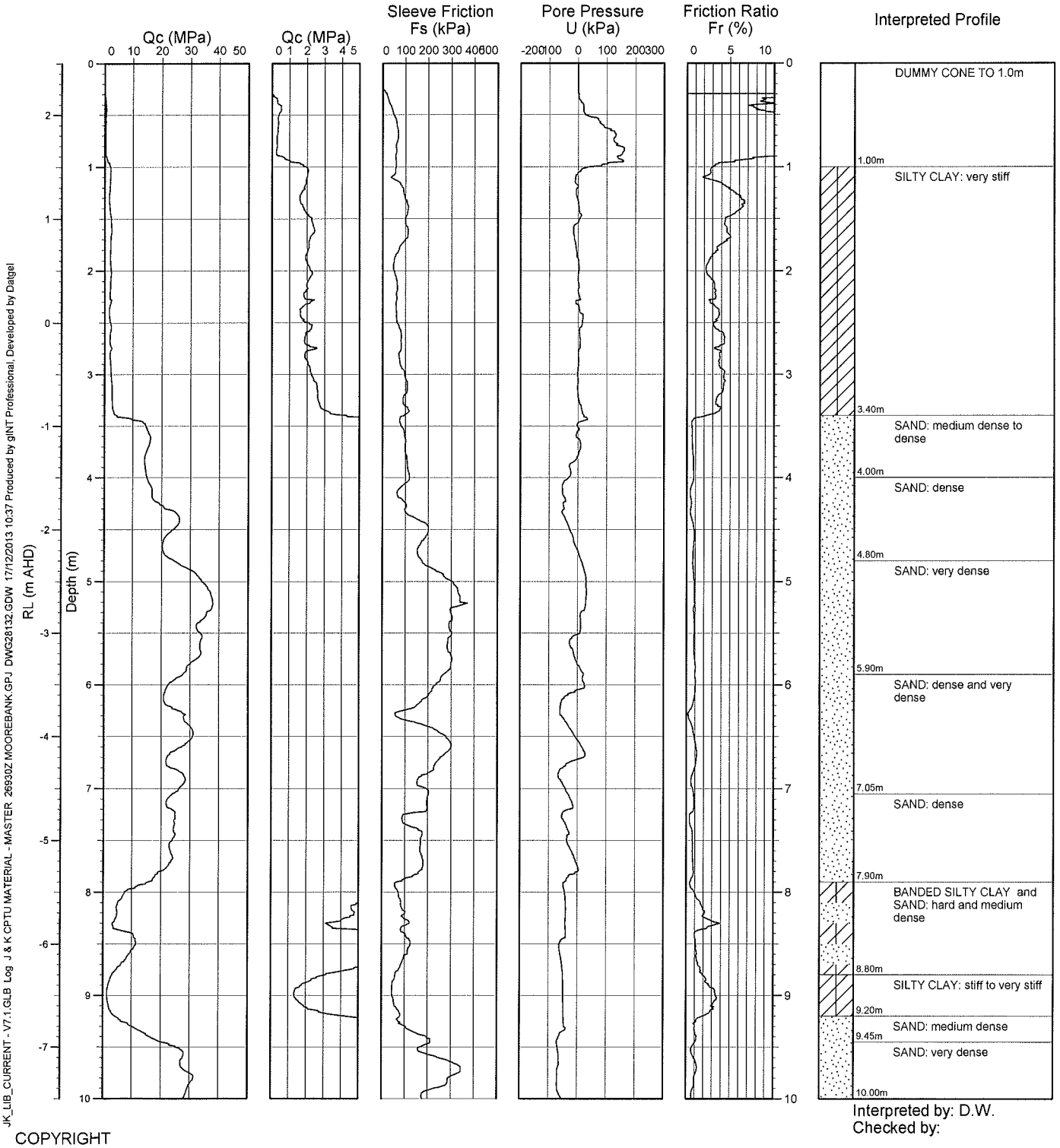
EFCP No. 2

1 / 2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	BENEDICT INDUSTRIES PTY LTD
Project:	PROPOSED RESIDENTIAL DEVELOPMENT
Location:	146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z	**R.L. Surface:** ~2.5 m	**Data File:** 26930Z_2.GEF
Date: 25/10/13	**Datum:** AHD	**Operator:** D.W.



Interpreted by: D.W.

Checked by:

JK_LIB_CURRENT - V7.1.GLB Log J & K CPTU MATERIAL - MASTER 26930Z MOOREBANK.GPJ DWG28132.GDW 17/12/2013 10:37 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

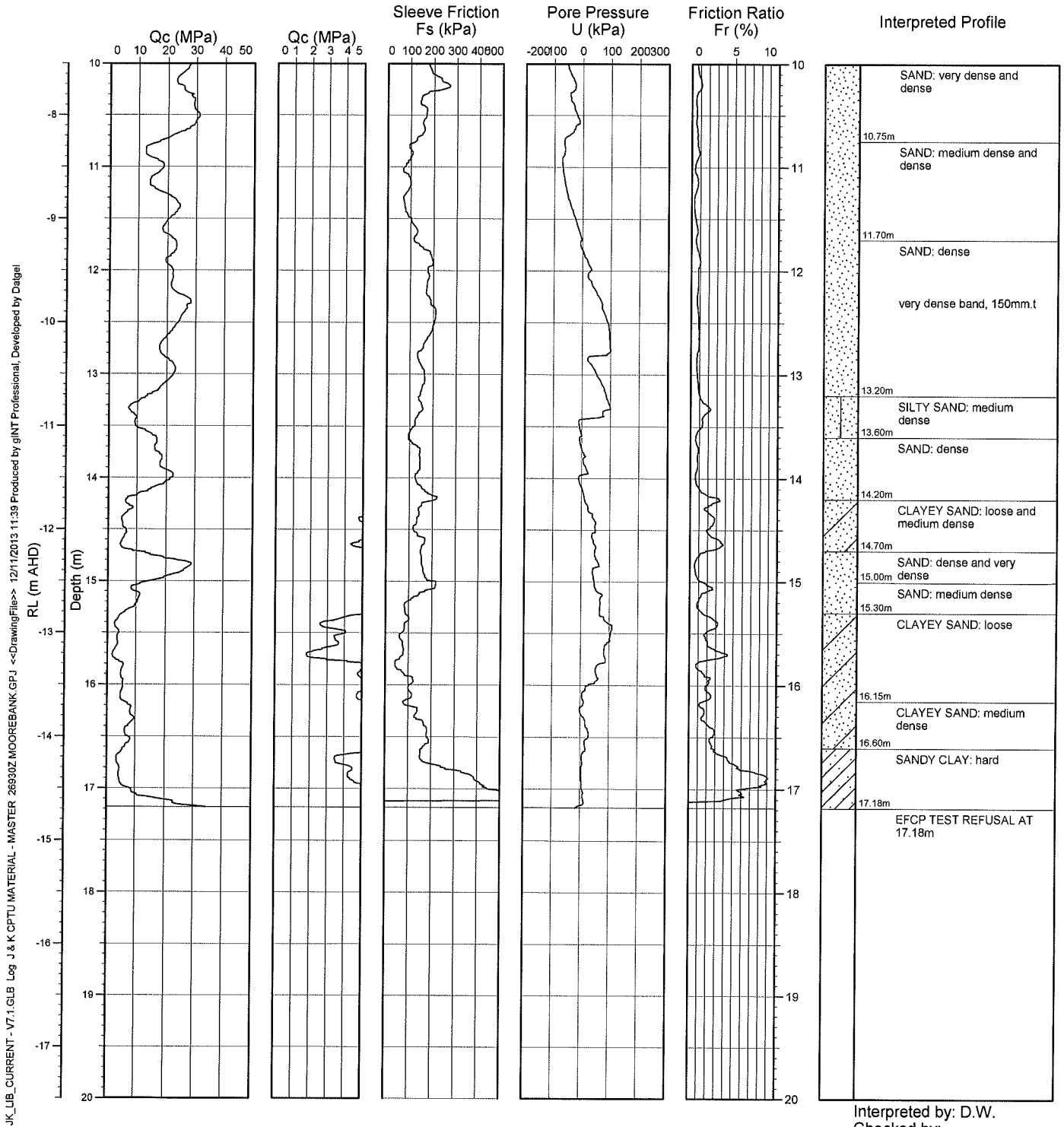
JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. 2
2 / 2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	BENEDICT INDUSTRIES PTY LTD
Project:	PROPOSED RESIDENTIAL DEVELOPMENT
Location:	146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z	**R.L. Surface:** ~2.5 m	**Data File:** 26930Z_2.GEF
Date: 25/10/13	**Datum:** AHD	**Operator:** D.W.



Interpreted by: D.W.
Checked by:

JK_LIB_CURRENT - V7.1.GLB Log J & K CPTU MATERIAL - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:39 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

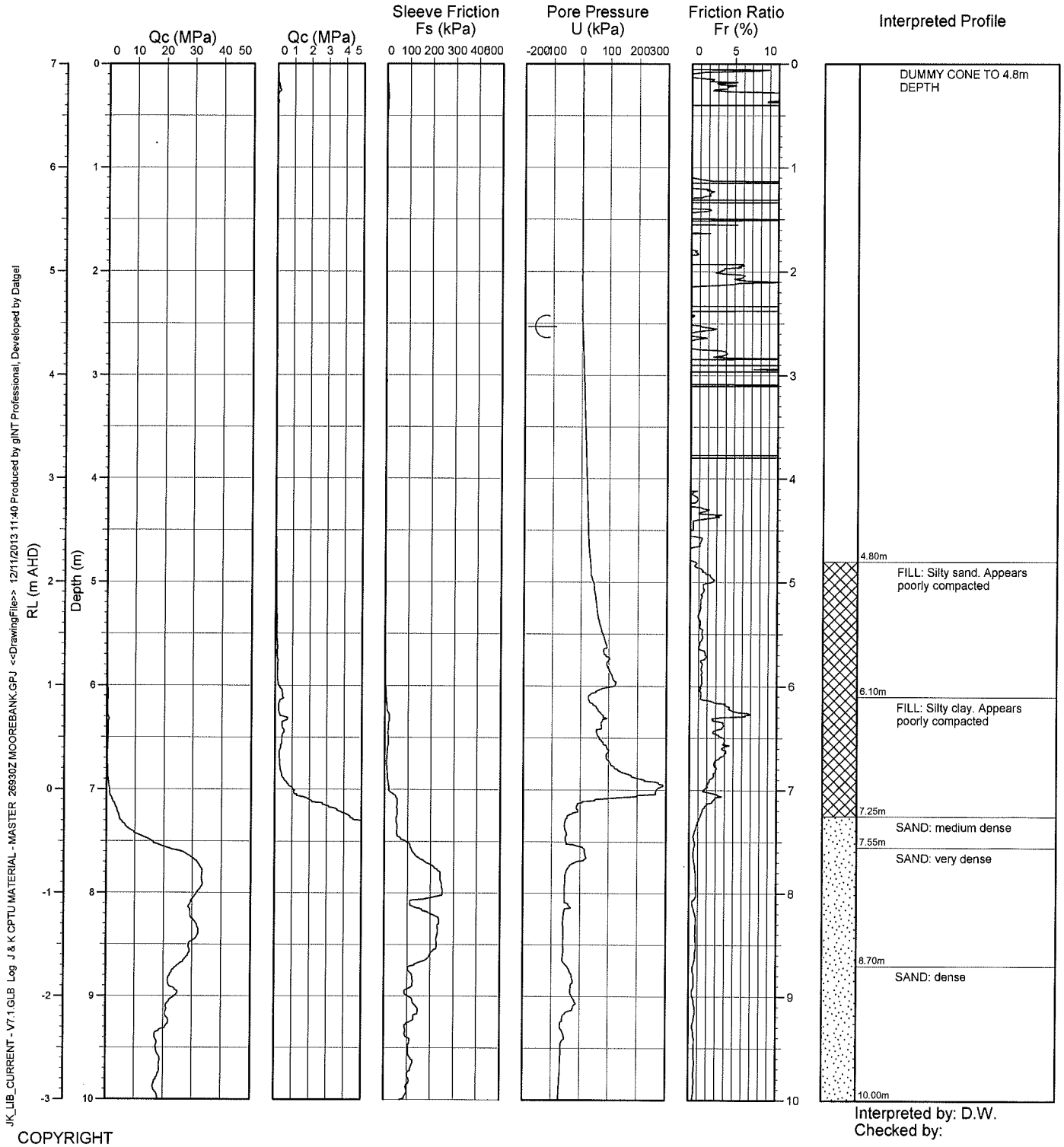
JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
8
1 / 3

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	BENEDICT INDUSTRIES PTY LTD
Project:	PROPOSED RESIDENTIAL DEVELOPMENT
Location:	146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z	**R.L. Surface:** ~7.0 m	**Data File:** 26930Z_8.GEF
Date: 25/10/13	**Datum:** AHD	**Operator:** D.W.



Interpreted by: D.W.
Checked by:

JK_UB_CURRENT - V7.1.GLB Log J & K CPTU MATERIAL - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:40 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

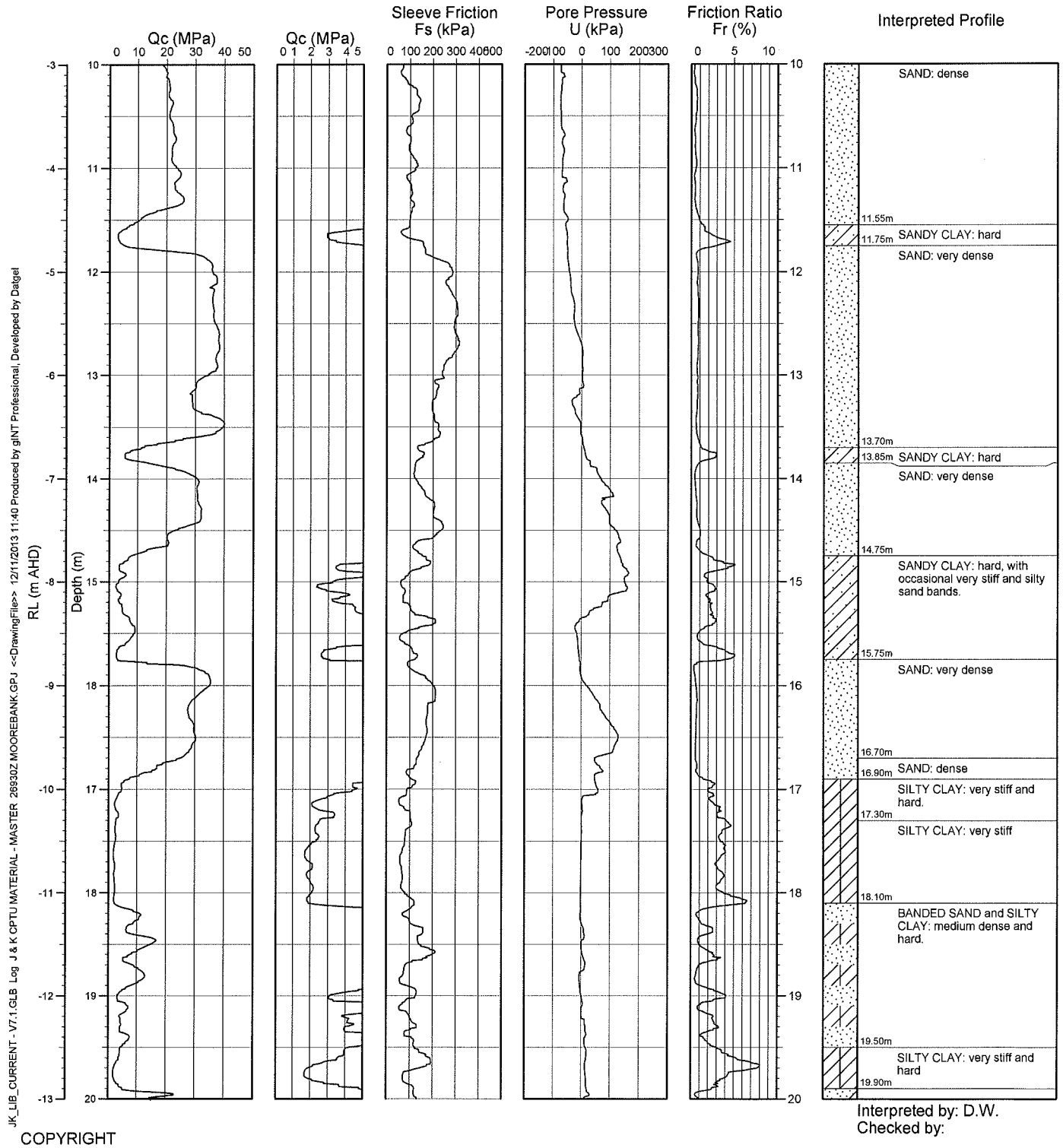
JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. 8 2 / 3

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	BENEDICT INDUSTRIES PTY LTD
Project:	PROPOSED RESIDENTIAL DEVELOPMENT
Location:	146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z	**R.L. Surface:** ~7.0 m	**Data File:** 26930Z_8.GEF
Date: 25/10/13	**Datum:** AHD	**Operator:** D.W.



Interpreted by: D.W.
Checked by:

JK_LIB_CURRENT - V7.1.GLB Log J & K CPTU MATERIAL - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:40 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

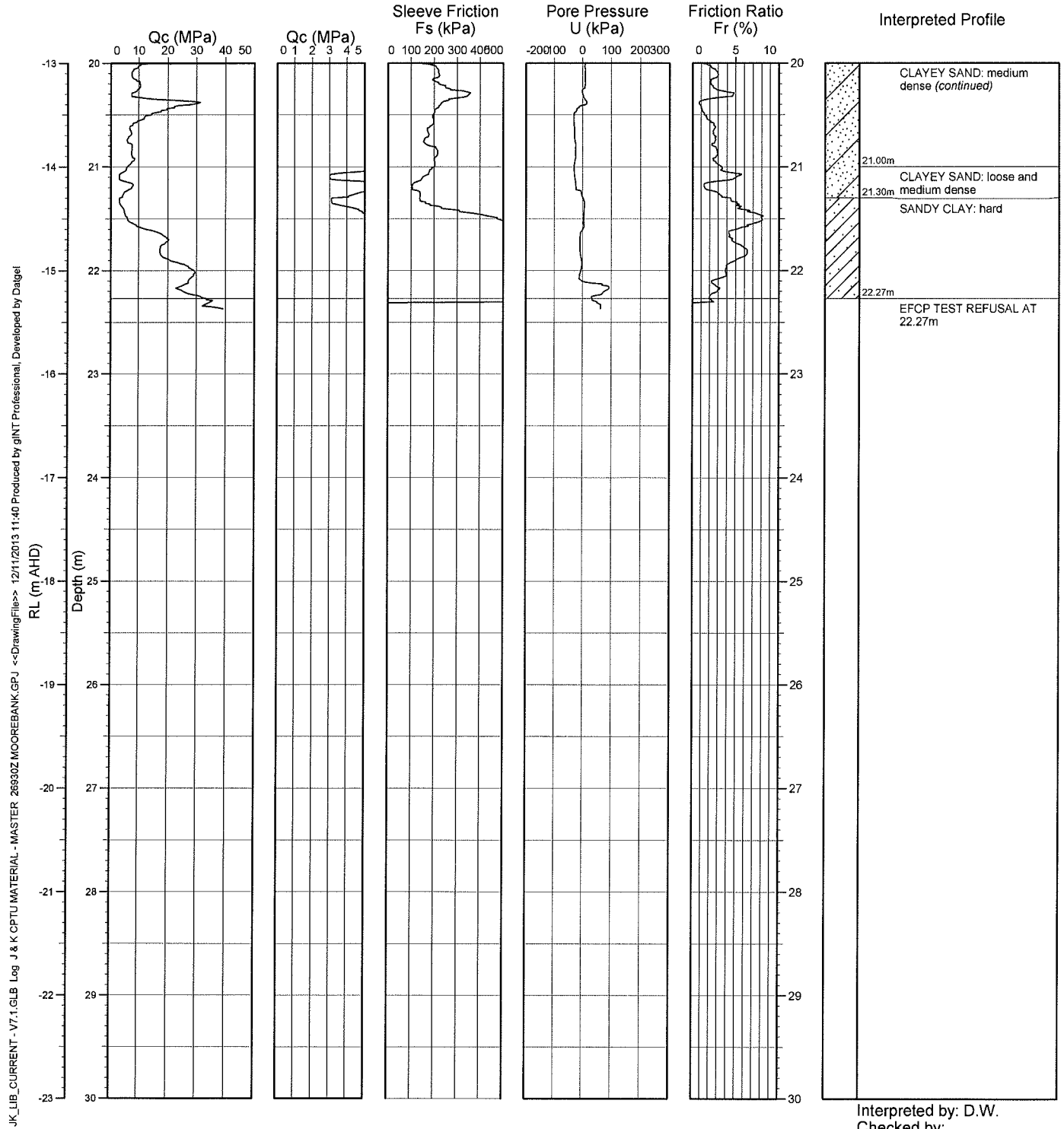
JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
8
3 / 3

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	BENEDICT INDUSTRIES PTY LTD
Project:	PROPOSED RESIDENTIAL DEVELOPMENT
Location:	146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z	**R.L. Surface:** ~7.0 m	**Data File:** 26930Z_8.GEF
Date: 25/10/13	**Datum:** AHD	**Operator:** D.W.



Interpreted by: D.W.
Checked by:

JK_LIB_CURRENT - V7.1.GLB Log J & K CPTU MATERIAL - MASTER 26930Z MOOREBANK.GPJ <<DrawingFile>> 12/11/2013 11:40 Produced by gINT Professional, Developed by Datgel

COPYRIGHT

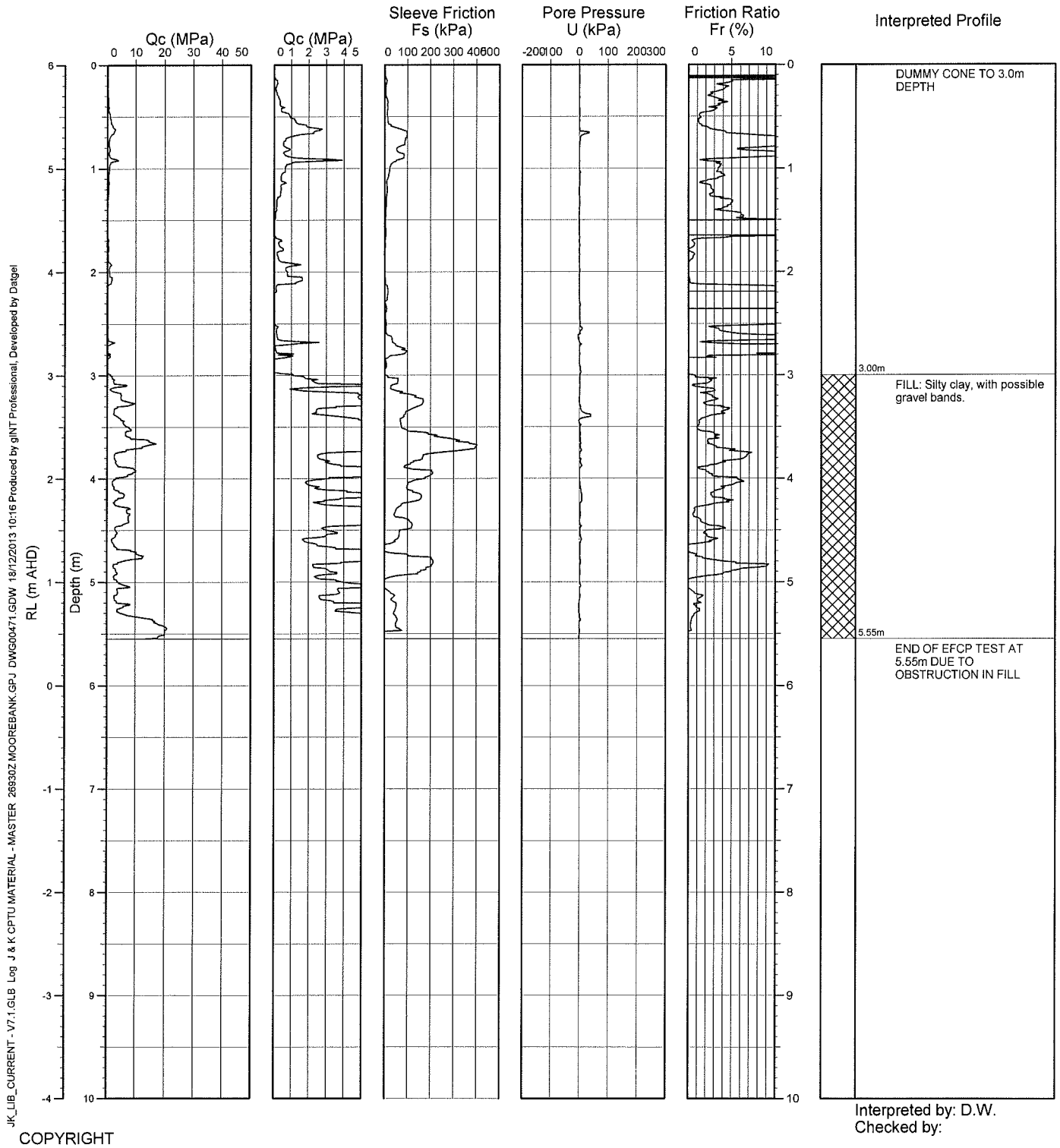
JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. 14 1 / 1

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	BENEDICT INDUSTRIES PTY LTD
Project:	PROPOSED RESIDENTIAL DEVELOPMENT
Location:	146 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No.: 26930Z	**R.L. Surface:** ~6.0 m	**Data File:** 26930Z_14_2.GEF
Date: 25/10/13	**Datum:** AHD	**Operator:** D.W.



Interpreted by: D.W.
Checked by:

JK_LIB_CURRENT - V7.1.GLB Log J & K CPTU MATERIAL - MASTER 26930Z MOOREBANK.GPJ DWG00471.GDW 18/12/2013 10:16 Produced by gINT Professional, Developed by Datgel

COPYRIGHT



NOTES:
Figure 1 has been recreated from the survey plan prepared by Freeburn Surveying Pty Ltd (Ref: 32825, dated 22/8/13).

The borehole locations presented on this plan have been established using a hand held GPS unit with an accuracy of +/- 5m.

Reference should be made to the report text for a full understanding of this plan.

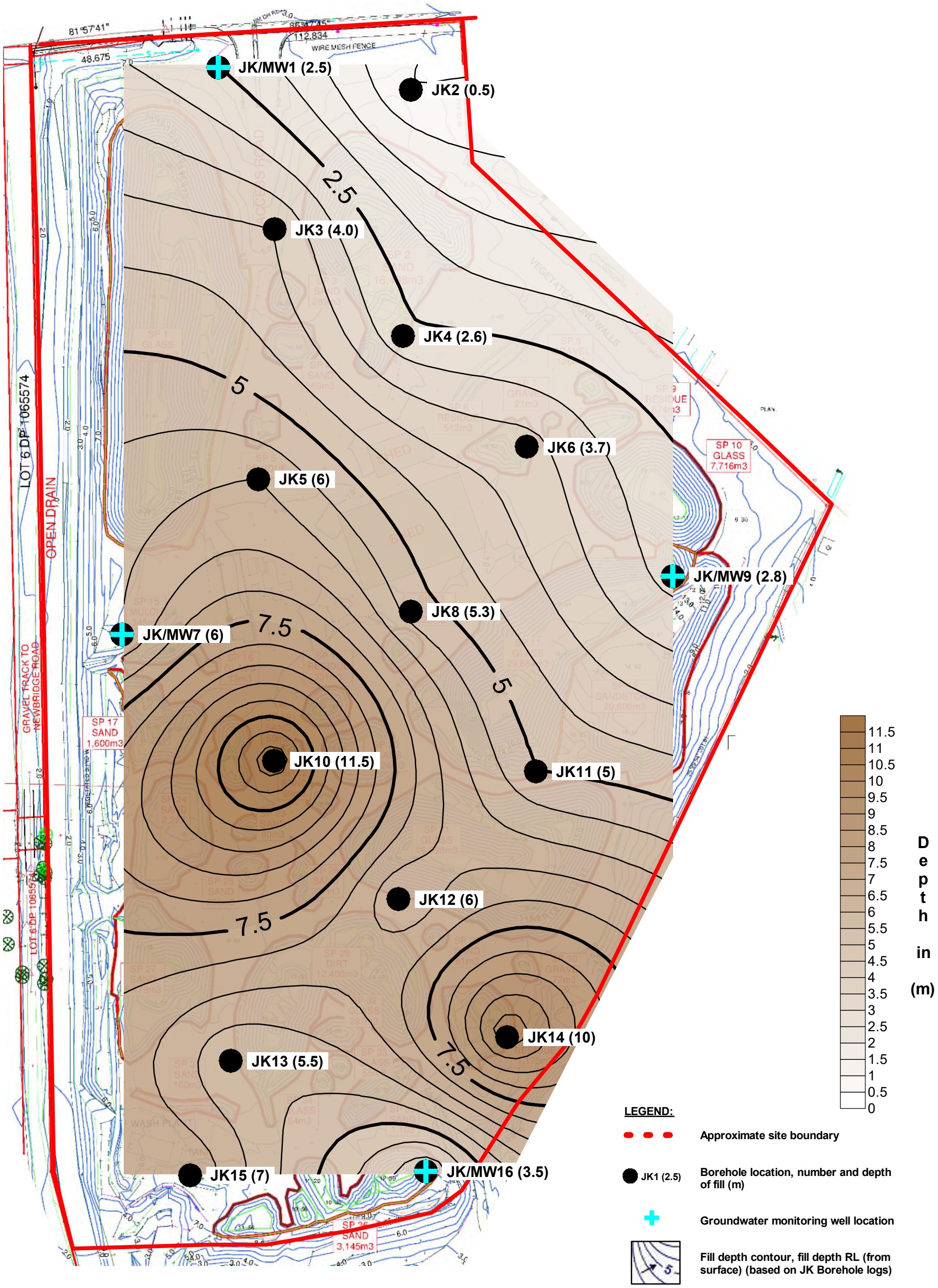
BOREHOLE LOCATION PLAN

Approximate Scale (m):

0 10 20 30 40 50

JK Geotechnics
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

Report No. 26930Z Figure No. 1



NOTES:
Figure 2 has been recreated from the survey plan prepared by Freeburn Surveying Pty Ltd (Ref: 32825, dated 22/8/13).

The borehole locations presented on this plan have been established using a hand held GPS unit with an accuracy of +/- 5m.

Reference should be made to the report text for a full understanding of this plan.

Approximate Scale (m):

0 10 20 30 40 50

FILL DEPTH CONTOUR PLAN

JK Geotechnics
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

Report No. 26930Z Figure No. 2

REPORT EXPLANATION NOTES

REPORT EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the geotechnical report in regard to classification methods, field procedures and certain matters relating to the Comments and Recommendations section. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, the SAA Site Investigation Code. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached Unified Soil Classification Table qualified by the grading of other particles present (e.g. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	less than 0.002mm
Silt	0.002 to 0.075mm
Sand	0.075 to 2mm
Gravel	2 to 60mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose	less than 4
Loose	4 – 10
Medium dense	10 – 30
Dense	30 – 50
Very Dense	greater than 50

Cohesive soils are classified on the basis of strength (consistency) either by use of hand penetrometer, laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength kPa
Very Soft	less than 25
Soft	25 – 50
Firm	50 – 100
Stiff	100 – 200
Very Stiff	200 – 400
Hard	Greater than 400
Friable	Strength not attainable – soil crumbles

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'Shale' is used to describe thinly bedded to laminated siltstone.

SAMPLING

Sampling is carried out during drilling or from other excavations to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon the degree of disturbance, some information on strength and structure. Bulk samples are similar but of greater volume required for some test procedures.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All except test pits, hand auger drilling and portable dynamic cone penetrometers require the use of a mechanical drilling rig which is commonly mounted on a truck chassis.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Premature refusal of the hand augers can occur on a variety of materials such as hard clay, gravel or ironstone, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock fragments. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from “feel” and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term ‘mud’ encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, an NMLC triple tube core barrel, which gives a core of about 50mm diameter, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS. The location of losses are determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the top end of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, “Methods of Testing Soils for Engineering Purposes” – Test F3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the ‘N’ value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of, say, 4, 6 and 7 blows, as

  N = 13
  4, 6, 7

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as

  N>30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

Occasionally, the drop hammer is used to drive 50mm diameter thin walled sample tubes (U50) in clays. In such circumstances, the test results are shown on the borehole logs in brackets.

A modification to the SPT test is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as "N_c” on the borehole logs, together with the number of blows per 150mm penetration.

Static Cone Penetrometer Testing and Interpretation: Cone penetrometer testing (sometimes referred to as a Dutch Cone) described in this report has been carried out using an Electronic Friction Cone Penetrometer (EFCP). The test is described in Australian Standard 1289, Test F5.1.

In the tests, a 35mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the frictional resistance on a separate 134mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are electrically connected by wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output as incremental digital records every 10mm. The results given in this report have been plotted from the digital data.

The information provided on the charts comprise:

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio – the ratio of sleeve friction to cone resistance, expressed as a percentage.

  The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and occasionally very soft clays, rising to 4% to 10% in stiff clays and peats. Soil descriptions based on cone resistance and friction ratios are only inferred and must not be considered as exact.

Correlations between EFCP and SPT values can be developed for both sands and clays but may be site specific.

Interpretation of EFCP values can be made to empirically derive modulus or compressibility values to allow calculation of foundation settlements.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive. The test method provides a continuous profile of engineering properties but, where precise information on soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometers: Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a rod into the ground with a sliding hammer and counting the blows for successive 100mm increments of penetration.

Two relatively similar tests are used:

- Cone penetrometer (commonly known as the Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS1289, Test F3.2). The test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various Road Authorities.
- Perth sand penetrometer – a 16mm diameter flat ended rod is driven with a 9kg hammer, dropping 600mm (AS1289, Test F3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.

LOGS

The borehole or test pit logs presented herein are an engineering and/or geological interpretation of the sub-surface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will enable the most reliable assessment, but is not always practicable or possible to justify on economic grounds. In any case, the boreholes or test pits represent only a very small sample of the total subsurface conditions.

The attached explanatory notes define the terms and symbols used in preparation of the logs.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than “straight line” variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

Where groundwater levels are measured in boreholes, there are several potential problems:

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole or ‘reverted’ chemically if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after stabilising at intervals ranging from several days to perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg bricks, steel etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably determine the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing is normally carried out in accordance with Australian Standard 1289 *'Methods of Testing Soil for Engineering Purposes'*. Details of the test procedure used are given on the individual report forms.

ENGINEERING REPORTS

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building) the information and interpretation may not be relevant if the design proposal is changed (eg to a twenty storey building). If this happens, the company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions – the potential for this will be partially dependent on borehole spacing and sampling frequency as well as investigation technique.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of persons or contractors responding to commercial pressures.

If these occur, the company will be pleased to assist with investigation or advice to resolve any problems occurring.

SITE ANOMALIES

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed that at some later stage, well after the event.

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

Attention is drawn to the document *'Guidelines for the Provision of Geotechnical Information in Tender Documents'*, published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Copyright in all documents (such as drawings, borehole or test pit logs, reports and specifications) provided by the Company shall remain the property of Jeffery and Katauskas Pty Ltd. Subject to the payment of all fees due, the Client alone shall have a licence to use the documents provided for the sole purpose of completing the project to which they relate. License to use the documents may be revoked without notice if the Client is in breach of any objection to make a payment to us.

REVIEW OF DESIGN

Where major civil or structural developments are proposed or where only a limited investigation has been completed or where the geotechnical conditions/ constraints are quite complex, it is prudent to have a joint design review which involves a senior geotechnical engineer.

SITE INSPECTION

The company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

Requirements could range from:

i) a site visit to confirm that conditions exposed are no worse than those interpreted, to

ii) a visit to assist the contractor or other site personnel in identifying various soil/rock types such as appropriate footing or pier founding depths, or

iii) full time engineering presence on site.

GRAPHIC LOG SYMBOLS FOR SOILS AND ROCKS

SOIL


FILL


TOPSOIL


CLAY (CL, CH)


SILT (ML, MH)


SAND (SP, SW)


GRAVEL (GP, GW)


SANDY CLAY (CL, CH)


SILTY CLAY (CL, CH)


CLAYEY SAND (SC)


SILTY SAND (SM)


GRAVELLY CLAY (CL, CH)


CLAYEY GRAVEL (GC)


SANDY SILT (ML)


PEAT AND ORGANIC SOILS

ROCK


CONGLOMERATE


SANDSTONE


SHALE


SILTSTONE, MUDSTONE, CLAYSTONE


LIMESTONE


PHYLLITE, SCHIST


TUFF


GRANITE, GABBRO


DOLERITE, DIORITE


BASALT, ANDESITE


QUARTZITE

DEFECTS AND INCLUSIONS


CLAY SEAM


SHEARED OR CRUSHED SEAM


BRECCIATED OR SHATTERED SEAM/ZONE


IRONSTONE GRAVEL


ORGANIC MATERIAL

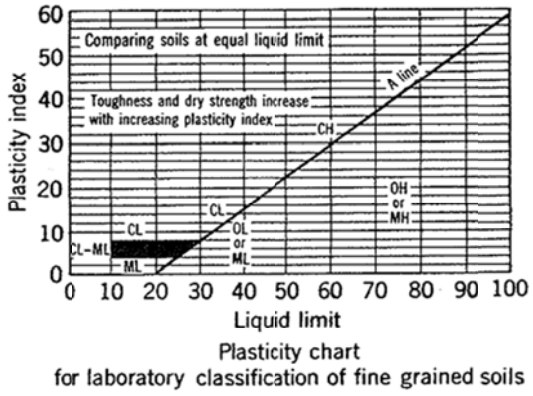
OTHER MATERIALS


CONCRETE


BITUMINOUS CONCRETE, COAL


COLLUVIUM

Field Identification Procedures (Excluding particles larger than 75 μm and basing fractions on estimated weights)				Group Symbols[a]	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria
Coarse-grained soils More than half of material is *larger* than 75 μm sieve size[b] (The 75 μm sieve size is about the smallest particle visible to naked eye)	Gravels More than half of coarse fraction is larger than 4 mm sieve size	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	*GW*	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name; indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics Example: *Silty sand*, gravelly; about 20% hard, angular gravel particles 12 mm maximum size; rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (*SM*)	Use grain size curve in identifying the fractions as given under field identification Determine percentages of gravel and sand from grain size curve Depending on percentage of fines (fraction smaller than 75 μm sieve size) coarse grained soils are classified as follows: Less than 5% *GW, GP, SW, SP* More than 12% *GM, GC, SM, SC* 5% to 12% *Borderline* cases requiring use of dual symbols $C_U = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 Not meeting all gradation requirements for *GW* Atterberg limits below "A" line, or *PI* less than 4 / Atterberg limits above "A" line, with *PI* greater than 7 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols $C_U = \frac{D_{60}}{D_{10}}$ Greater than 6 $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 Not meeting all gradation requirements for *SW* Atterberg limits below "A" line or *PI* less than 5 / Atterberg limits below "A" line with *PI* greater than 7 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
		Gravels with fines (appreciable amount of fines)	Predominantly one size or a range of sizes with some intermediate sizes missing	*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines		
			Nonplastic fines (for identification procedures see *ML* below)	*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures		
			Plastic fines (for identification procedures, see *CL* below)	*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures		
	Sands More than half of coarse fraction is smaller than 4 mm sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	*SW*	Well graded sands, gravelly sands, little or no fines		
			Predominantly one size or a range of sizes with some intermediate sizes missing	*SP*	Poorly graded sands, gravelly sands, little or no fines		
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)	*SM*	Silty sands, poorly graded sand-silt mixtures		
			Plastic fines (for identification procedures, see *CL* below)	*SC*	Clayey sands, poorly graded sand-clay mixtures		
Fine-grained soils More than half of material is *smaller* than 75 μm sieve size (The 75 μm sieve size is about the smallest particle visible to naked eye)	Identification Procedures on Fraction Smaller than 380 μm Sieve Size						
	Silts and clays liquid limit less than 50	Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)			
		None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions Example: *Clayey silt*, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (*ML*)
		Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity	
	Silts and clays liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
		High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays	
		Medium to high	None to very slow	Slight to medium	*OH*	Organic clays of medium to high plasticity	
Highly Organic Soils		Readily identified by colour, odour, spongy feel and frequently by fibrous texture			*Pt*	Peat and other highly organic soils	



Plasticity chart
for laboratory classification of fine grained soils

Note: 1 Soils possessing characteristics of two groups are designated by combinations of group symbols (eg. GW-GC, well graded gravel-sand mixture with clay fines).
2 Soils with liquid limits of the order of 35 to 50 may be visually classified as being of medium plasticity.

LOG SYMBOLS

LOG COLUMN	SYMBOL	DEFINITION
Groundwater Record	▼	Standing water level. Time delay following completion of drilling may be shown.
	C	Extent of borehole collapse shortly after drilling.
	▶	Groundwater seepage into borehole or excavation noted during drilling or excavation.
Samples	ES	Soil sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
	ASB	Soil sample taken over depth indicated, for asbestos screening.
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.
	SAL	Soil sample taken over depth indicated, for salinity analysis.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'R' as noted below.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60 degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25	Vane shear reading in kPa of Undrained Shear Strength.
	PID = 100	Photoionisation detector reading in ppm (Soil sample headspace test).
Moisture Condition (Cohesive Soils)	MC>PL	Moisture content estimated to be greater than plastic limit.
	MC≈PL	Moisture content estimated to be approximately equal to plastic limit.
	MC<PL	Moisture content estimated to be less than plastic limit.
(Cohesionless Soils)	D	DRY – Runs freely through fingers.
	M	MOIST – Does not run freely but no free water visible on soil surface.
	W	WET – Free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS	VERY SOFT – Unconfined compressive strength less than 25kPa
	S	SOFT – Unconfined compressive strength 25-50kPa
	F	FIRM – Unconfined compressive strength 50-100kPa
	St	STIFF – Unconfined compressive strength 100-200kPa
	VSt	VERY STIFF – Unconfined compressive strength 200-400kPa
	H	HARD – Unconfined compressive strength greater than 400kPa
	( )	Bracketed symbol indicates estimated consistency based on tactile examination or other tests.
Density Index/ Relative Density (Cohesionless Soils)		**Density Index (I_D) Range (%)** / **SPT 'N' Value Range (Blows/300mm)**
	VL	Very Loose <15 0-4
	L	Loose 15-35 4-10
	MD	Medium Dense 35-65 10-30
	D	Dense 65-85 30-50
	VD	Very Dense >85 >50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other tests.
Hand Penetrometer Readings	300 250	Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise.
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Tungsten carbide wing bit.
	T 60	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.

LOG SYMBOLS continued

ROCK MATERIAL WEATHERING CLASSIFICATION

TERM	SYMBOL	DEFINITION
Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely weathered rock	XW	Rock is weathered to such an extent that it has "soil" properties, ie it either disintegrates or can be remoulded, in water.
Distinctly weathered rock	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Slightly weathered rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh rock	FR	Rock shows no sign of decomposition or staining.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Journal of Rock Mechanics, Mining, Science and Geomechanics. Abstract Volume 22, No 2, 1985.

TERM	SYMBOL	Is (50) MPa	FIELD GUIDE
Extremely Low:	EL		Easily remoulded by hand to a material with soil properties.
----------	----------	0.03	
Very Low:	VL		May be crumbled in the hand. Sandstone is "sugary" and friable.
----------	----------	0.1	
Low:	L		A piece of core 150mm long x 50mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
----------	----------	0.3	
Medium Strength:	M		A piece of core 150mm long x 50mm dia. can be broken by hand with difficulty. Readily scored with knife.
----------	----------	1	
High:	H		A piece of core 150mm long x 50mm dia. core cannot be broken by hand, can be slightly scratched or scored with knife; rock rings under hammer.
----------	----------	3	
Very High:	VH		A piece of core 150mm long x 50mm dia. may be broken with hand-held pick after more than one blow. Cannot be scratched with pen knife; rock rings under hammer.
----------	----------	10	
Extremely High:	EH		A piece of core 150mm long x 50mm dia. is very difficult to break with hand-held hammer. Rings when struck with a hammer.

ABBREVIATIONS USED IN DEFECT DESCRIPTION

ABBREVIATION	DESCRIPTION	NOTES
Be	Bedding Plane Parting	Defect orientations measured relative to the normal to the long core axis (ie relative to horizontal for vertical holes)
CS	Clay Seam	
J	Joint	
P	Planar	
Un	Undulating	
S	Smooth	
R	Rough	
IS	Ironstained	
XWS	Extremely Weathered Seam	
Cr	Crushed Seam	
60t	Thickness of defect in millimetres	

APPENDIX A

Aerial Photographs Between 1991 and 2015

20th September 1991



4th October 1994



29th September 1998



16th March 2002



10th December 2005



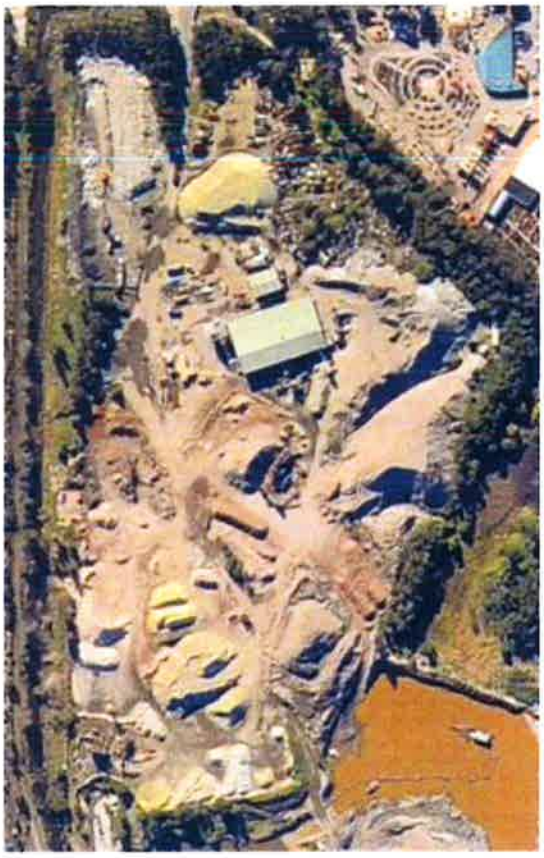
14th November 2009



22nd April 2010



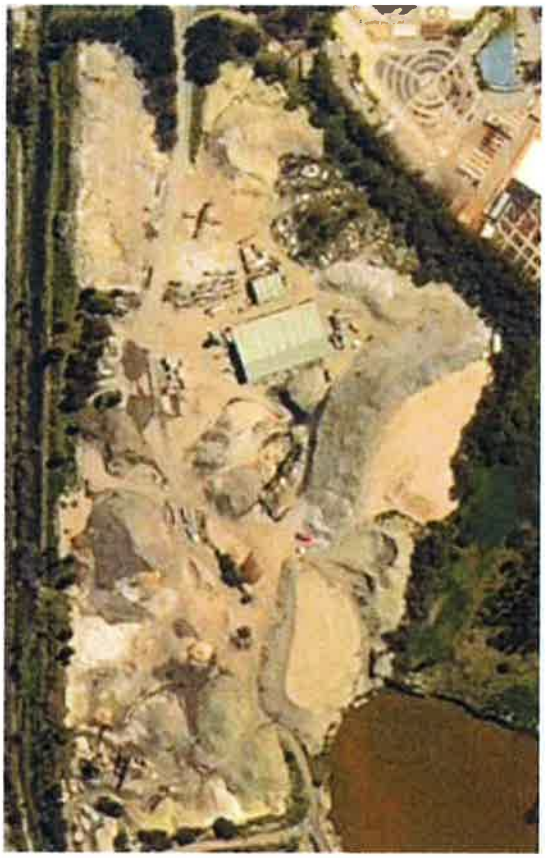
15th July 2010



3rd June 2011



23rd October 2011



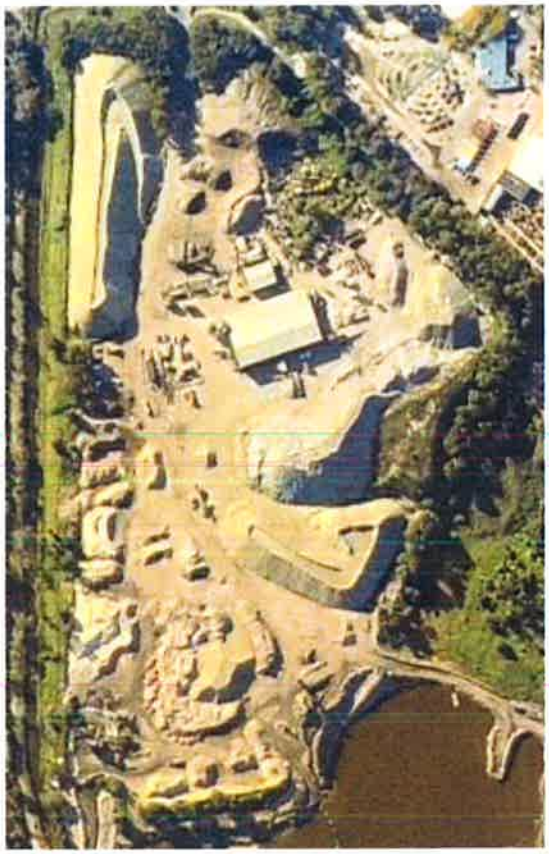
9th May 2012



24th October 2012



3rd May 2013



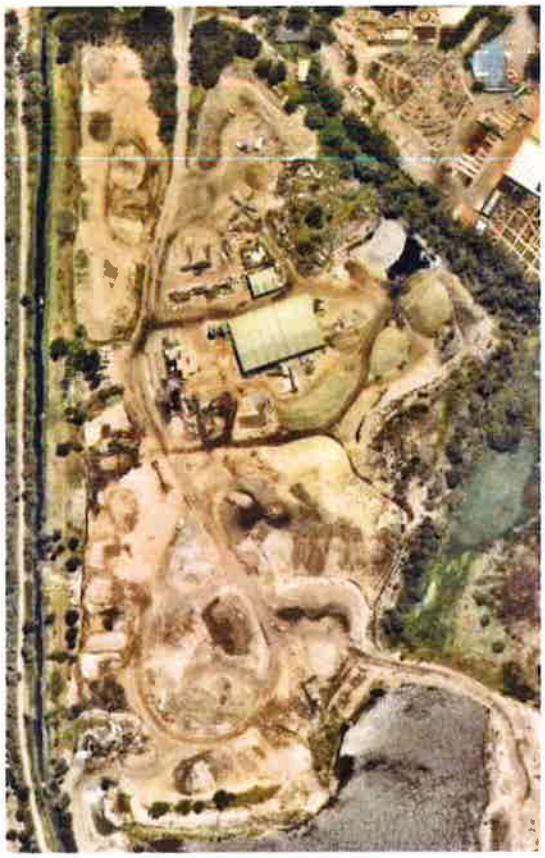
30th September 2013



8th February 2014



21st November 2014

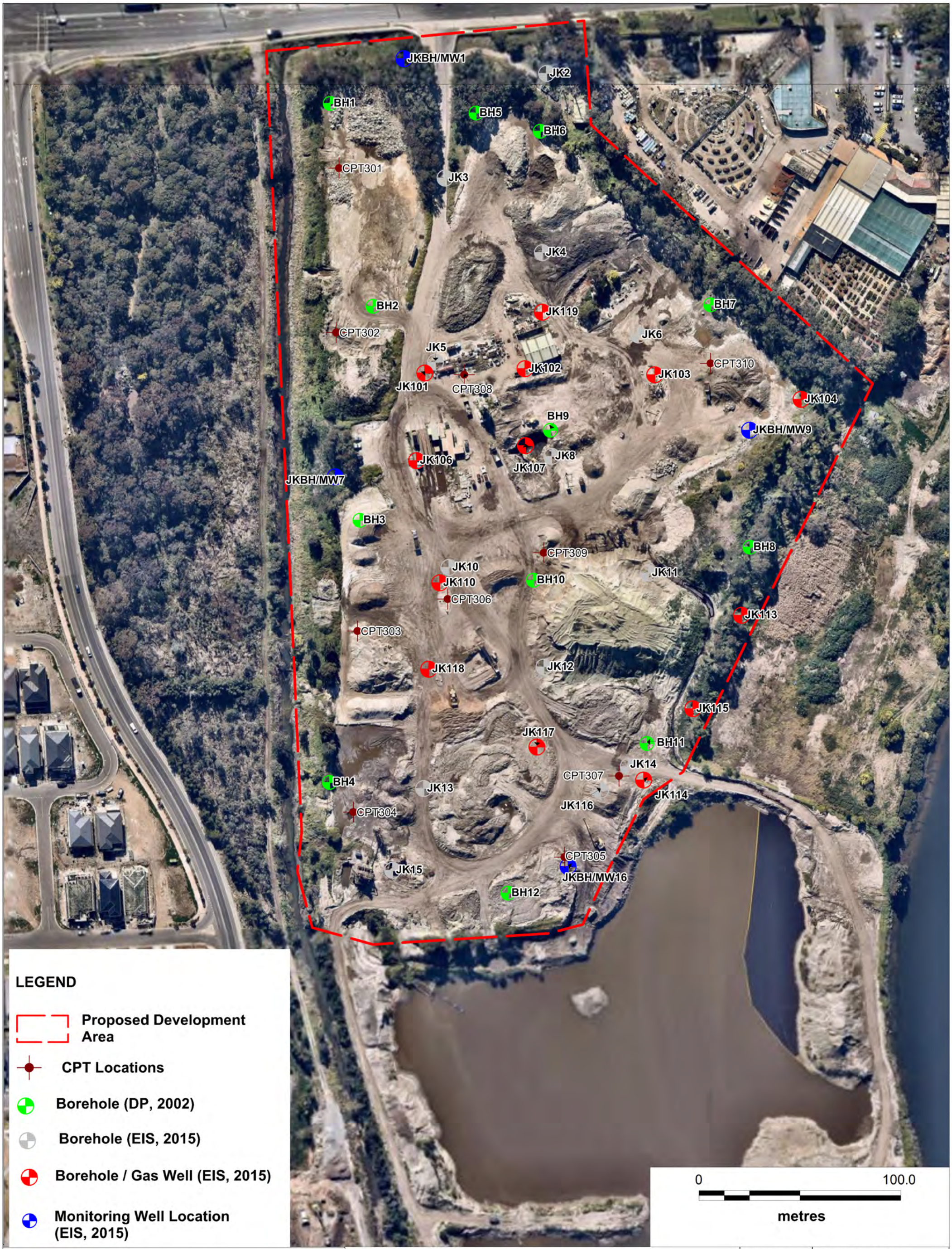


6th May 2015



APPENDIX B

Douglas Partners
Test Locations and Test Results
(Project 30410, dated 30 May 2002)



Douglas Partners
Geotechnics / Environment / Groundwater

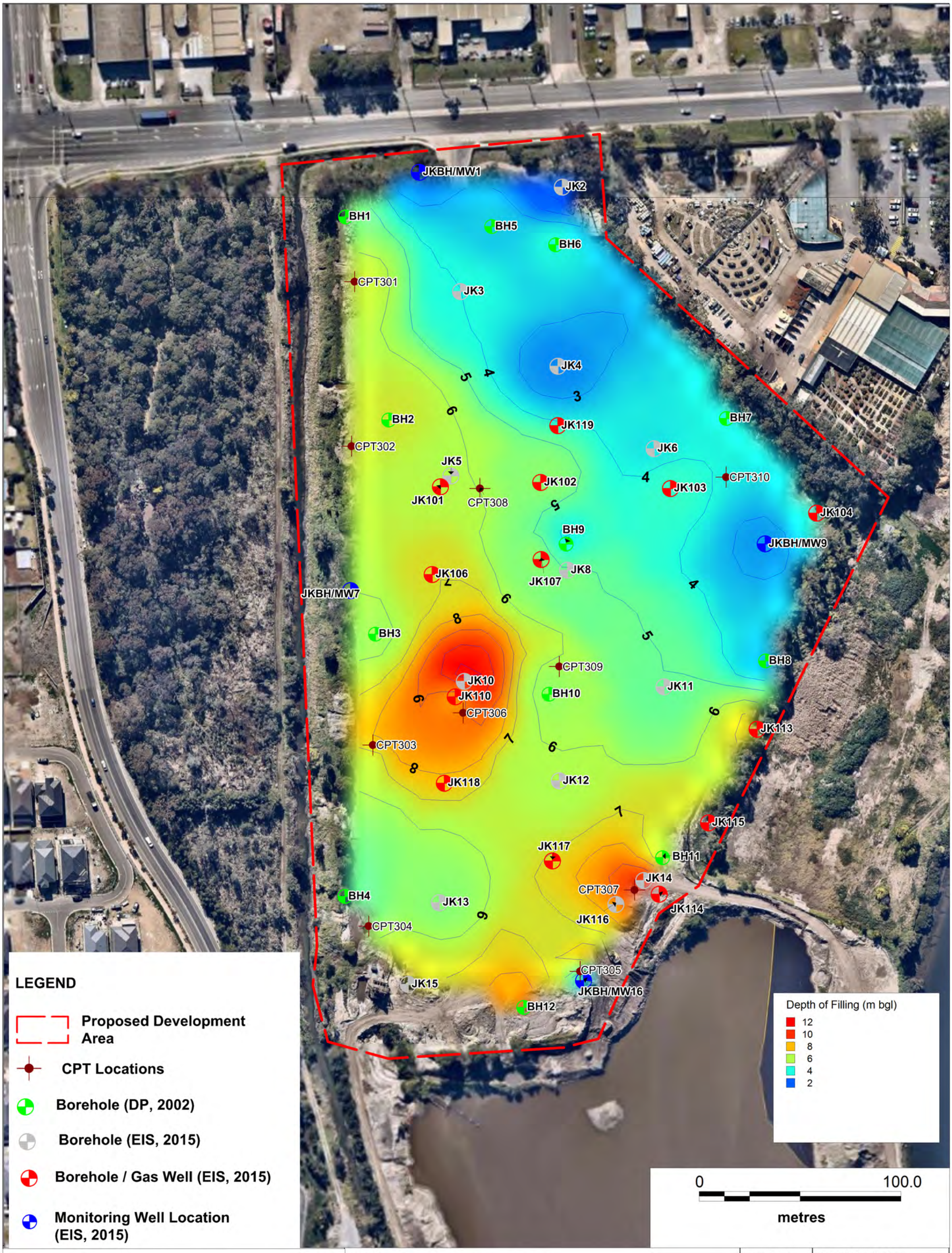
TITLE: Location of Tests

146 Newbridge Road, Moorebank, NSW

N
MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 11.11.2015

CLIENT: Benedict Industries Pty Ltd	PROJECT No: 71459.04	DRAWING No: 1	REVISION: A	SCALE: As shown



Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Depth of Filling Contours

146 Newbridge Road, Moorebank, NSW

CLIENT: Benedict Industries Pty Ltd	PROJECT No: 71459.04	DRAWING No: 2	REVISION: A	SCALE: As shown

OFFICE: Sydney
DRAWN BY: MJC
DATE: 13.11.2015

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

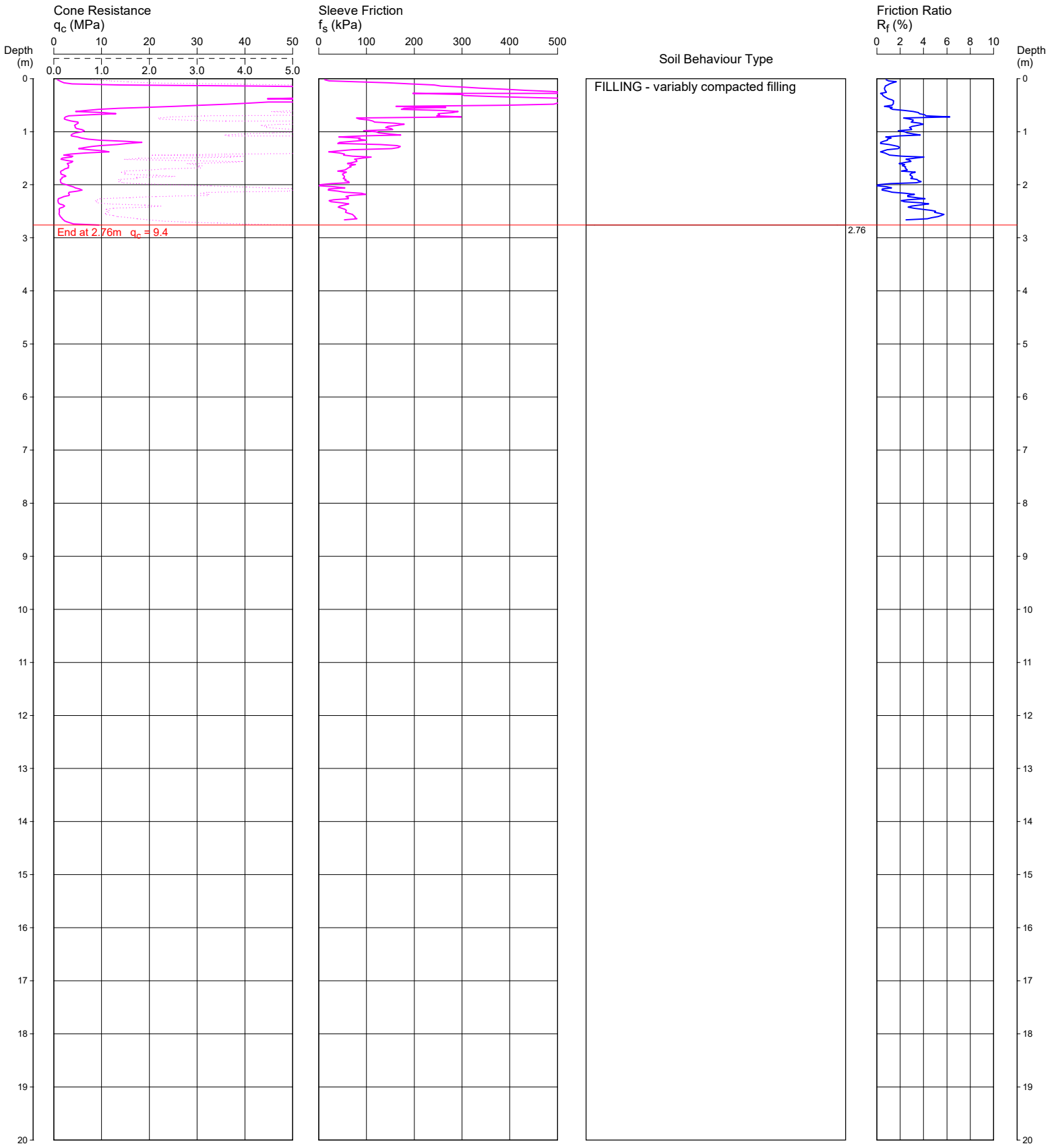
COORDINATES:

CPT301

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT201.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

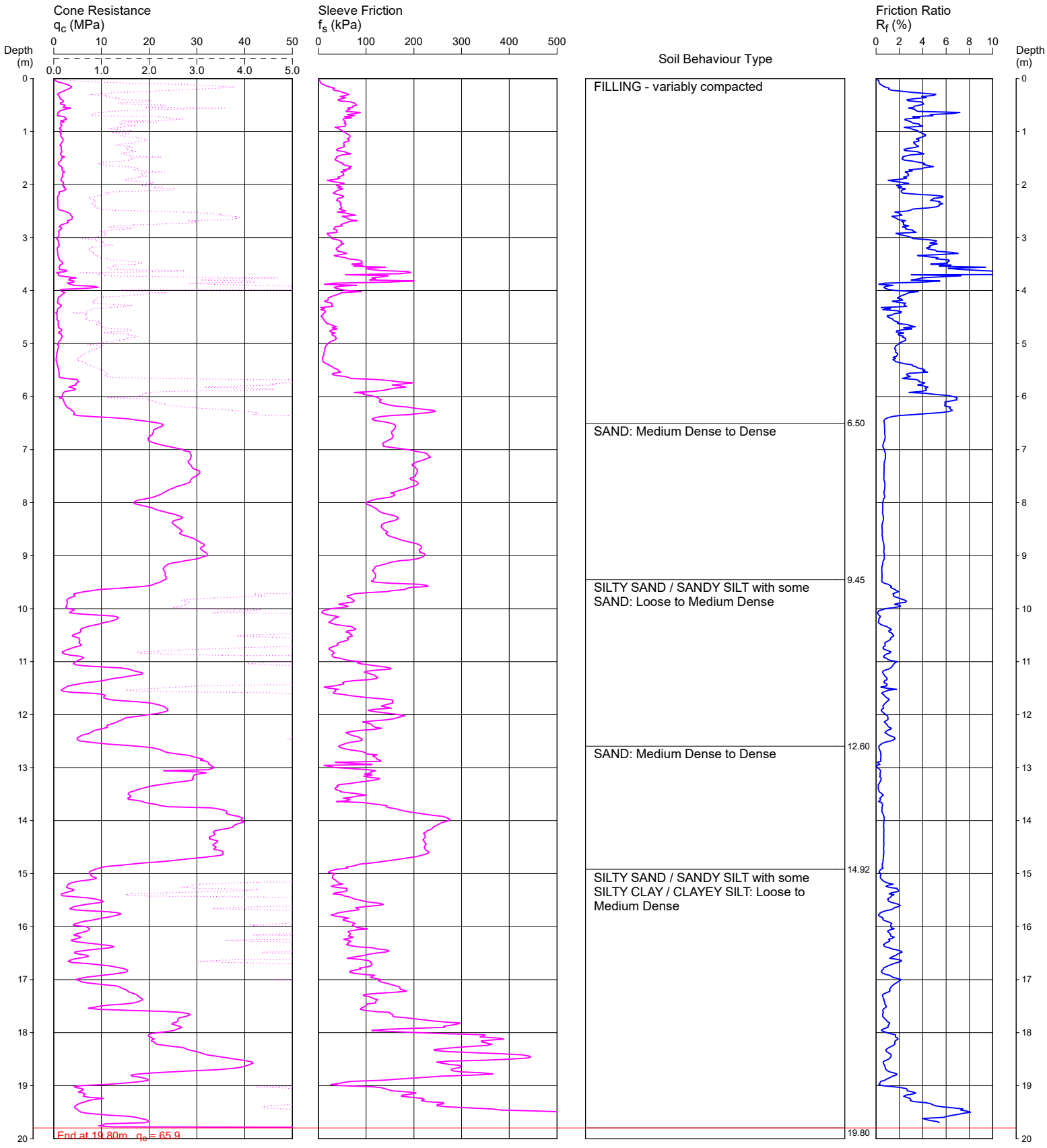
COORDINATES:

CPT301A

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO CONE TIP REFUSAL.
HOLE COLLAPSE AT 4.9 m DEPTH AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT201A.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

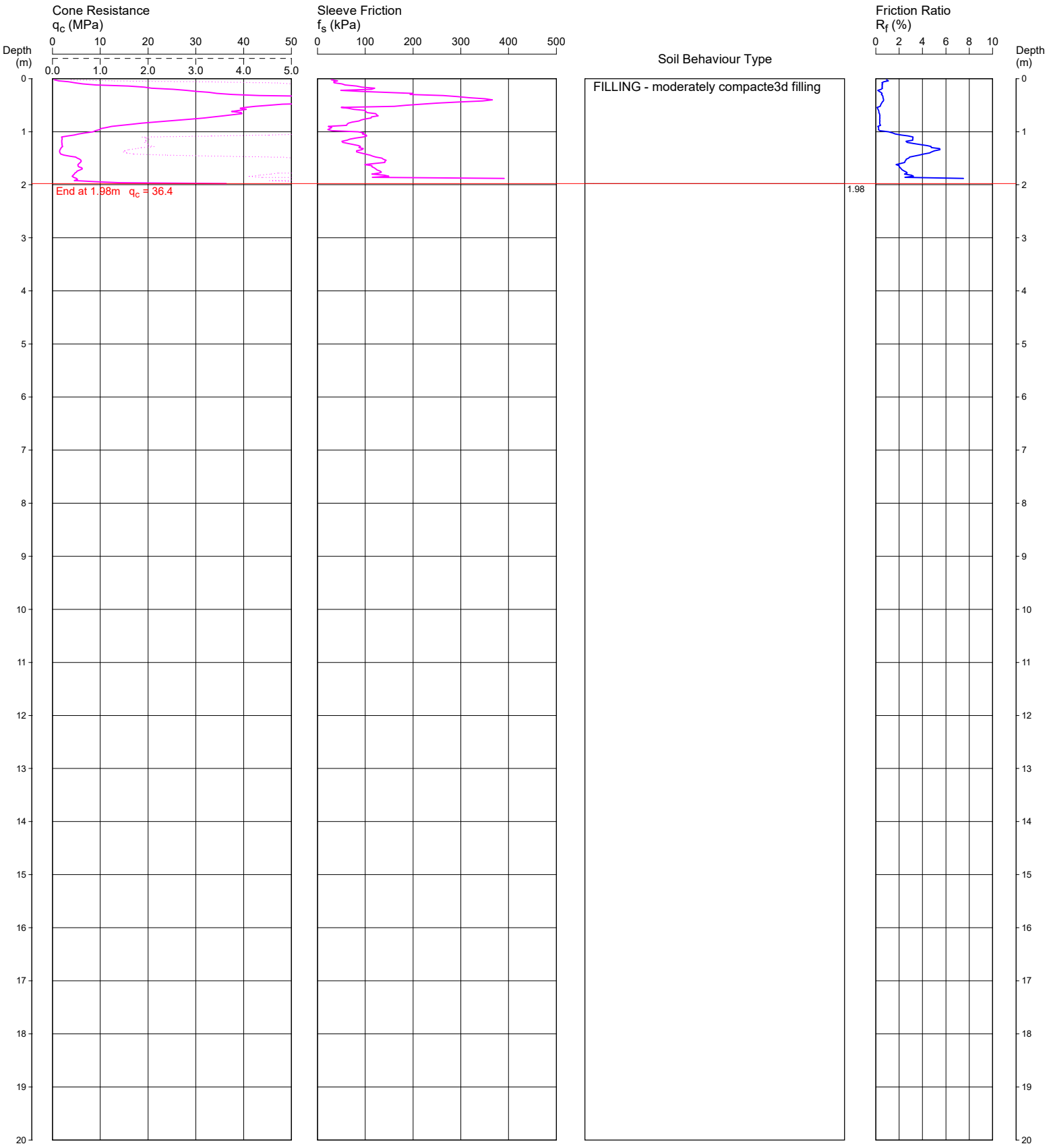
COORDINATES:

CPT302

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT302.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

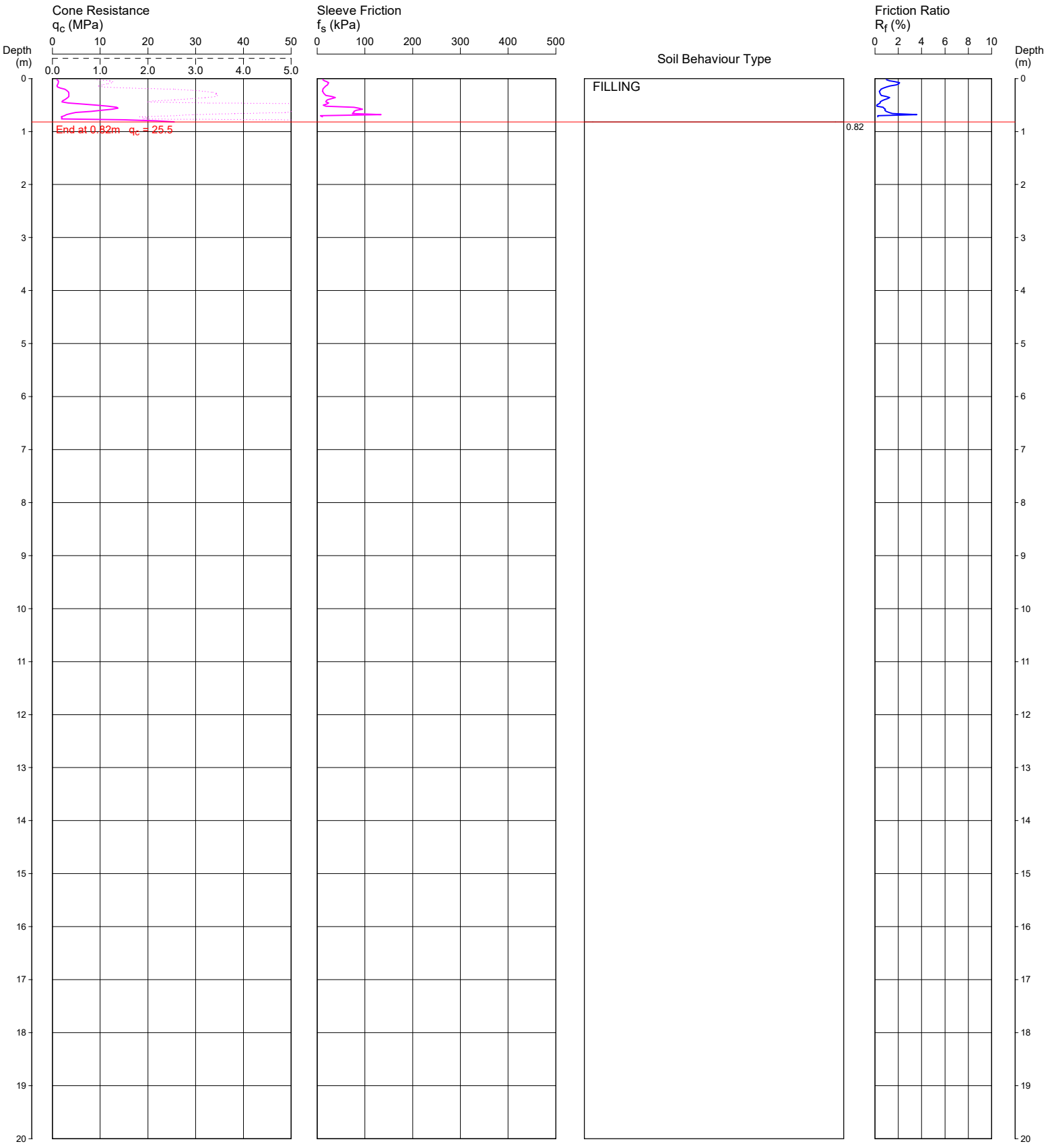
COORDINATES:

CPT302A

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT302A.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

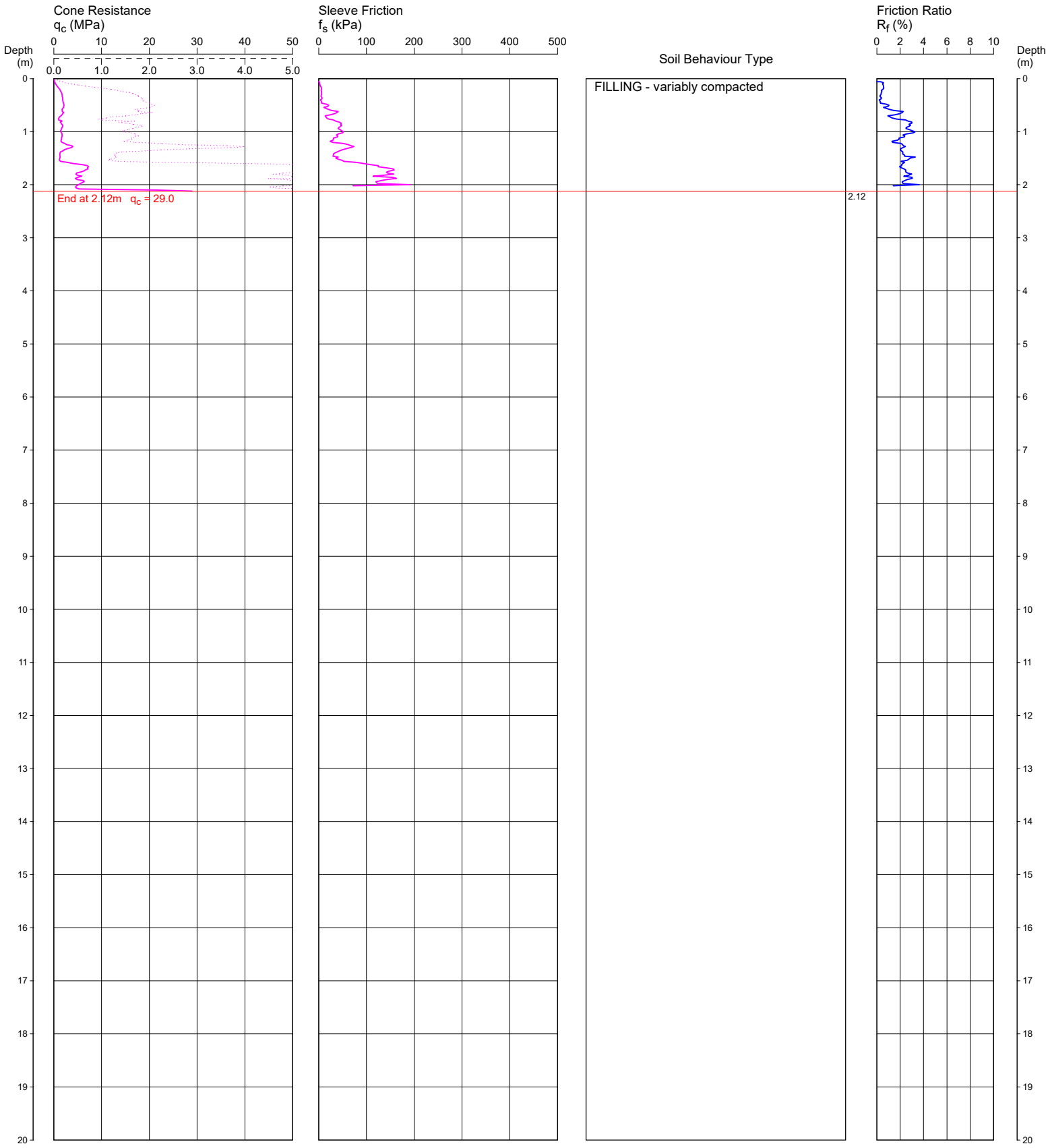
COORDINATES:

CPT302B

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT302B.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

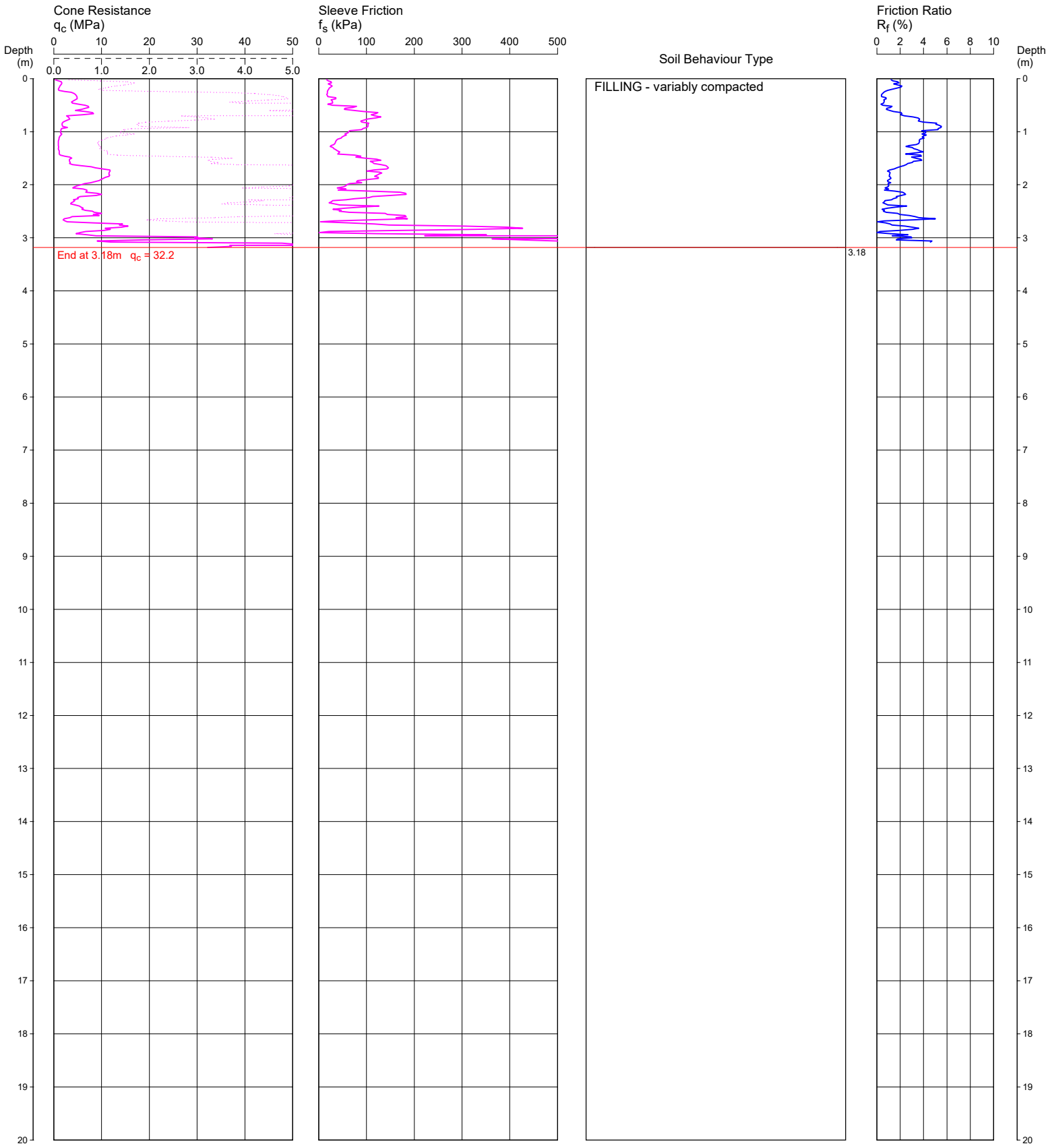
COORDINATES:

CPT302C

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO HIGH CONE SLEEVE OFFSET.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT302C.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

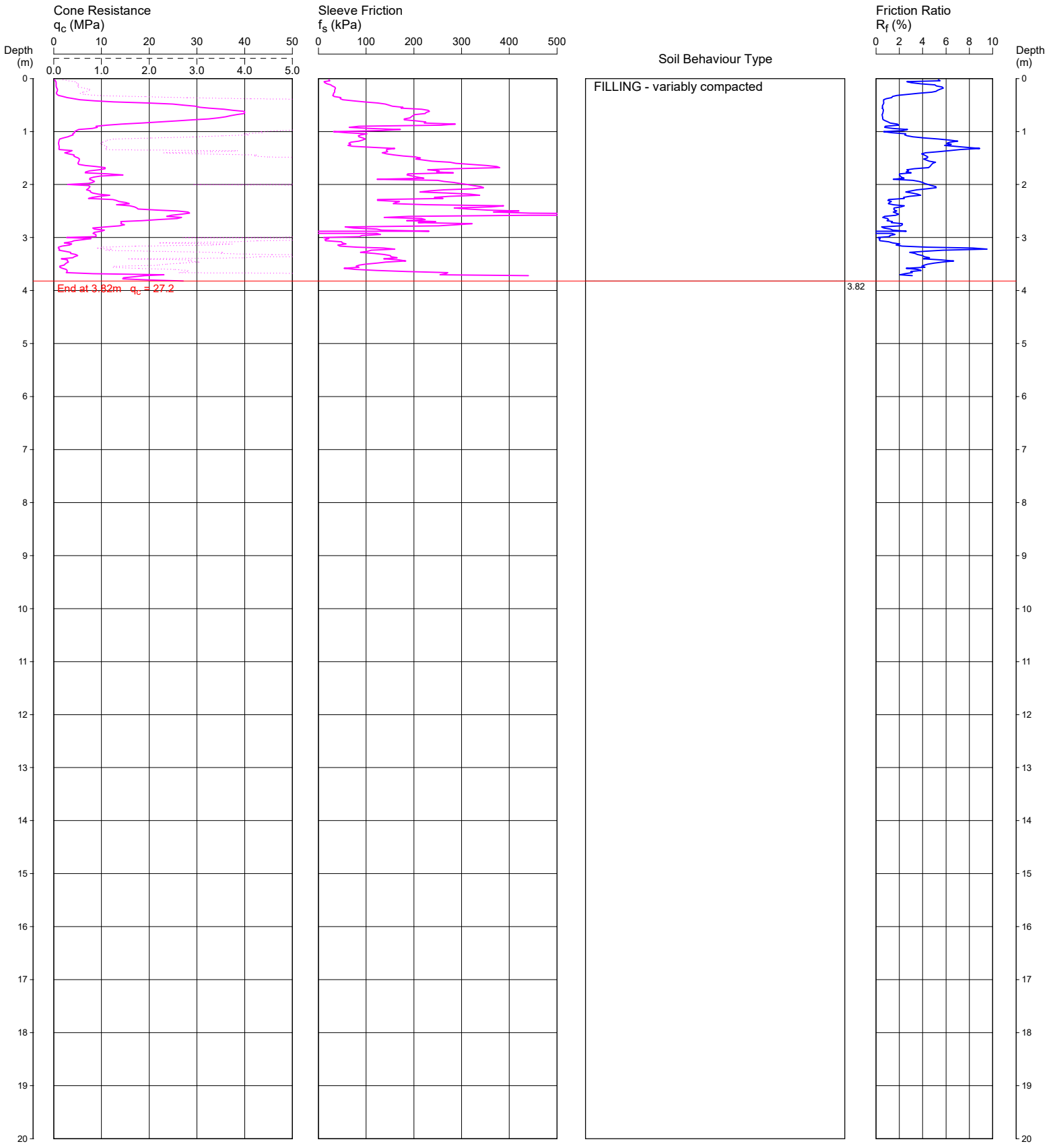
COORDINATES:

CPT302D

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT302D.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

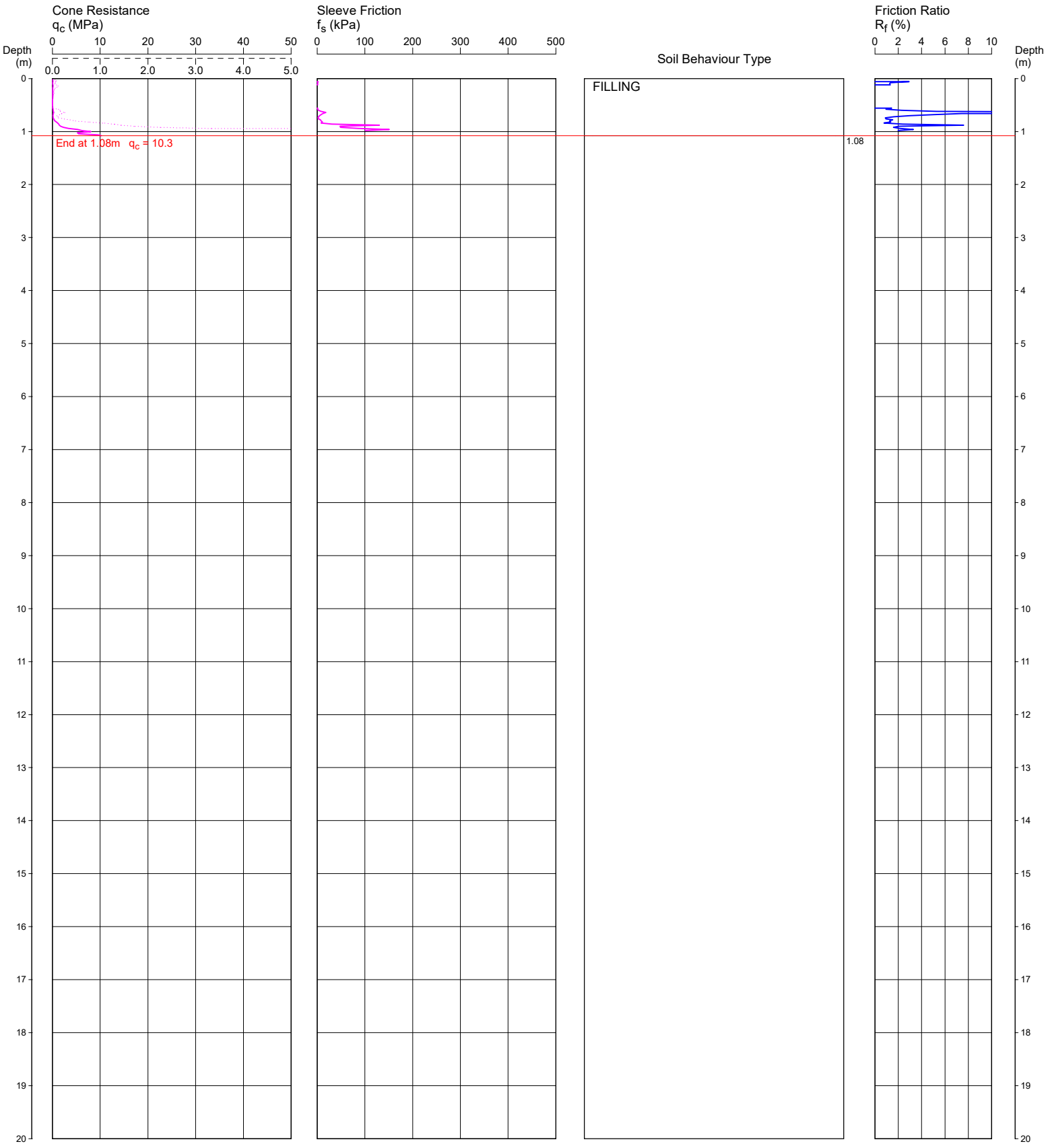
COORDINATES:

CPT303

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0 m TO 1.0 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO BENDING IN FILLING. NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT303.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

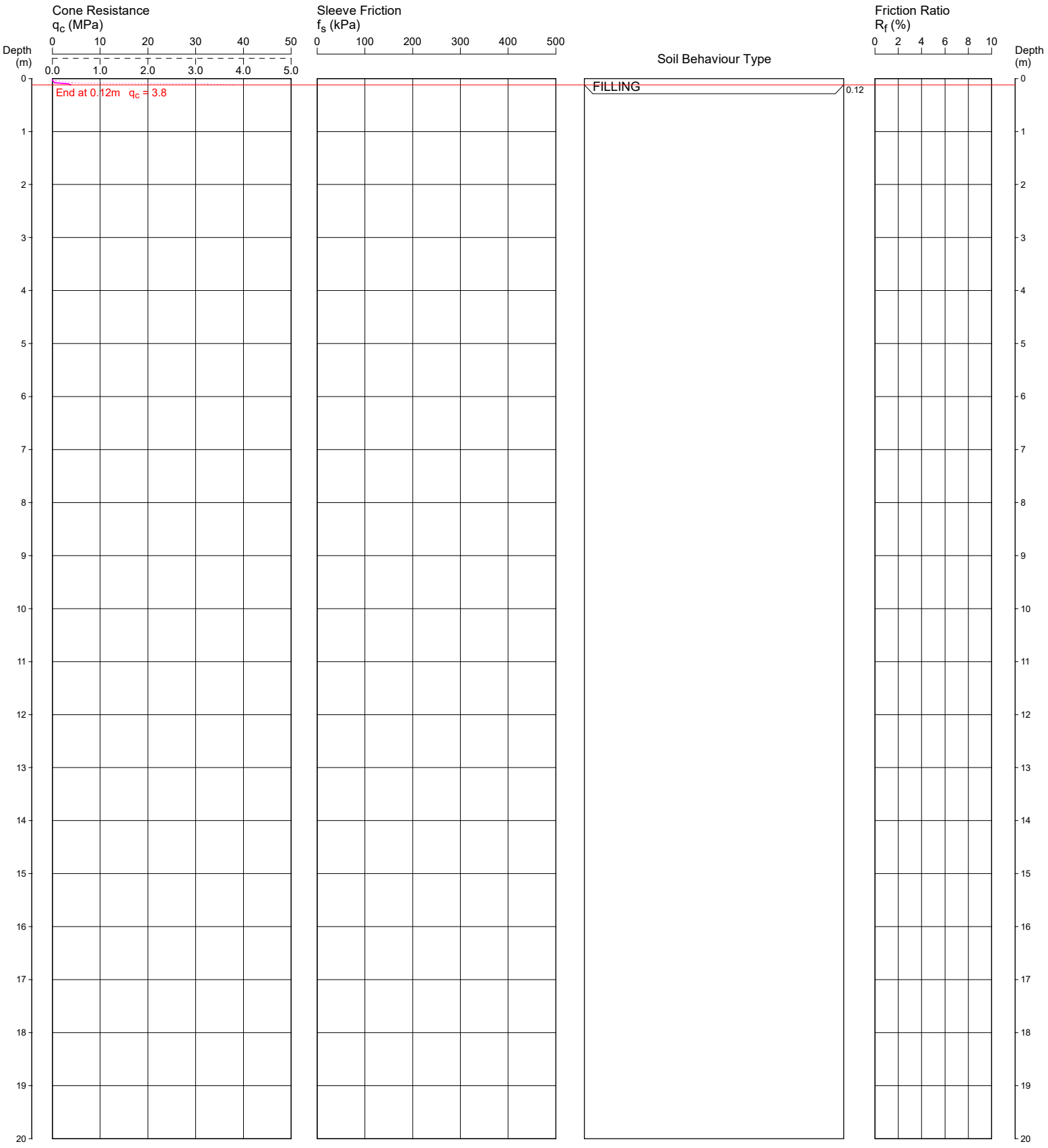
COORDINATES:

CPT303A

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT303A.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

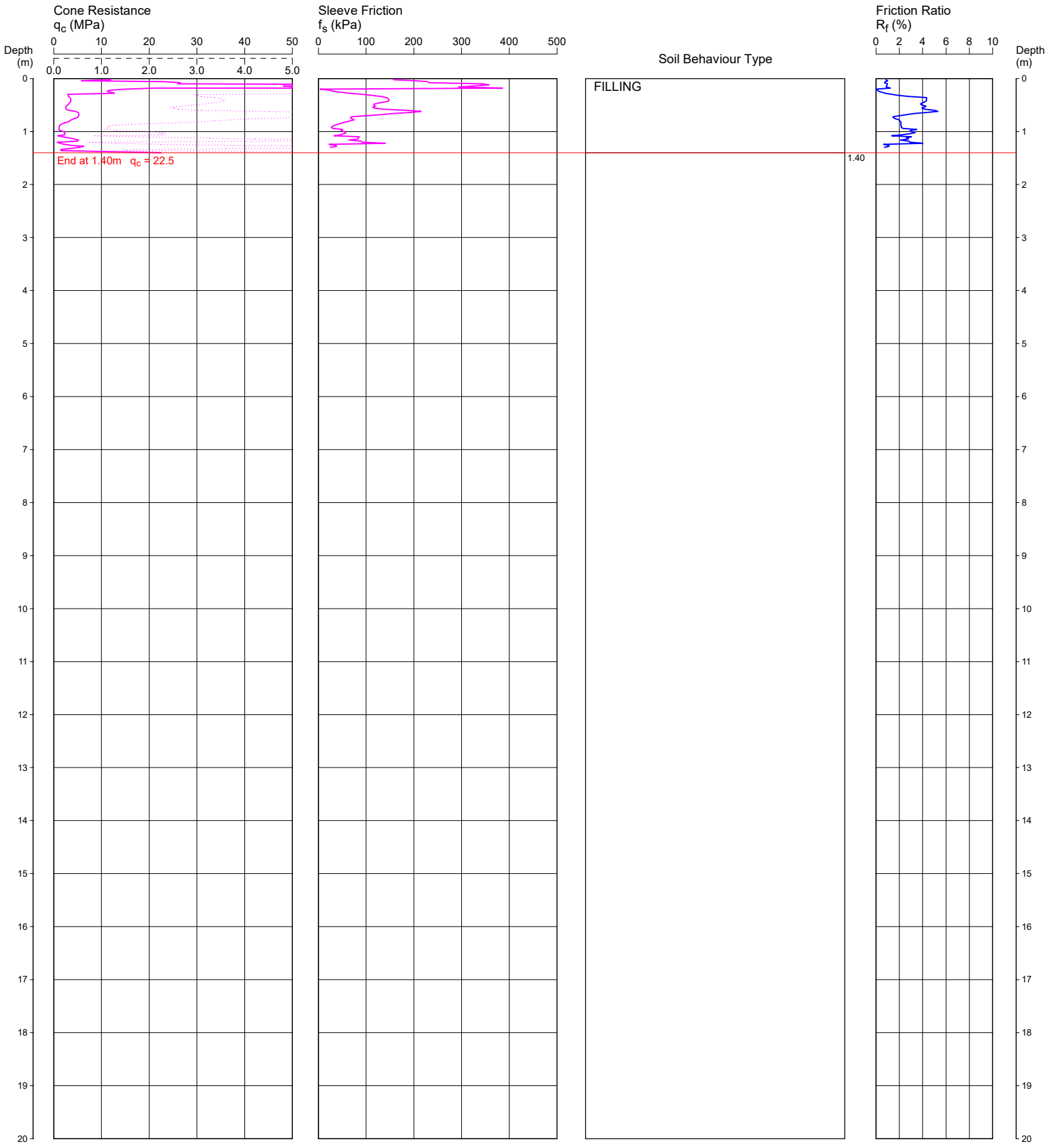
COORDINATES:

CPT303B

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT303B.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

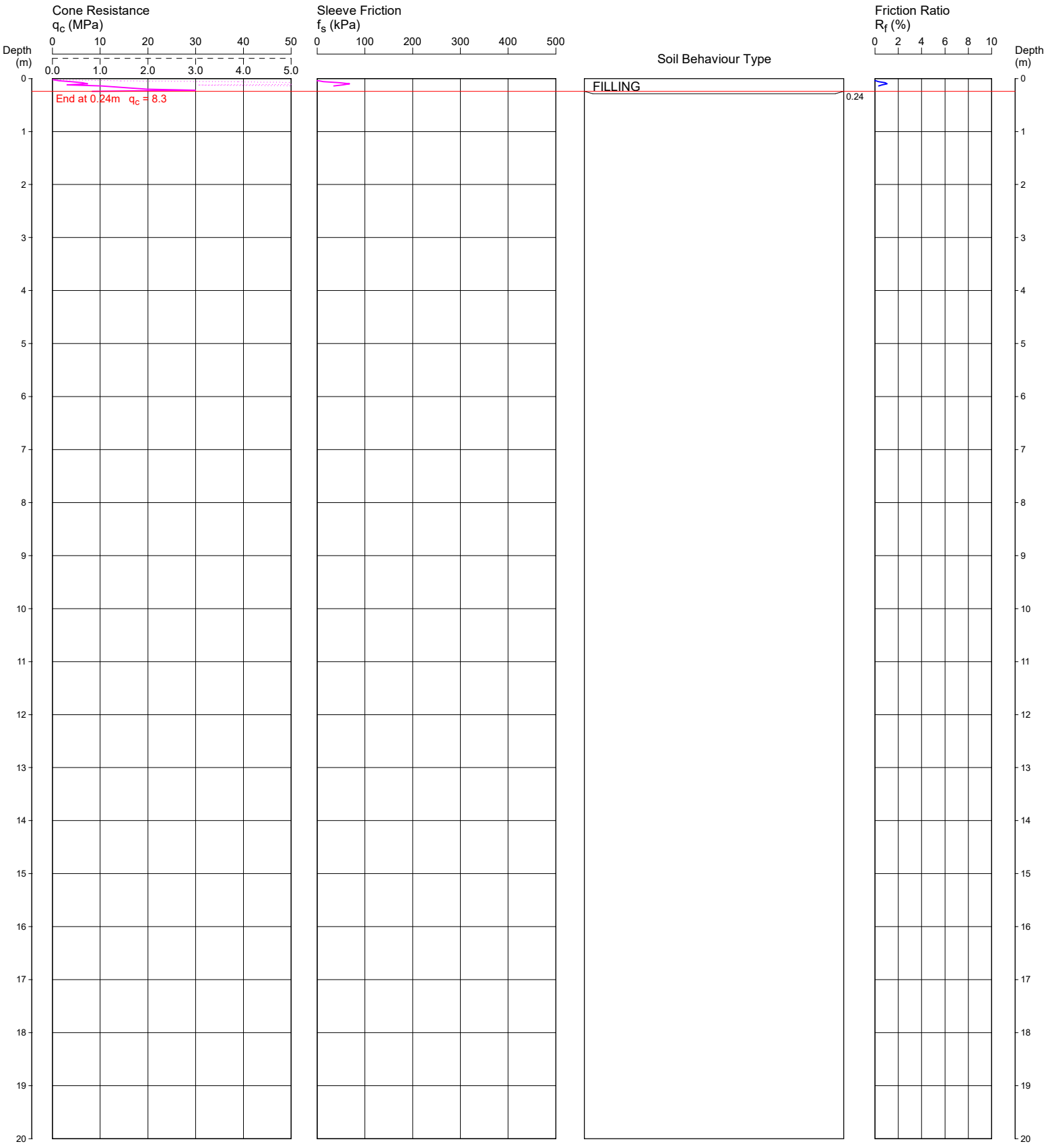
COORDINATES:

CPT304

Page 1 of 1

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT304.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

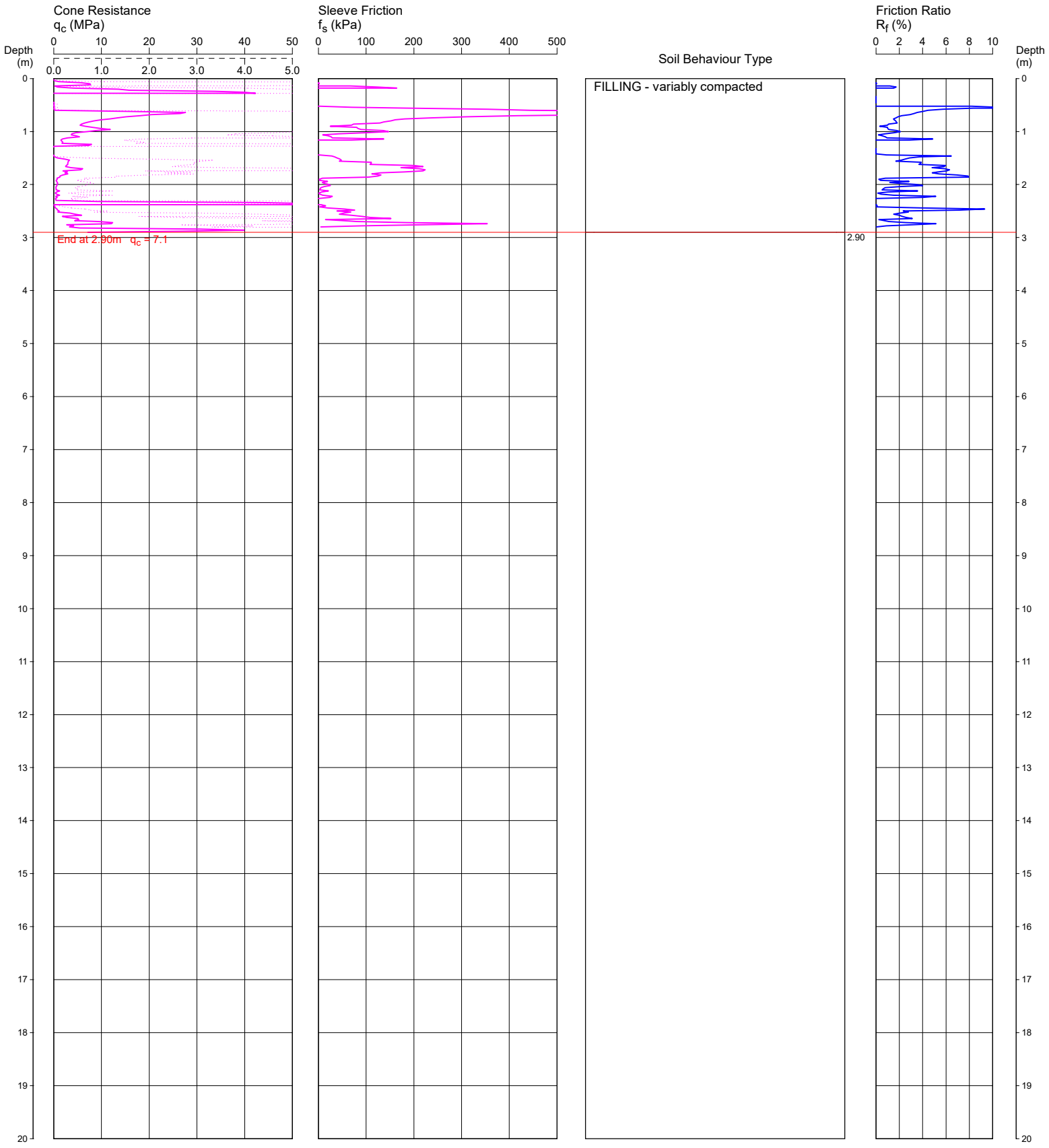
COORDINATES:

CPT304A

Page 1 of 1

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0.28 m TO 0.60 m, 1.26 m TO 1.50 m, 2.36 m TO 2.50 m AND 2.88 m TO 4.10 m DEPTH TO PENETRATE FILLING. HOLE DISCONTINUED DUE TO BENDING IN FILLING; NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT304A.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

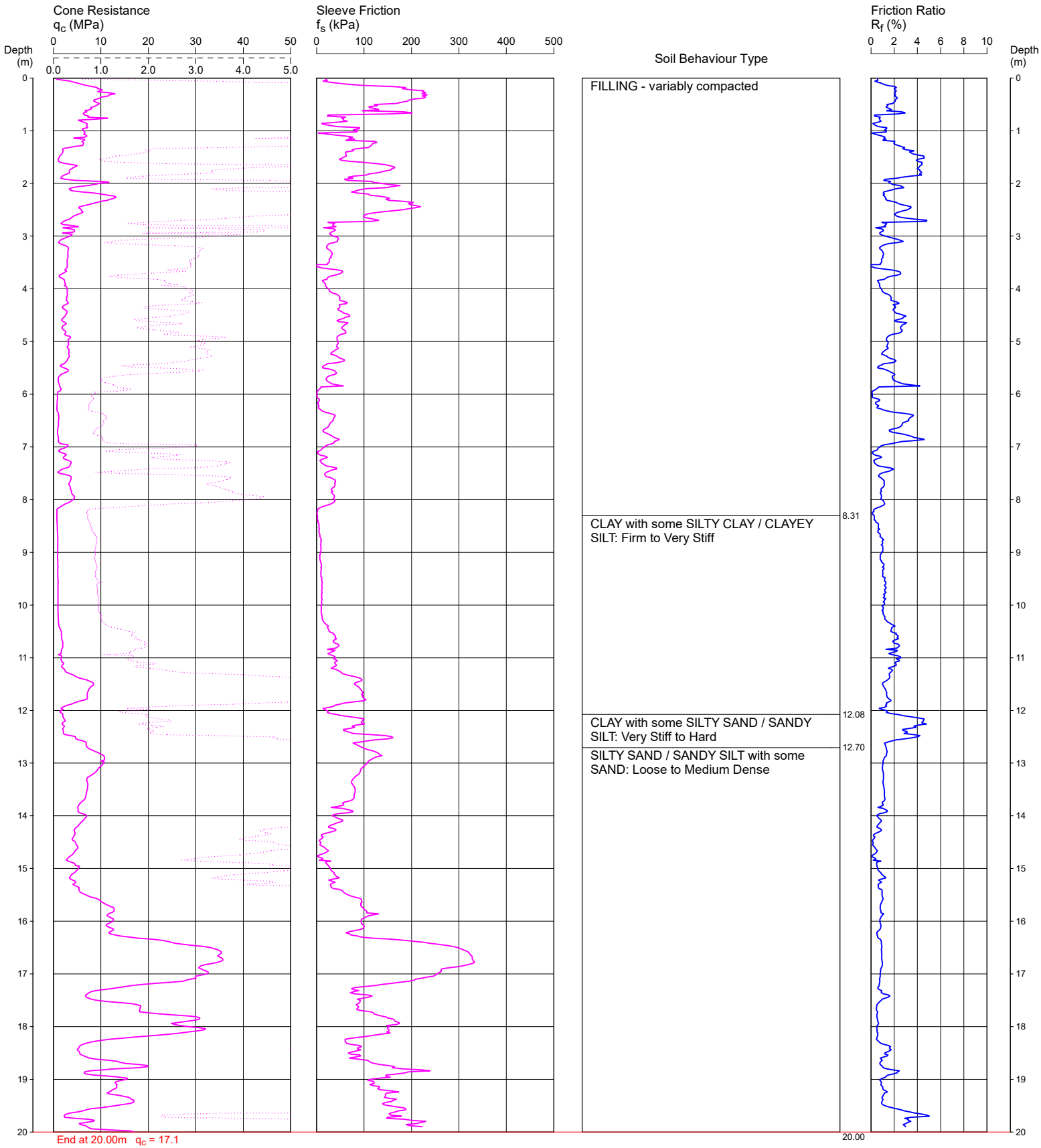
COORDINATES:

CPT305

Page 1 of 1

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: HOLE COLLAPSE AT 5.55 m DEPTH AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT305.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

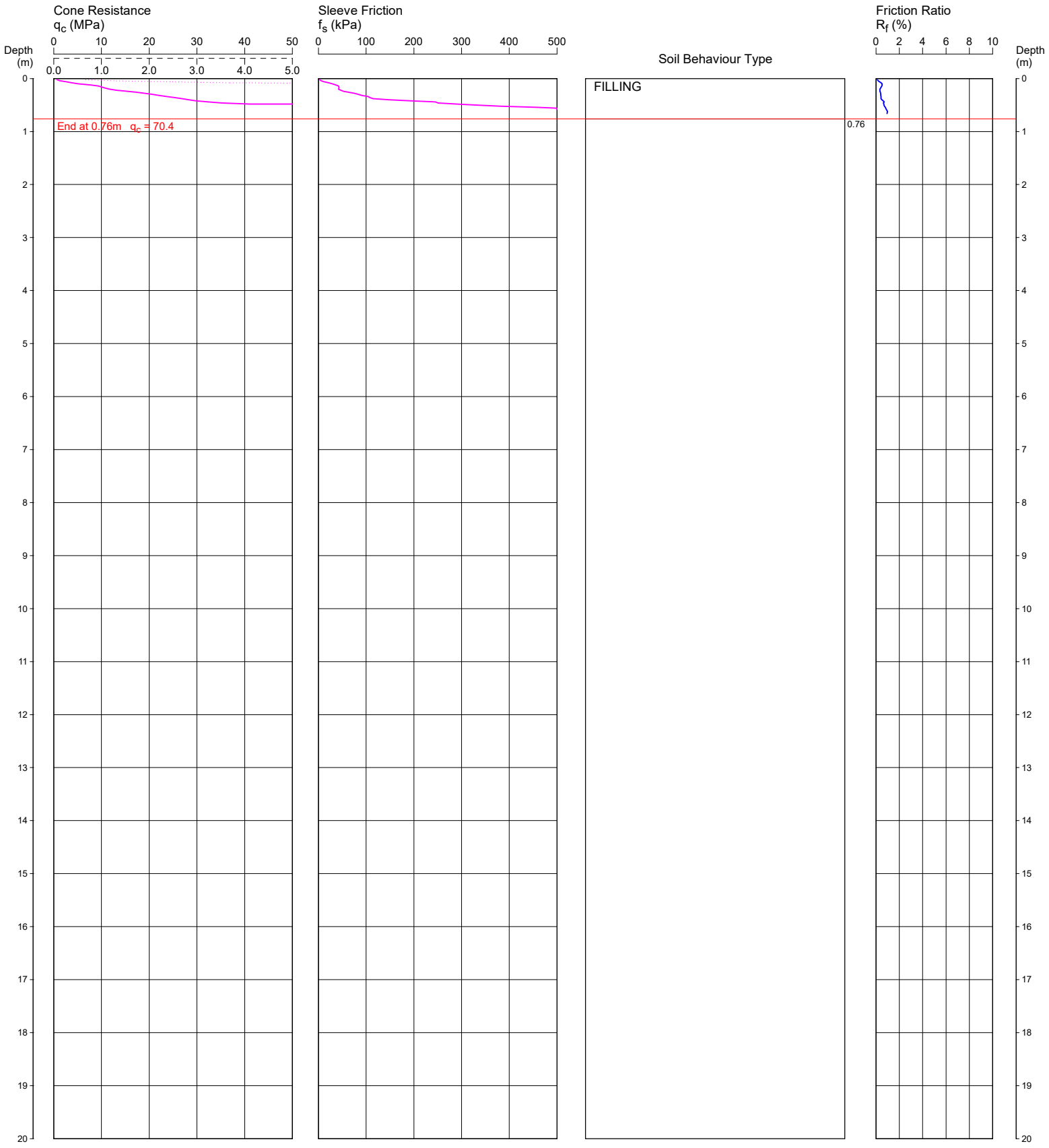
COORDINATES:

CPT306

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT306.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

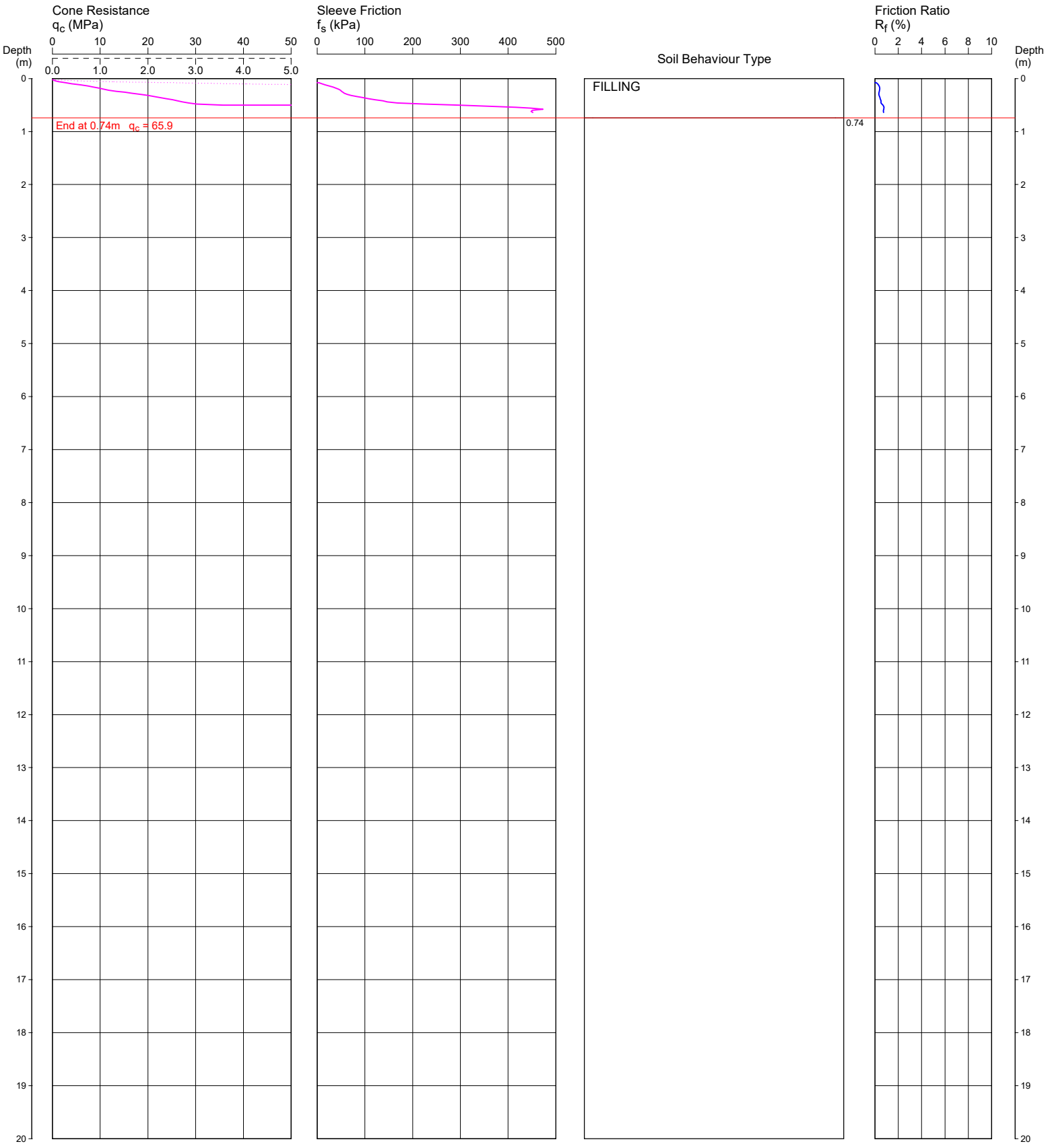
COORDINATES:

CPT306A

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT306A.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

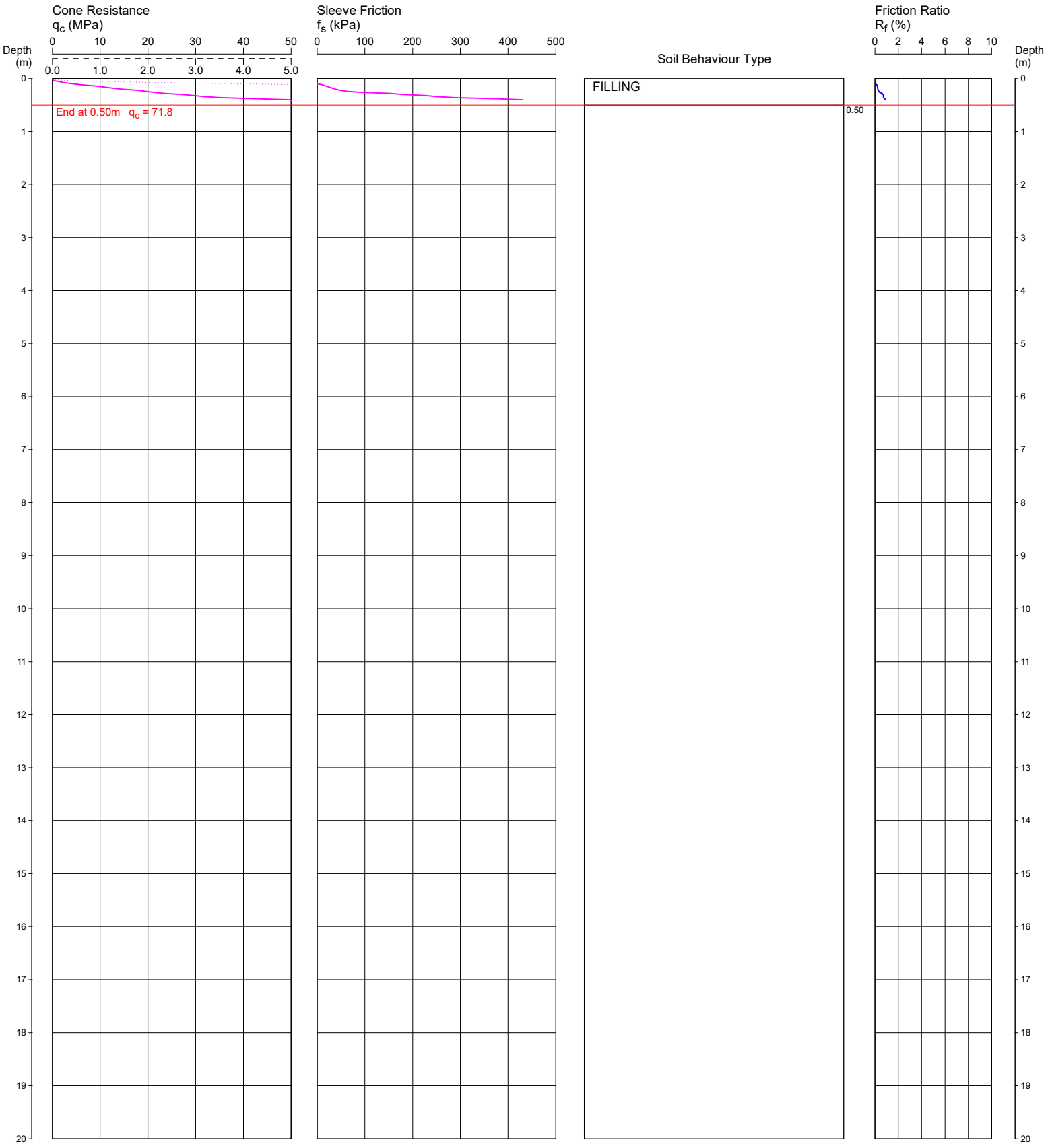
REDUCED LEVEL:

COORDINATES:

CPT306B

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0.5 m TO 1.02 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING. NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT306B.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

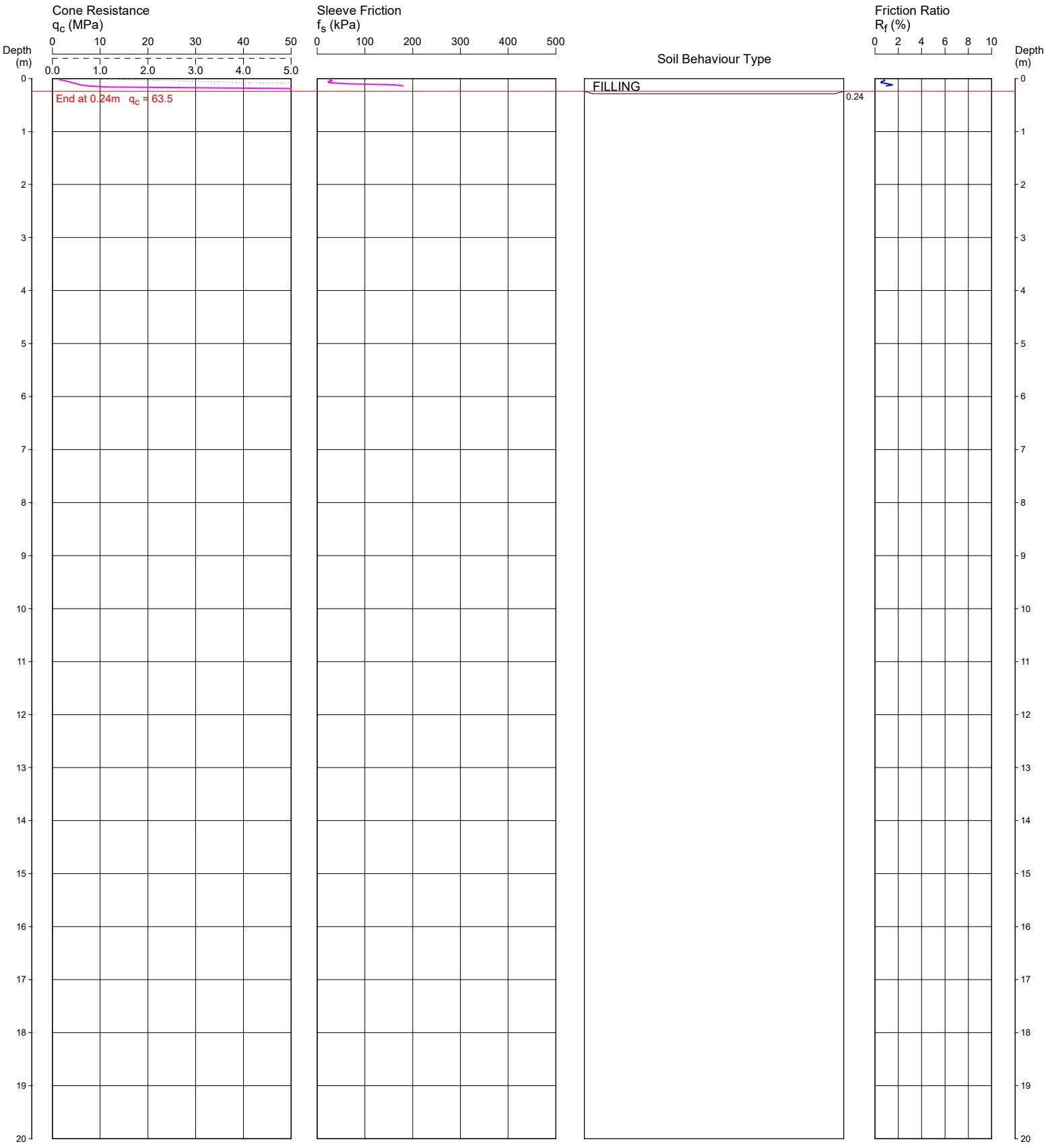
REDUCED LEVEL:

COORDINATES:

CPT306C

DATE 3/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0.24 m TO 0.66 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO BENDING IN FILLING. NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT306C.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

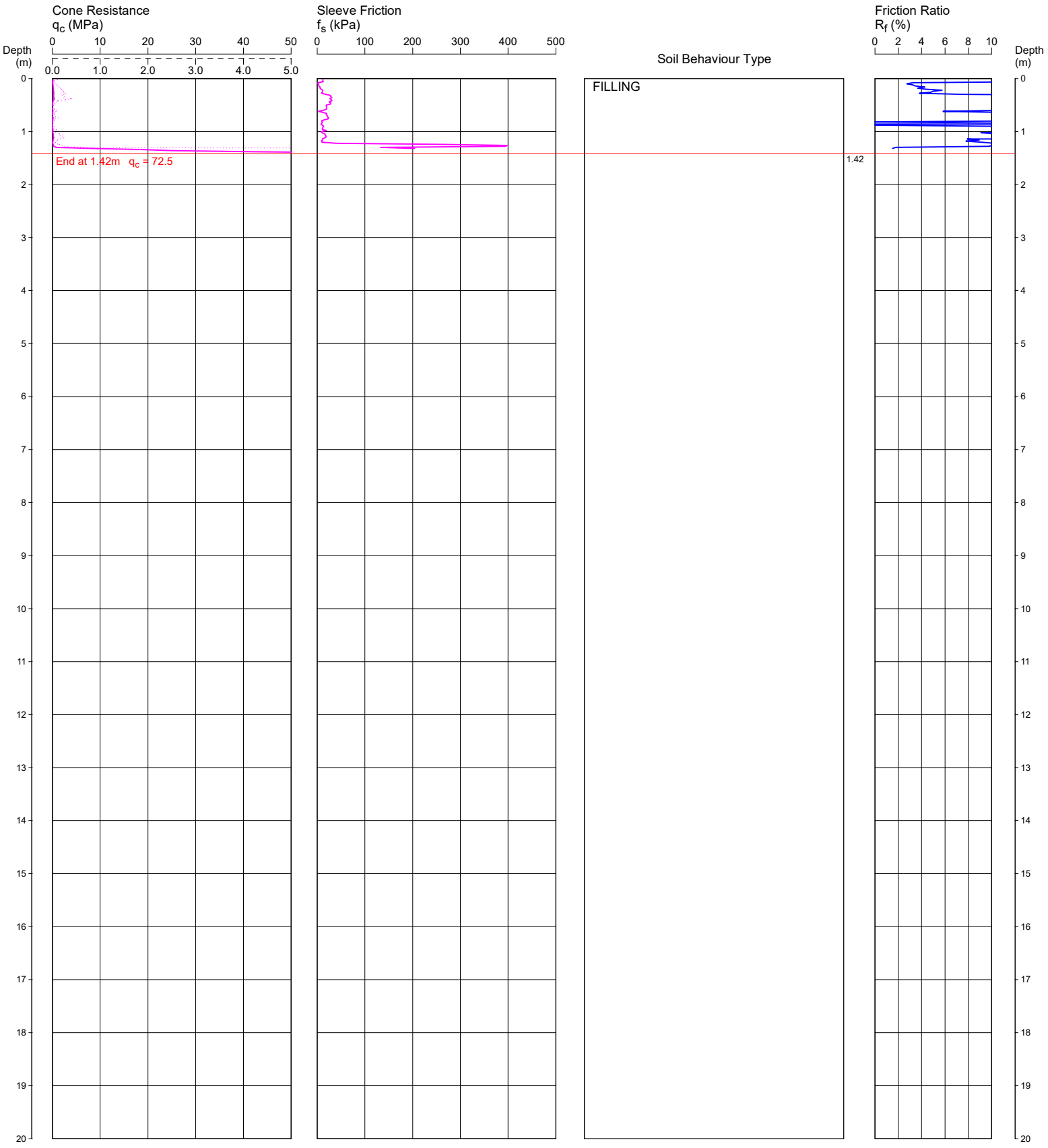
REDUCED LEVEL:

COORDINATES:

CPT306D

DATE 3/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0 m TO 1.5 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO BENDING IN FILLING. NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT306D.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

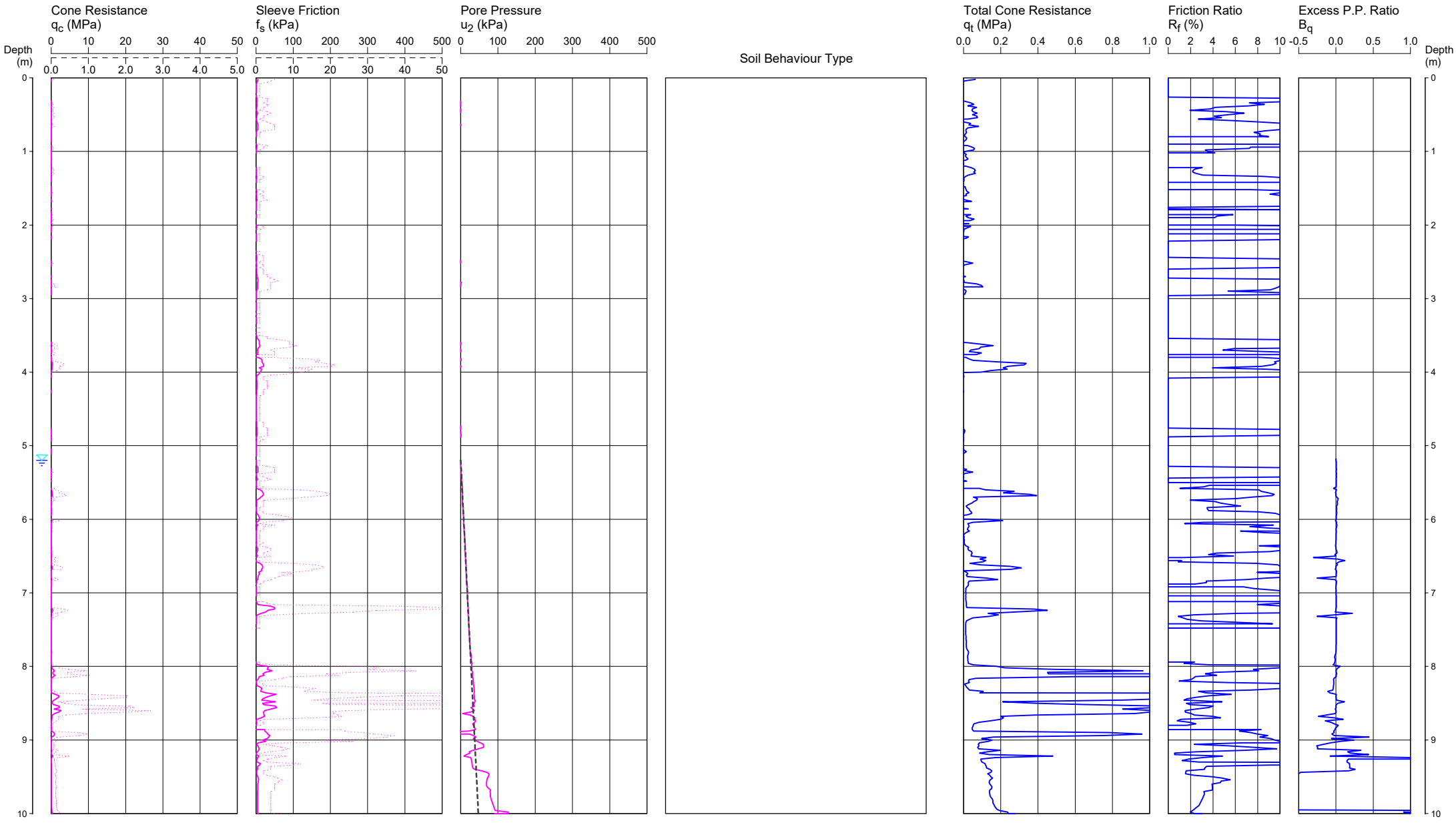
REDUCED LEVEL:

COORDINATES:

CPT306E PIEZO

DATE 3/9/2015

PROJECT No: 71459.04



REMARKS: STANDARD CONE AND DUMMY CONE USED FROM 0 m TO 10.40 m DEPTH. POTENTIAL TO OBTAIN ERRONEOUS RESULTS DUE TO CONE TIP REFUSAL.
GROUNDWATER OBSERVED AT 5.2 m DEPTH AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 MOOREBANK, 146 Newbridge Rd, Collected Work\71459.04 MOOREBANK CPTs\CPT306E PIEZO.CP5

Cone ID: 120509 **Type:** I-CFXYP20-10

Water depth after test: 5.20m depth (assumed)

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

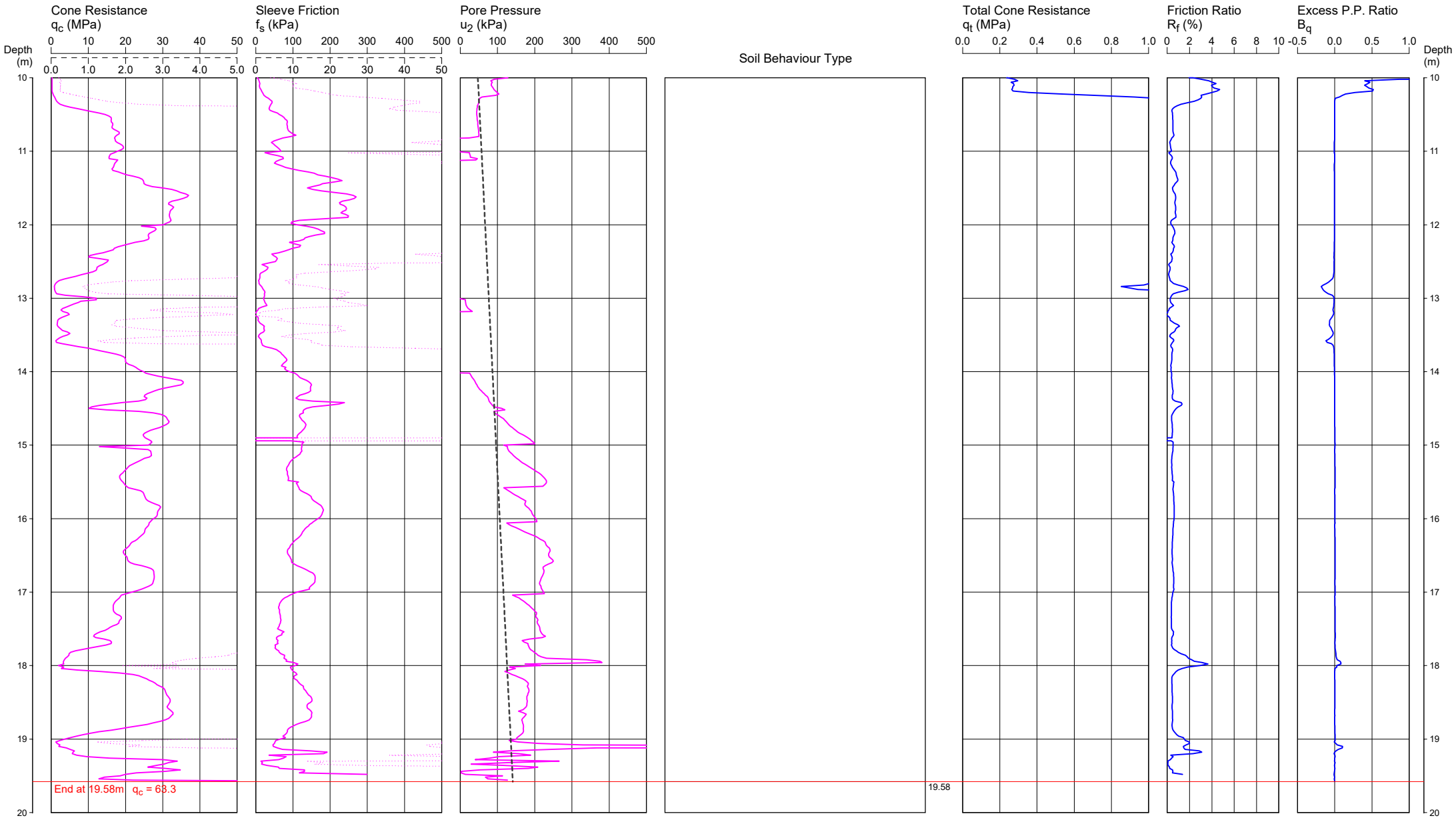
REDUCED LEVEL:

COORDINATES:

CPT306E PIEZO

DATE 3/9/2015

PROJECT No: 71459.04



REMARKS: STANDARD CONE AND DUMMY CONE USED FROM 0 m TO 10.40 m DEPTH. POTENTIAL TO OBTAIN ADDITIONAL DISSIPATION DATA IF REQUIRED. GROUNDWATER OBSERVED AT 5.2 m DEPTH AFTER WITHDRAWAL OF CONE.

File: P:\71459.04 MOOREBANK, 146 Newbridge Rd, Deductive Cone Tip Ref\71459.04 MOOREBANK CPTs\CPT306E PIEZO.CP5

Cone ID: 120509 **Type:** I-CFXYP20-10

Water depth after test: 5.20m depth (assumed)

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

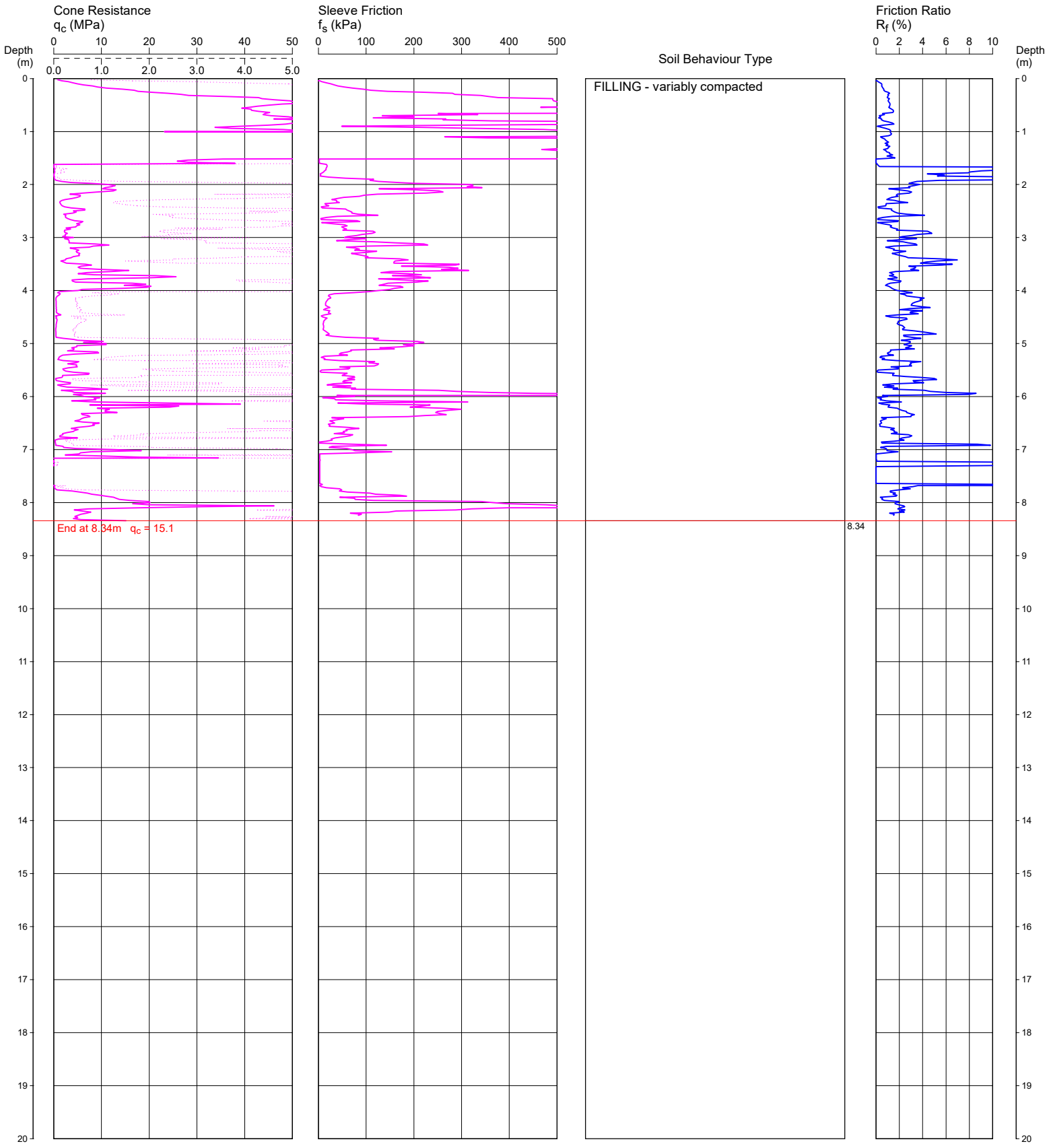
REDUCED LEVEL:

COORDINATES:

CPT306E

DATE 3/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 1.60 m TO 2.00 m, 7.16 m TO 7.80 m AND 8.34 m TO 10.40 m DEPTH TO PENETRATE FILLING.
HOLE DISCONTINUED DUE TO REPLACEMENT WITH PIEZO-CONE; NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT306E.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

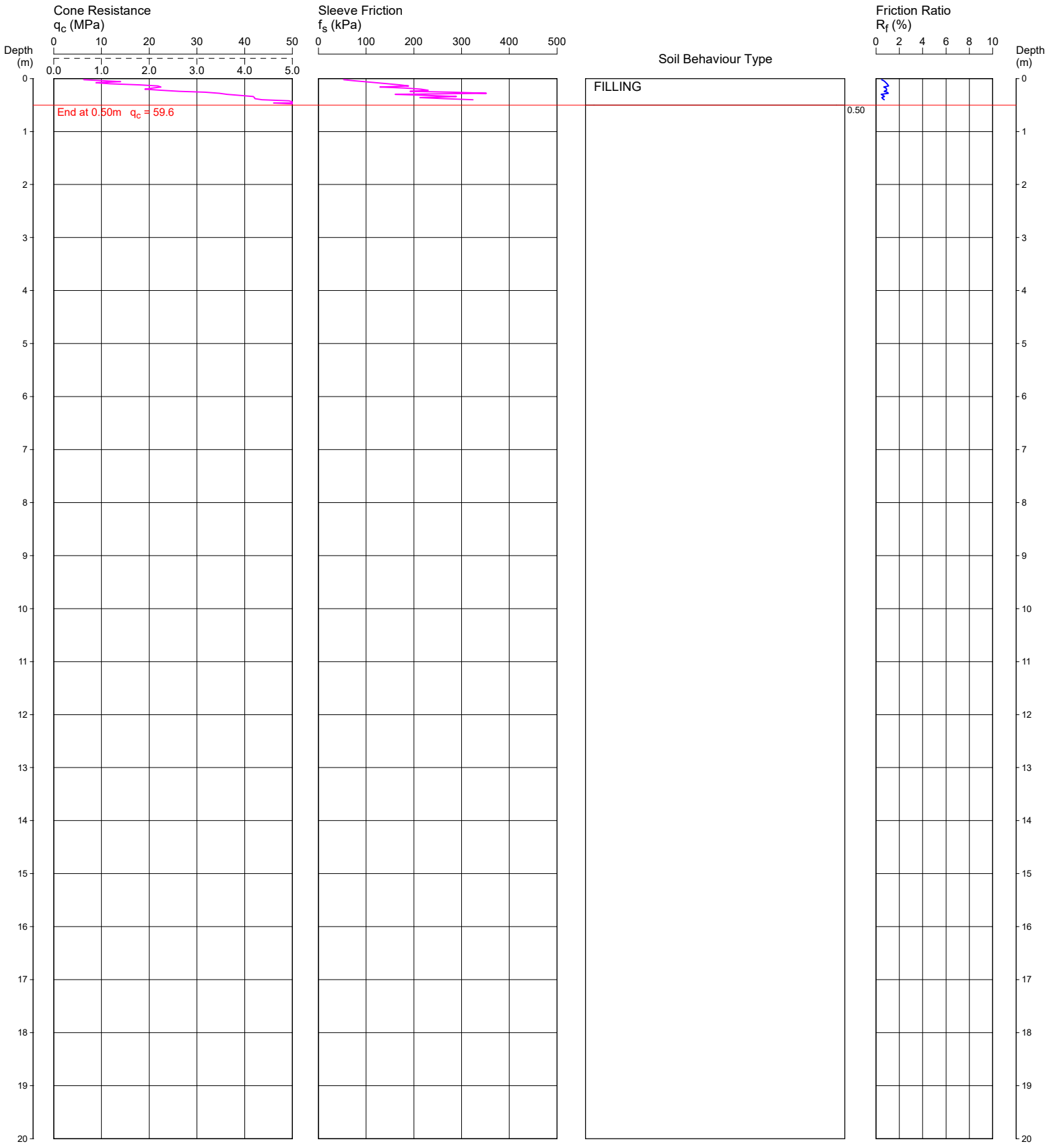
COORDINATES:

CPT307

Page 1 of 1

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT307.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

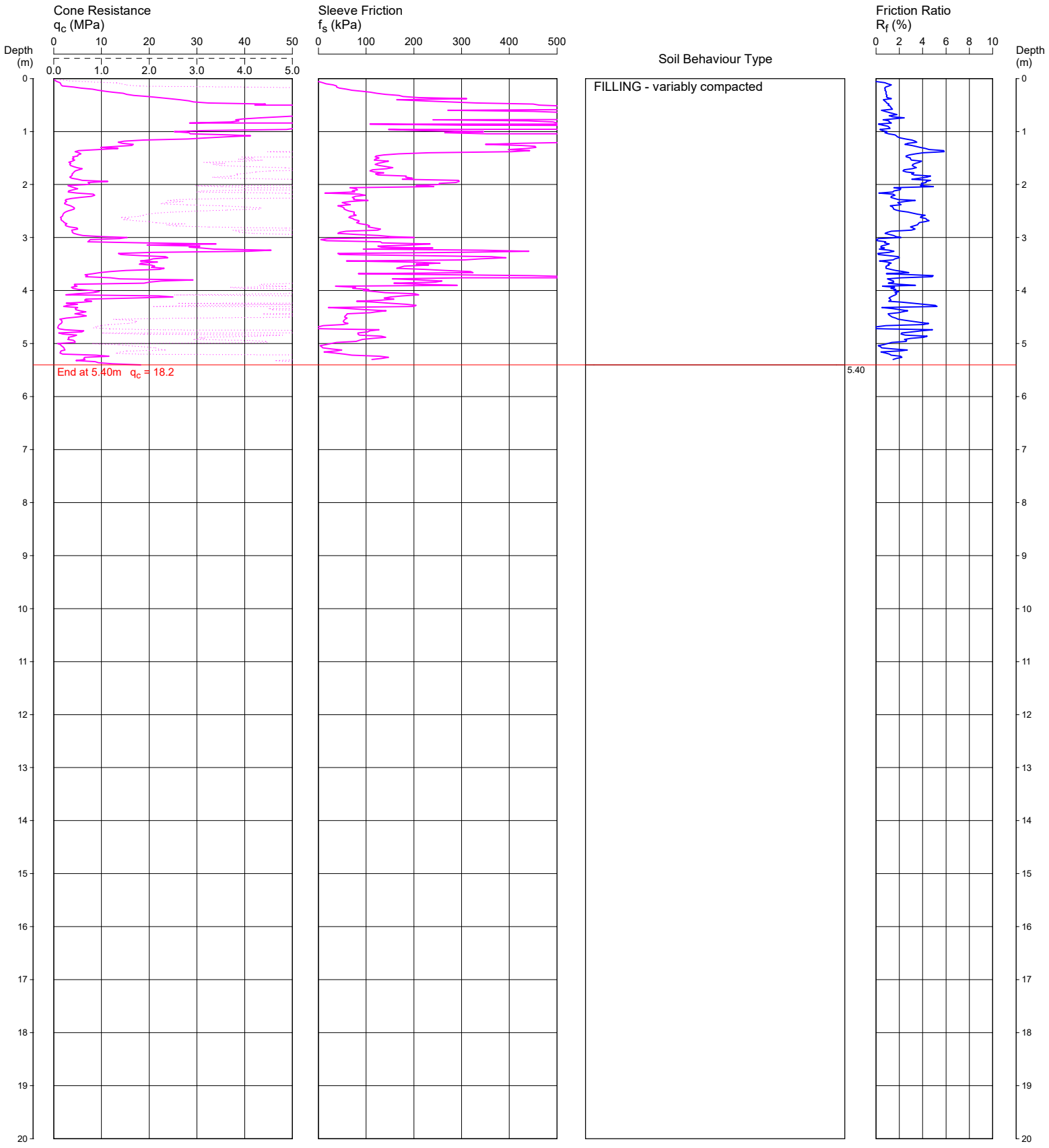
REDUCED LEVEL:

COORDINATES:

CPT307A

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 5.4 m TO 5.6 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO BENDING IN FILLING. NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT307A.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

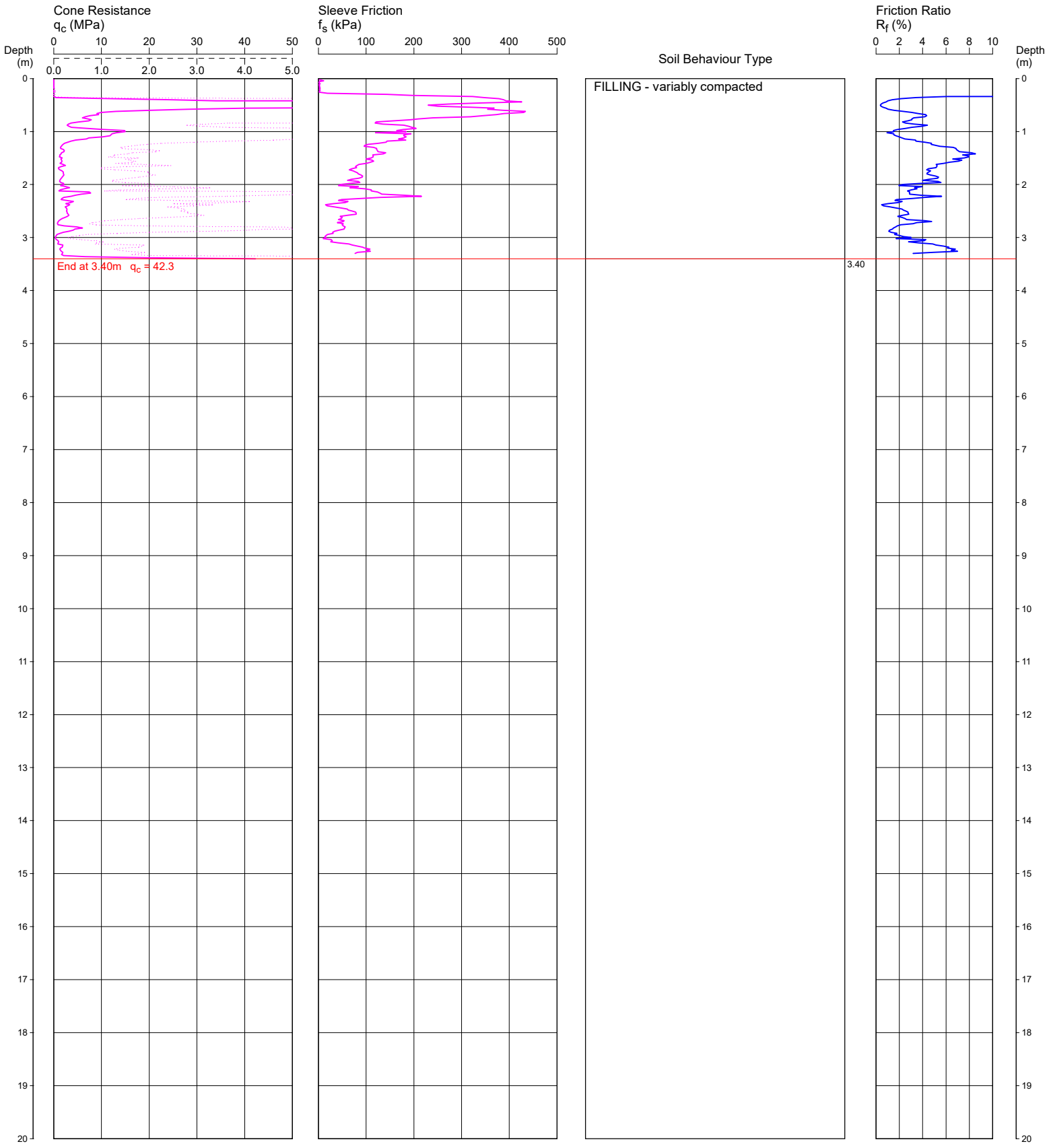
COORDINATES:

CPT308

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0.02 m TO 0.40 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING. NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT308.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

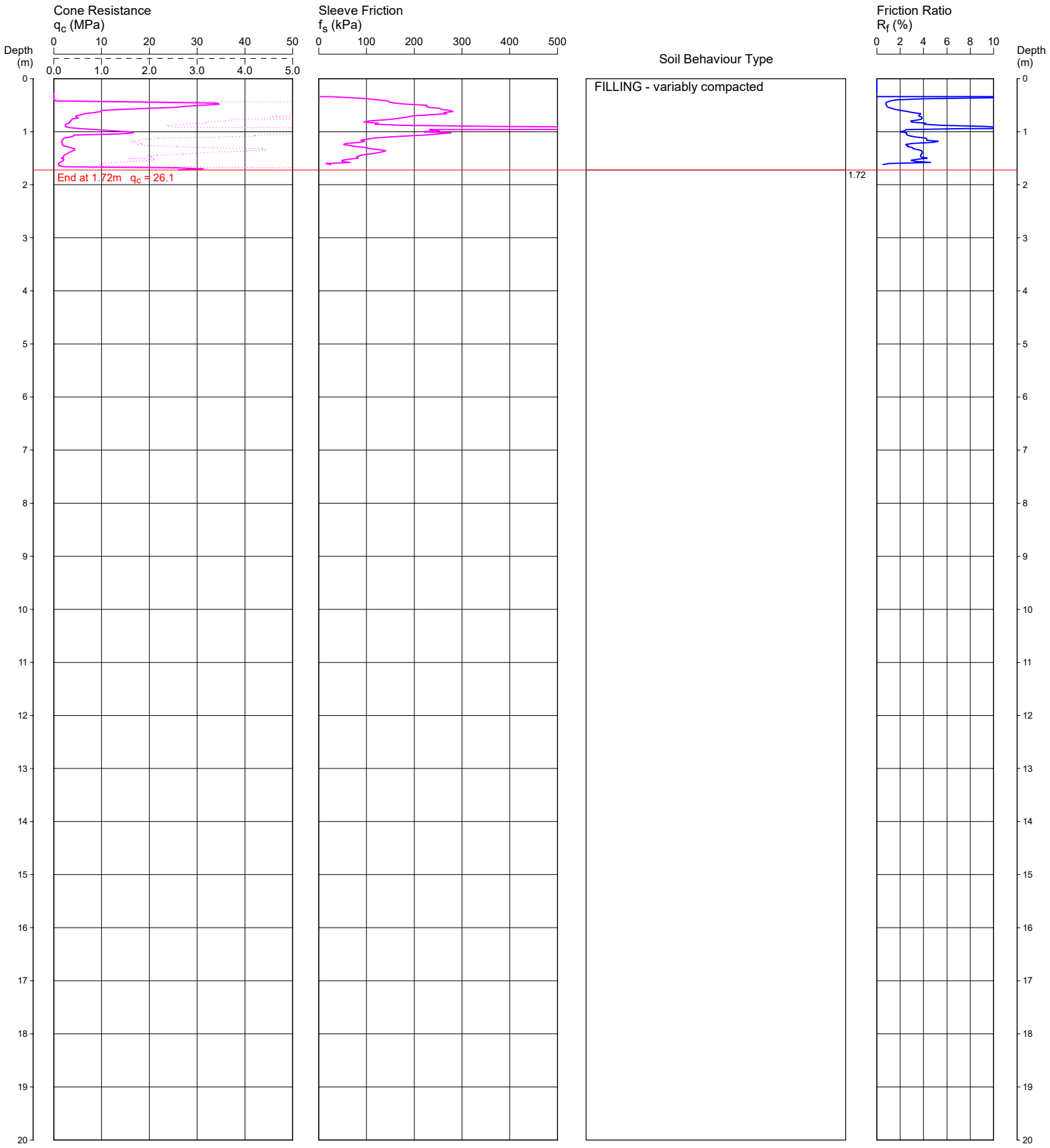
COORDINATES:

CPT308A

Page 1 of 1

DATE 1/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0 m TO 0.46 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO BENDING IN FILLING. NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT308A.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

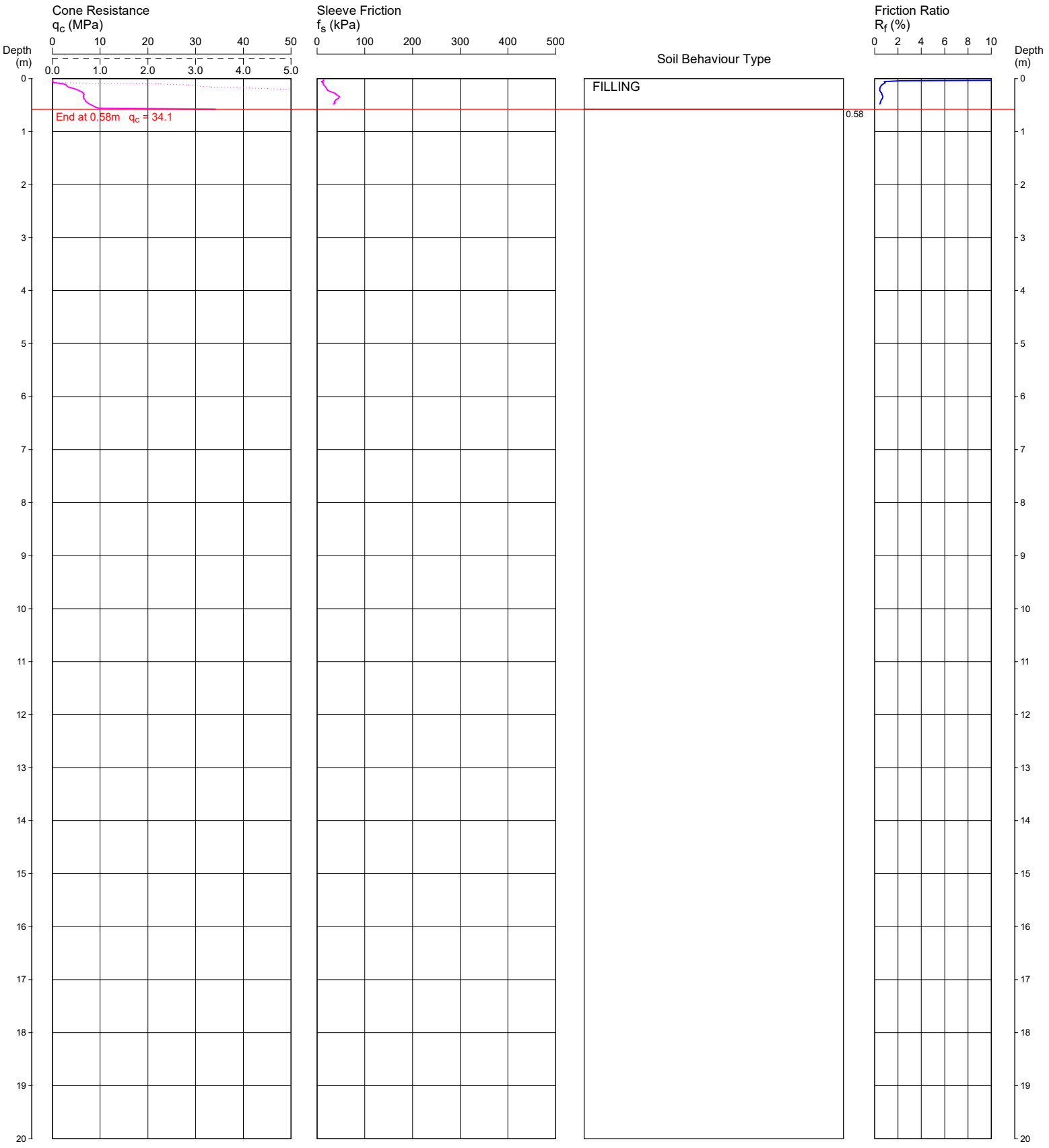
REDUCED LEVEL:

COORDINATES:

CPT309

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: HOLE DISCONTINUED DUE TO BENDING IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT309.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

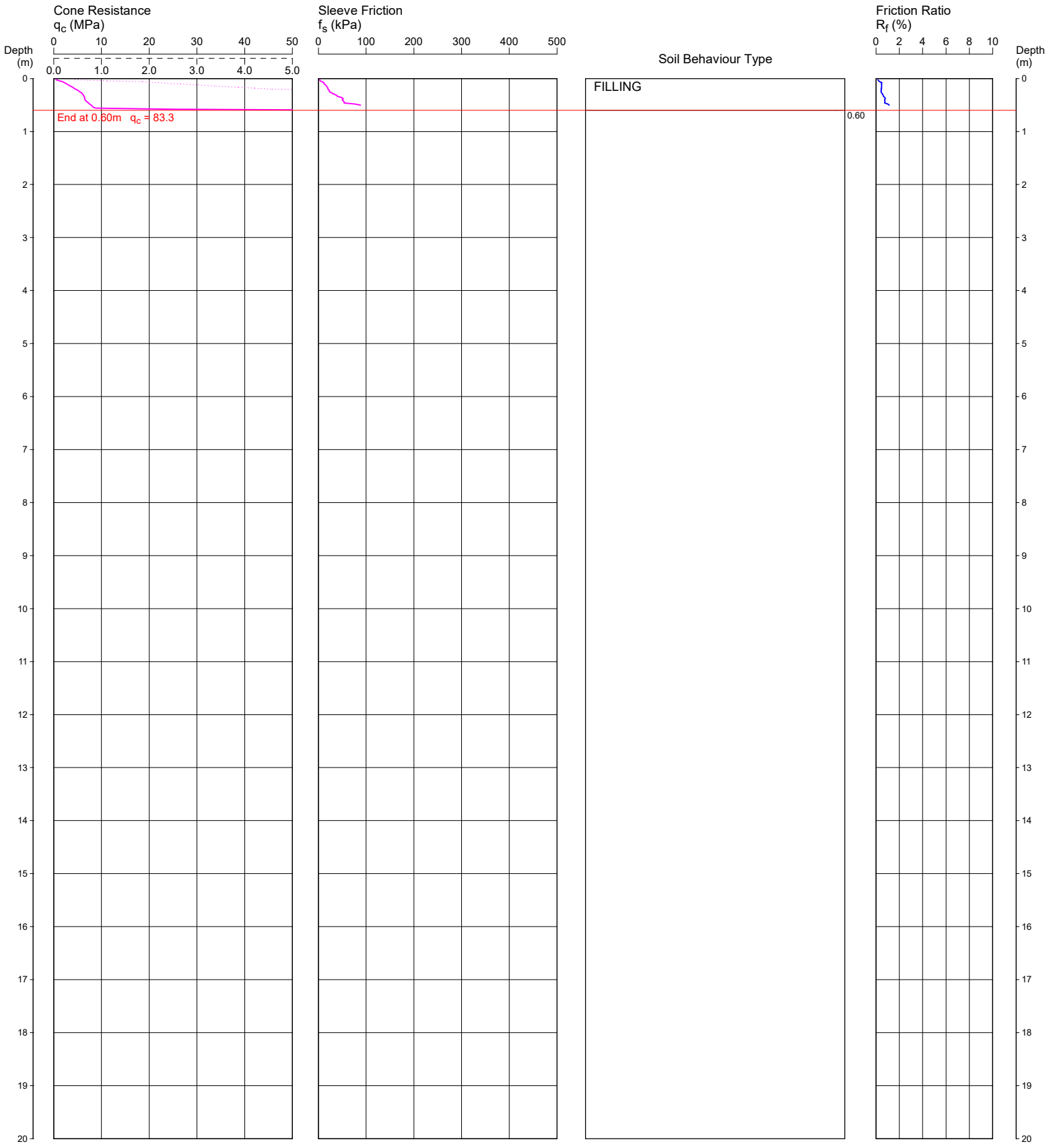
REDUCED LEVEL:

COORDINATES:

CPT309A

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE ATTEMPTED TO PENETRATE FILLING AT 0.6 m DEPTH; HOLE DISCONTINUED DUE TO OBSTRUCTION IN FILLING.
NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT309A.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

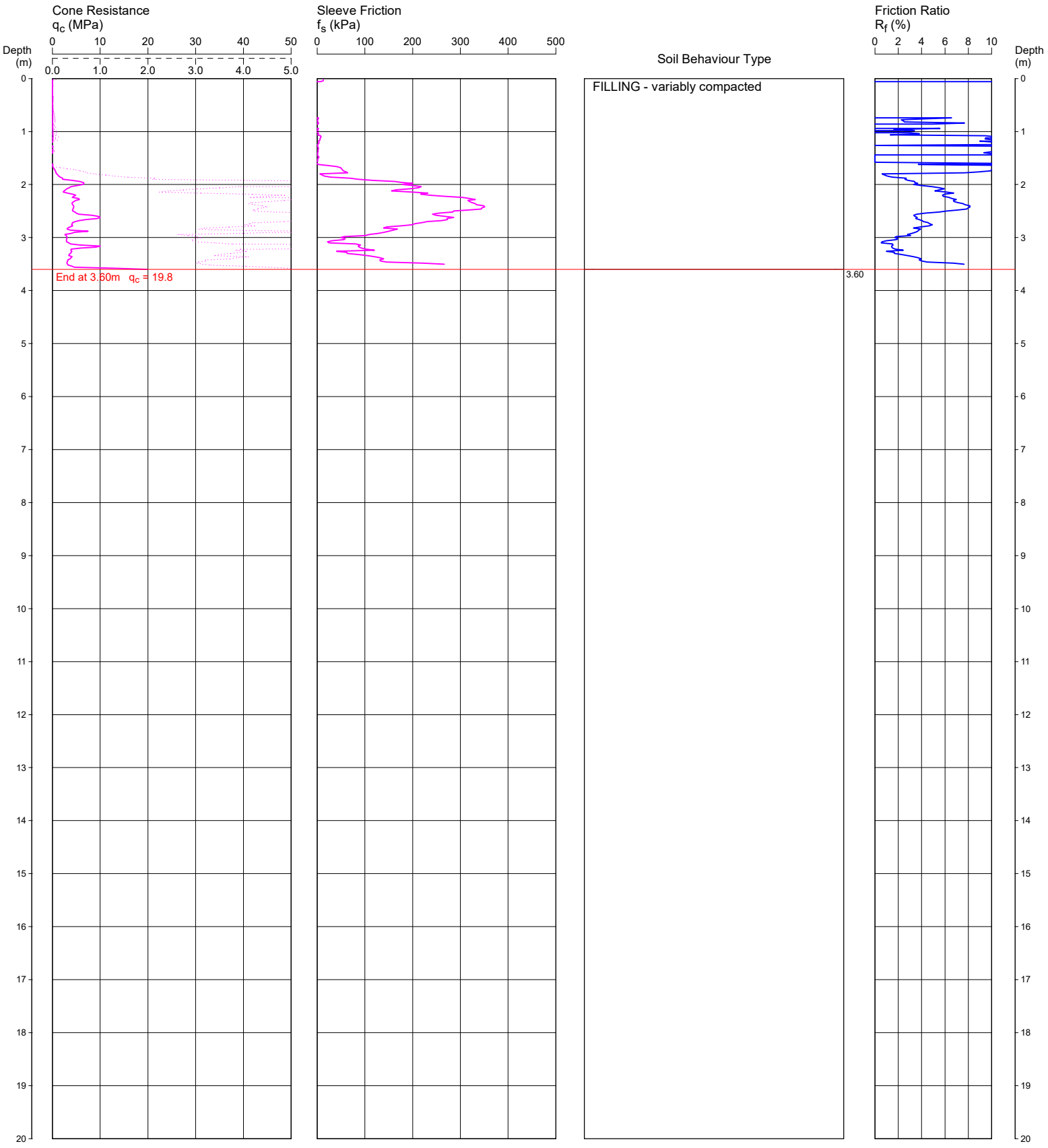
COORDINATES:

CPT309B

Page 1 of 1

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0 m TO 2.0 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO BENDING IN FILLING. NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT309B.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

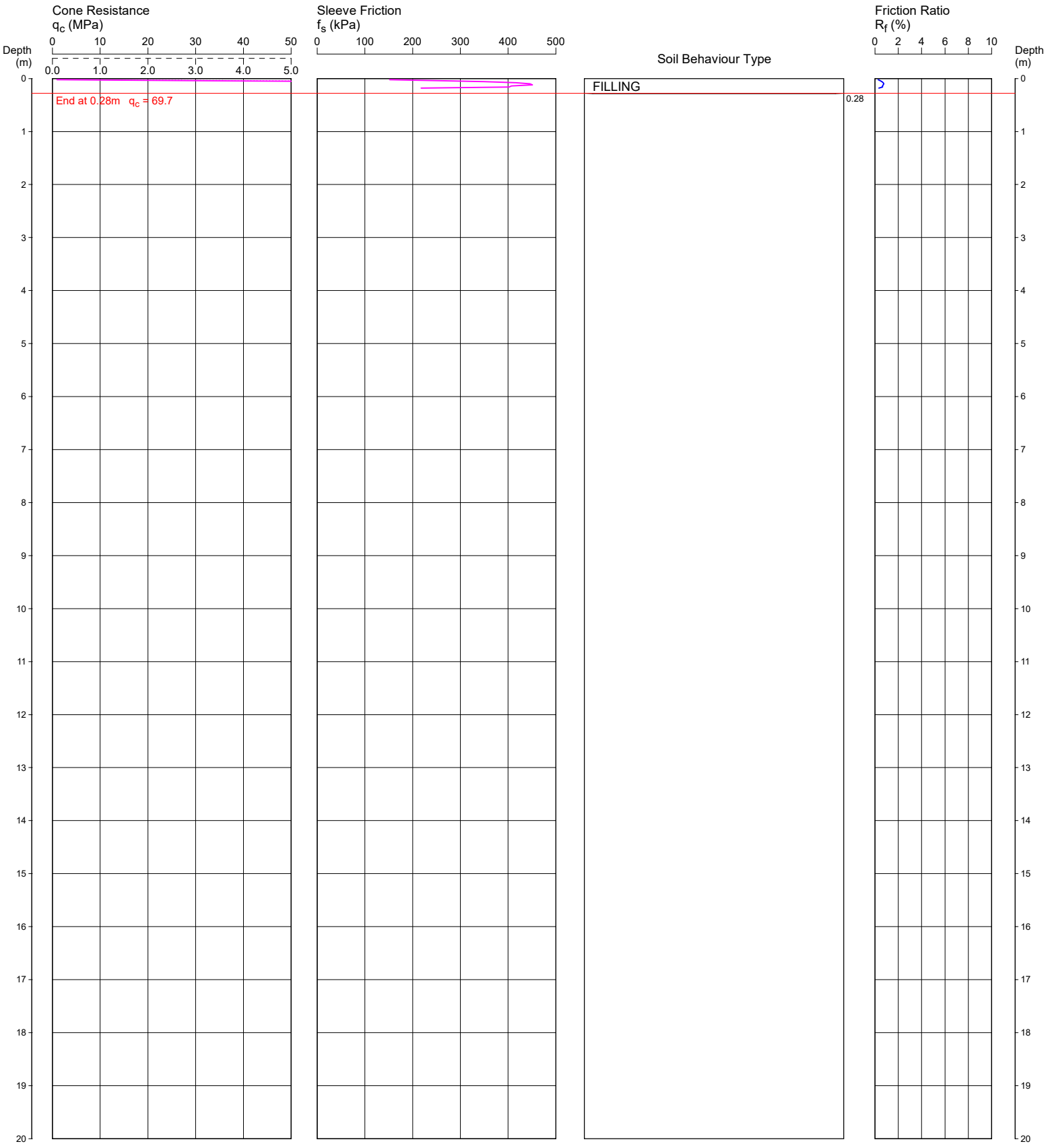
REDUCED LEVEL:

COORDINATES:

CPT310

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0.28 m TO 0.32 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO BENDING IN FILLING. NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT310.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: BENEDICT INDUSTRIES PTY LTD

PROJECT: MOOREBANK

LOCATION: 146 NEWBRIDGE ROAD, MOOREBANK

REDUCED LEVEL:

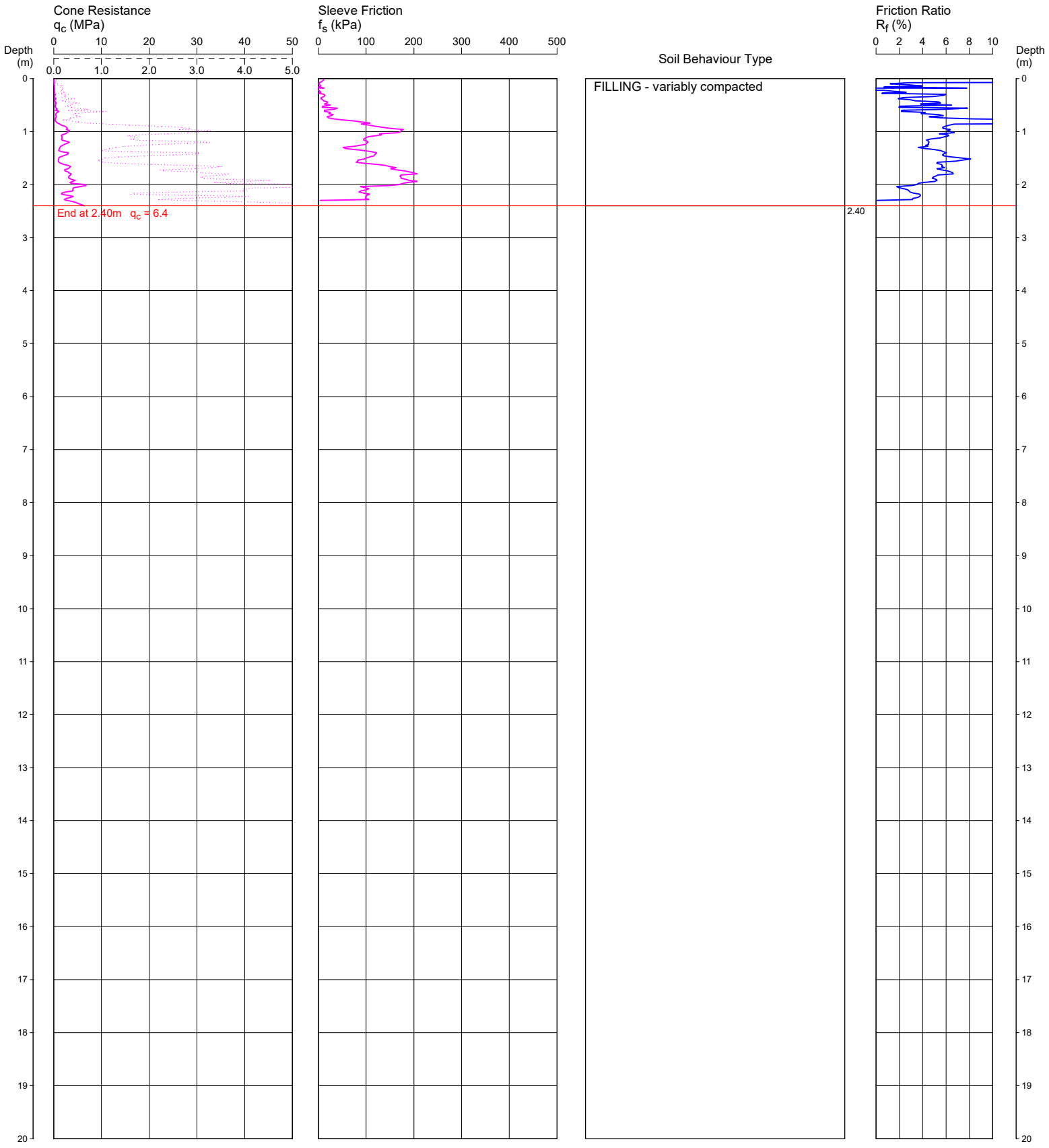
COORDINATES:

CPT310B

Page 1 of 1

DATE 2/9/2015

PROJECT No: 71459.04



REMARKS: DUMMY CONE USED FROM 0 m TO 1.0 m DEPTH TO PENETRATE FILLING; HOLE DISCONTINUED DUE TO BENDING IN FILLING. NO WATER OBSERVED IN CPT HOLE AFTER WITHDRAWAL OF RODS.

File: P:\71459.04 - MOOREBANK, 146 Newbridge Rd, Geotech\4.0 Field Work\71459.04 MOOREBANK CPTs\CPT310B.CP5
Cone ID: 120634 **Type:** I-CFXY-10

ConePlot Version 5.9.2

© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

APPENDIX C

Landpac HEIC Report

Landpac Technologies Pty Ltd ®
LAND PAC
Ground Engineering

AUSTRALIA – NEW ZEALAND – MALAYSIA - SOUTH AFRICA – EUROPE – USA – MIDDLE EAST

REPORT

Impact Compaction

Benedict Ground Improvement Trial

Moorebank, NSW.

October 2015

R1044-01 Issue C

This document is subject to the copyright of Landpac Technologies and its contents should not be used without written permission from Landpac

A.B.N. 12 069 528 696

LAND PAC WORLD LEADER IN COMPACTION TECHNOLOGY

PO BOX 132, SEVEN HILLS, NSW 1730 ---- PO BOX 454, OXENFORD, QLD 4210, Australia.
Tel 1300 237 045; +61 (0)2 9627 4599 info@landpac.com.au; www.landpac.com.au
DIRECTORS: K T McCANN, E J COOK, C DAVIS

Table of Contents

1. Summary
2. Introduction
3. Impact Compaction Methodology
4. Ground Improvement works
5. Soil Response and Induced Settlement Results
6. Geotechnical Testing
7. Conclusion and Discussion

APPENDICIES

1- CIS Plots
2- CIR Plots
3- DCP Results

Record of Amendments:

REV	DATE	COMMENTS	BY	CHKD	APPD
A	30th September 2015	1st Issue	MC	MC	KTM
B	30th September 2015	Cover page date correction	MC	MC	KTM
C	7th October 2015	DCP results appendix addition	MC	MC	KTM

1. SUMMARY

This report describes the Impact Compaction works conducted for the Ground Improvement Trial for Benedict Industries, and presents the methodology used and records of the controls and monitoring conducted by Landpac during the works.

The compaction settlement (CIS) monitoring indicated that the average compaction settlements on the in-situ fill area had been reduced to acceptable levels with 40 surface passes with a Landpac 3-sided Heavy Impact Compactor. The soil response (CIR) monitoring indicated that the sub-grade was relatively uniform at the completion of the Impact compaction works with the exception of a localised weaker zone identified in one of the trial areas during the impact compaction trial works.

It is understood that Douglas Partners Pty Ltd have been engaged by Benedict Industries Pty Ltd to provide sub-grade design recommendations following the completion of the impact compaction works.

2. INTRODUCTION

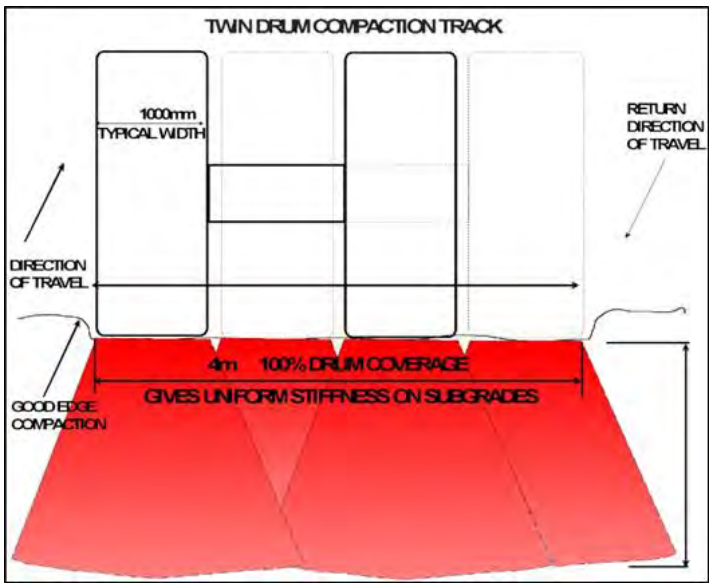
Landpac was engaged by Benedict Industries Pty Ltd to undertake a Ground Improvement Trial on the existing in-situ fill using Impact Compaction. Douglas Partners were engaged by Benedict Industries to conduct pre and post compaction geotechnical testing.

Impact compaction was used as a ground improvement means to alleviate the differential settlement in in-situ fill. The Impact Compaction was carried out using Landpac's 3-Sided Heavy Impact Compactor. Landpac's 3-Sided Heavy Impact Compactor has a Kinetic Energy rating of 160 kJ.



The Impact Compactor was mobilised on to site on the 18th September '15 and works commenced on the 21st September '15. Works were completed on 24th September '15.

3. IMPACT COMPACTION METHODOLOGY



The compaction was applied with an interlocking drum pattern across the trial areas to ensure that the whole surface area was subject to a consistent number of impact blows. The application of a surface pass methodology as indicated is preferred to a conventional pass methodology. A characteristic of Impact Compactors is that the width of the drums whether twin drum or single drum does not cover the width of the machine. Therefore unlike conventional rollers the application of a pass methodology does not cover the whole surface leaving uncompacted strips. A surface pass methodology covers the whole width with approximately 50% greater compaction work done than that with a pass methodology.

The compaction works were carried out in an engineered manner with the monitoring of the sub-grade behaviour with the regular measurement compaction induced settlements and the soil response to the dynamic impact loads.

CIS (Continuous Impact Settlement) monitoring and CIR (Continuous Impact Response) monitoring was carried out to control the compaction process. CIS is used for monitoring settlement and CIR is used for monitoring soil response of the nominated sub-grade.

4. GROUND IMPROVEMENT TRIAL WORKS

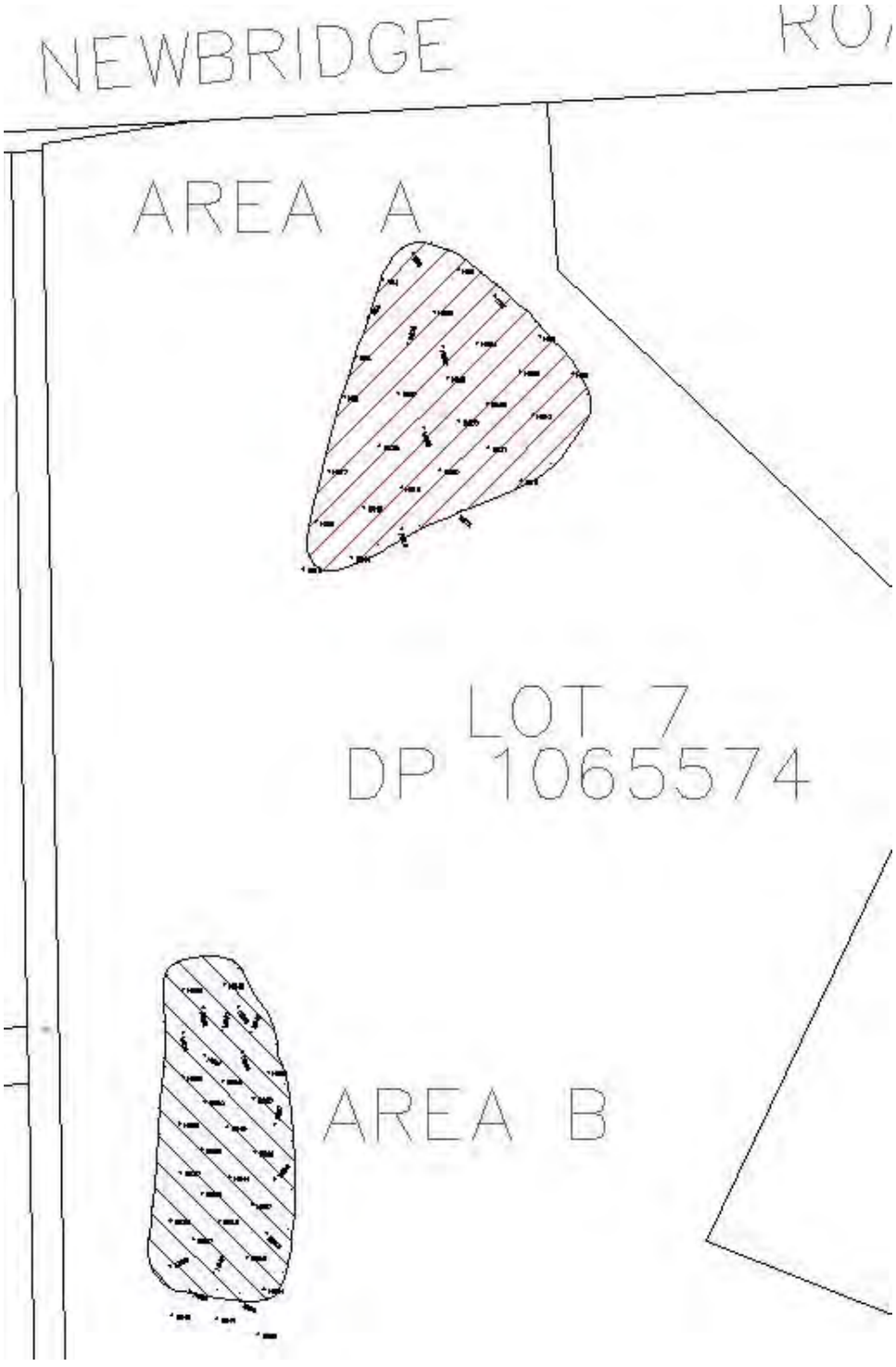
The trial works were carried out on two sections (Area A & Area B) as shown in diagram 1 with a Landpac 3-sided Heavy Impact Compactor until the average compaction settlements had been reduced to a ‘near zero’ condition.

The specifications of the 3-sideds Heavy Impact Compactor are shown in Table 1. The compactive effort imparted by Impact Compactors during compaction is primarily dependent on the weight of the impact drum assembly and the height the drum falls during rotation.

Table 1: Impact Roller Specifications

	Landpac- 3 sided (Heavy)
Impact Compactor Module Weight (without Tractor)	14 Tonne
Lift Height (h)	0.23 metre
Kinetic Energy	**160 kJ**

Diagram 1: Site Area



A.B.N. 12 069 528 696

LANDPAC
WORLD LEADER IN COMPACTION TECHNOLOGY

PO BOX 132, SEVEN HILLS, NSW 1730; PO BOX 454, OXENFORD, QLD 4210, Australia:
Tel 1300 237 045; +61 (0)2 9627 4599 info@landpac.com.au ; www.landpac.com.au
DIRECTORS: K T McCANN, E J COOK, C DAVIS

5. SOIL RESPONSE AND SETTLEMENT MONITORING RESULTS

Compaction settlements were measured from 0-40 passes (at 10 pass intervals) before a 'near zero' compaction settlement condition had been achieved.

The measured settlements (See Appendix 1) indicated that the average compaction settlements on the total area had been reduced to less than 3mm over the last ten surface passes thereby confirming that sufficient compaction work with a 3-sided heavy impact compactor had been applied.

The total settlements were an average of 60 to 63mm respectively across the trial areas, with localised settlements in excess of 250mm. A zone in trial area 'A' where a large stockpile was apparently located exhibited less settlement (about 20 to 60mm) than on areas outside of this where settlements ranged from about 100 to 250mm (See Appendix 1).

Continuous Impact Response (CIR) technology was used to measure and plot the relative soil response to the dynamic loads induced by the impact drums. The CIR plots shown in appendix 2 indicate the relative soil response to the dynamic loads imposed by the impact drums. The plot is derived from the recorded deceleration of the impact drums and the GPS locations of each impact point.

Low soil response are typically an indication of very weak near surface material (say <300mm depth) or deleterious or over wet material to about 1.5m or so depth. Low response areas would typically warrant some remediation if footings or pavements are located close to the weak soils. Medium response areas are typically an indication of near surface moist or loose material (say <300mm depth) or relatively lower strength material to 1.5m or so depth. The medium response values can be influenced by near surface soil conditions and do not necessarily indicate weaker sub-grade stiffness below the near surface material. Further inspection of the medium response areas is required to ascertain whether the response is simply weak or loose near surface material or lower strength material to a greater depth. High response values typically indicate the average sub-grade stiffness to a depth of 1.5 metres or so and under most circumstances consist of a compacted stiff sub-grade.

The final CIR (soil response monitoring) at the completion of the Impact Compaction works indicated a relatively uniform sub-grade with a portion in area 'A' that showed a lower response (See CIR Plot in Appendix 2).

6. GEOTECHNICAL TESTING

It is understood that the assessment of the in-situ compaction methodology and the verification of sub-grade design parameters will be carried out by independently by Douglas Partners who have been engaged by Benedict Industries.

7. CONCLUSION AND DISCUSSION

The measured compaction settlements over the last 10 surface passes indicated that sufficient impact compaction passes have been applied using Landpac's 3-sided Heavy (160kJ Kinetic Energy) Impact Compactor. The variation in

compaction settlements indicates the variability of the site and demonstrates the usefulness of heavy Impact Compaction in providing a more uniform sub-grade.

The final CIR (soil response monitoring) at the completion of the Impact Compaction works indicated a relatively uniform sub-grade over the impact compaction trial area. There was however, one weaker sub-grade zone in area "A" (See Appendix 2) identified during the compaction works with the CIR monitoring where a stockpile of material had been located prior to the trial. Eight DCP's were conducted on this area (See DCP Results in Appendix 3) after the completion of the trial. DCP's No's 1, 2, 4 & 8 in the CIR medium response areas confirm weak subsurface soils most likely as a result of excess moisture infiltration into loose soils under the stockpile. Impact Compaction besides compacting soils at depth also provides an onerous proof roll of sub-grades, which is a useful means of identifying localised uncompacted soils (moist/wet clays; organic materials; non-soil matter; etc) that are sometimes evident on uncontrolled fill sites. Typically such areas identified during production works would be investigated further and subject to further treatment if necessary. This further treatment could involve additional compaction passes or removal, drying and replacement or exposing the moisture via ripping to dry and subsequent additional impact compaction. In this instance the treatment on the localised area (Approx 220m^2) identified in the trial area would require excavation (Approx 220m^3) and drying/replacement of the fill.

We would recommend a minimum of 40 surface passes with an impact compactor with Impact Drum module weight of 14 Tonne with a minimum kinetic energy rating of 160kJ. Where deeper fill is encountered additional surface passes may be required, this would be ascertained by on site by monitoring using Landpac's settlement monitoring system and ground response monitoring system

This report has been provided for use by Benedict Industries and Douglas Partners and should only be used for purposes relating to this project and should not be copied in whole or part thereof for use by any other party or parties unless with written permission from Landpac.

Should you have any queries regarding this report or require further clarification of the findings please do not hesitate to contact the undersigned.

For and Behalf of
LANDPAC TECHNOLOGIES Pty Ltd



Matthew Clenton

Reviewed by



Kevin McCann

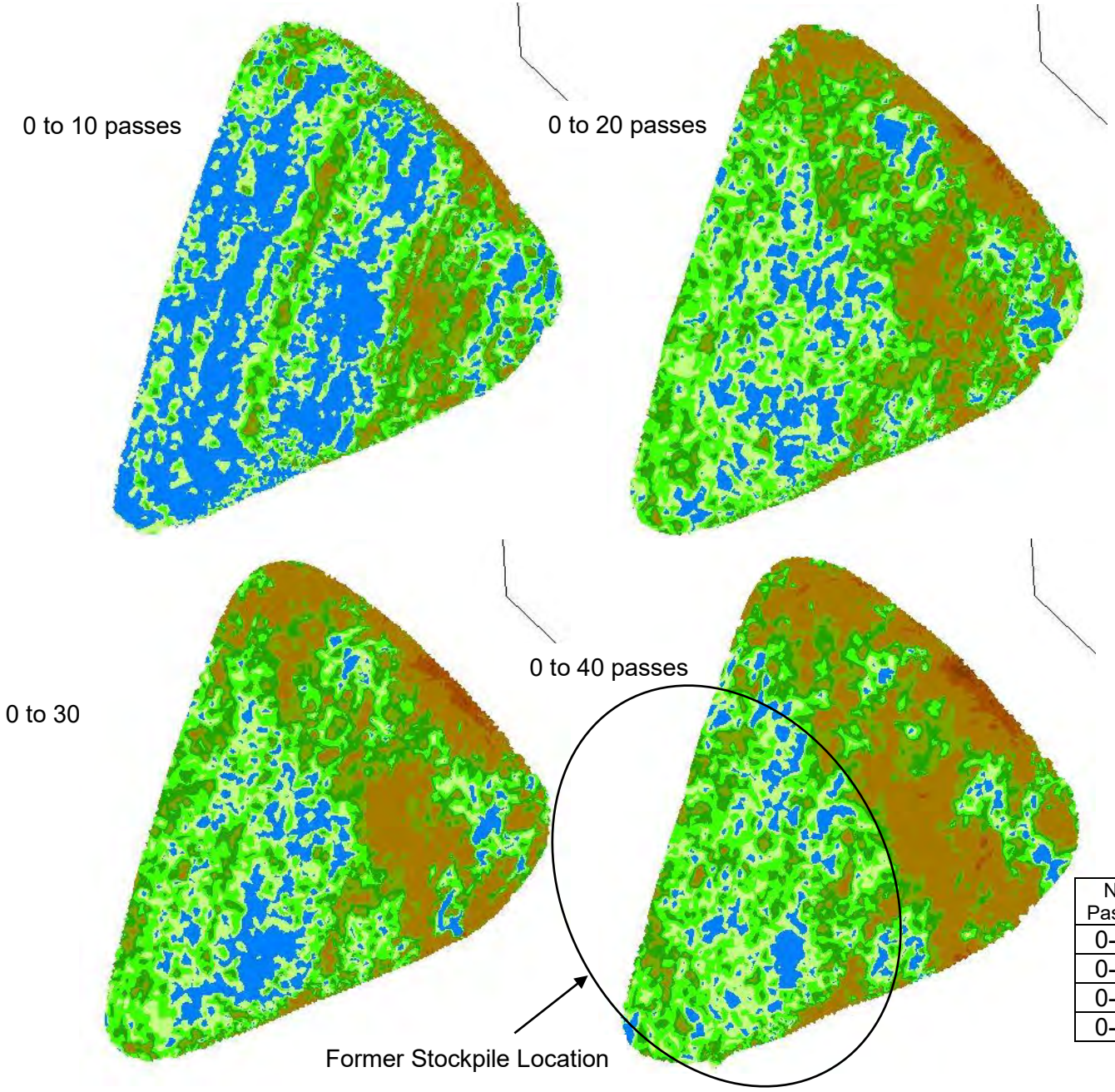
APPENDIX 1

CIS (Continuous Induced Settlement)

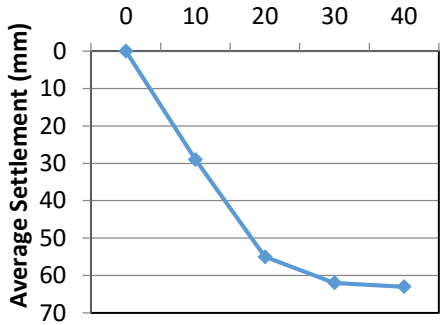
Plots

Project
Benedict Moorebank Ground Improvement Trial
Job No. P1044

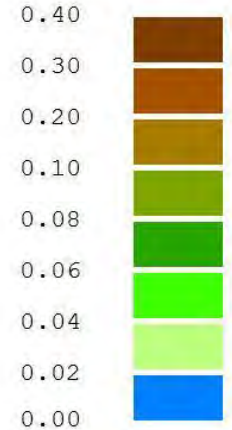
Drawing Title
CIS COMPACTION SETTLEMENT PLOT
AREA A



No. Surface Passes



CIS SETTLEMENT LEGEND
METERS



N

No. Passes	Average Settlement
0-10	29
0-20	55
0-30	62
0-40	63

A.B.N. 12 069 528 696

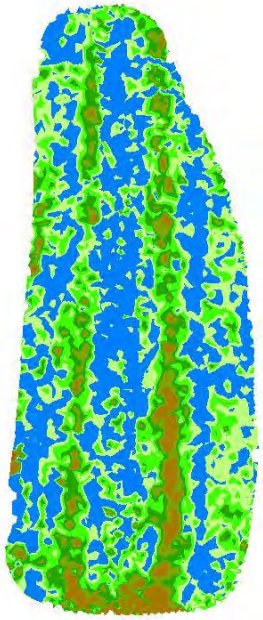
PO BOX 132, SEVEN HILLS, NSW 1730; PO BOX 454, OXENFORD, QLD 4210, Australia:
Tel 1300 237 045; +61 (0)2 9627 4599 info@landpac.com.au; www.landpac.com.au
DIRECTORS: K T McCANN, E J COOK, C DAVIS

LAND PAC
WORLD LEADER IN COMPACTION TECHNOLOGY

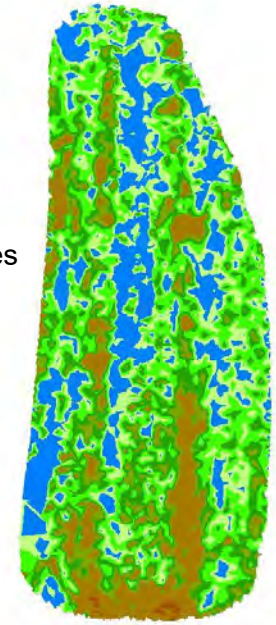
Project
Benedict Moorebank Ground Improvement Trial
Job No. P1044

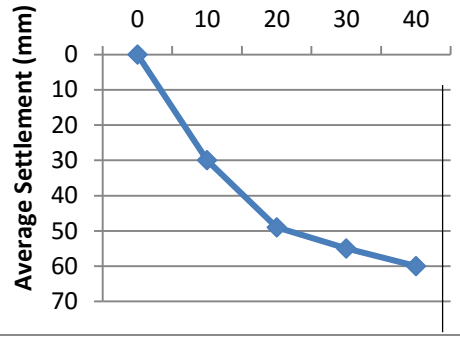
Drawing Title
CIS COMPACTION SETTLEMENT PLOT
AREA B

0 to 10 passes

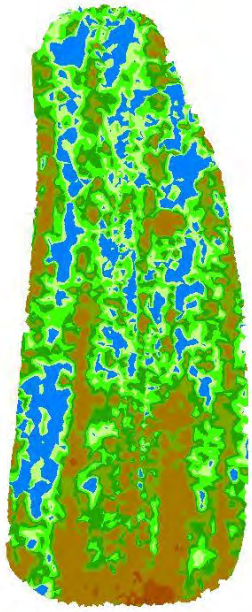


0 to 20 passes

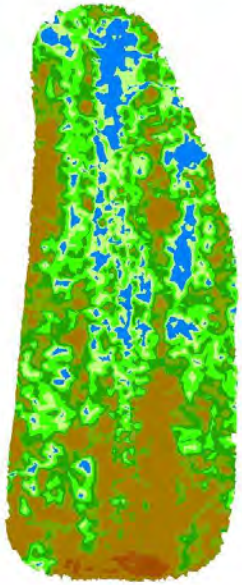




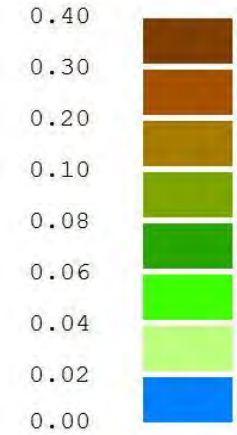
0 to 30 passes



0 to 40 passes



CIS SETTLEMENT LEGEND
METERS



N



No. Passes	Average Settlement
0-10	30
0-20	49
0-30	55
0-40	60

A.B.N. 12 069 528 696

LAND PAC
WORLD LEADER IN COMPACTION TECHNOLOGY

PO BOX 132, SEVEN HILLS, NSW 1730; PO BOX 454, OXENFORD, QLD 4210, Australia:
Tel 1300 237 045; +61 (0)2 9627 4599 info@landpac.com.au; www.landpac.com.au
DIRECTORS: K T McCANN, E J COOK, C DAVIS

APPENDIX 2

CIR (Continuous Impact Response)

Plots

A.B.N. 12 069 528 696

PO BOX 132, SEVEN HILLS, NSW 1730; PO BOX 454, OXENFORD, QLD 4210, Australia:
Tel 1300 237 045; +61 (0)2 9627 4599 info@landpac.com.au; www.landpac.com.au
DIRECTORS: K T McCANN, E J COOK, C DAVIS

LAND PAC
WORLD LEADER IN COMPACTION TECHNOLOGY

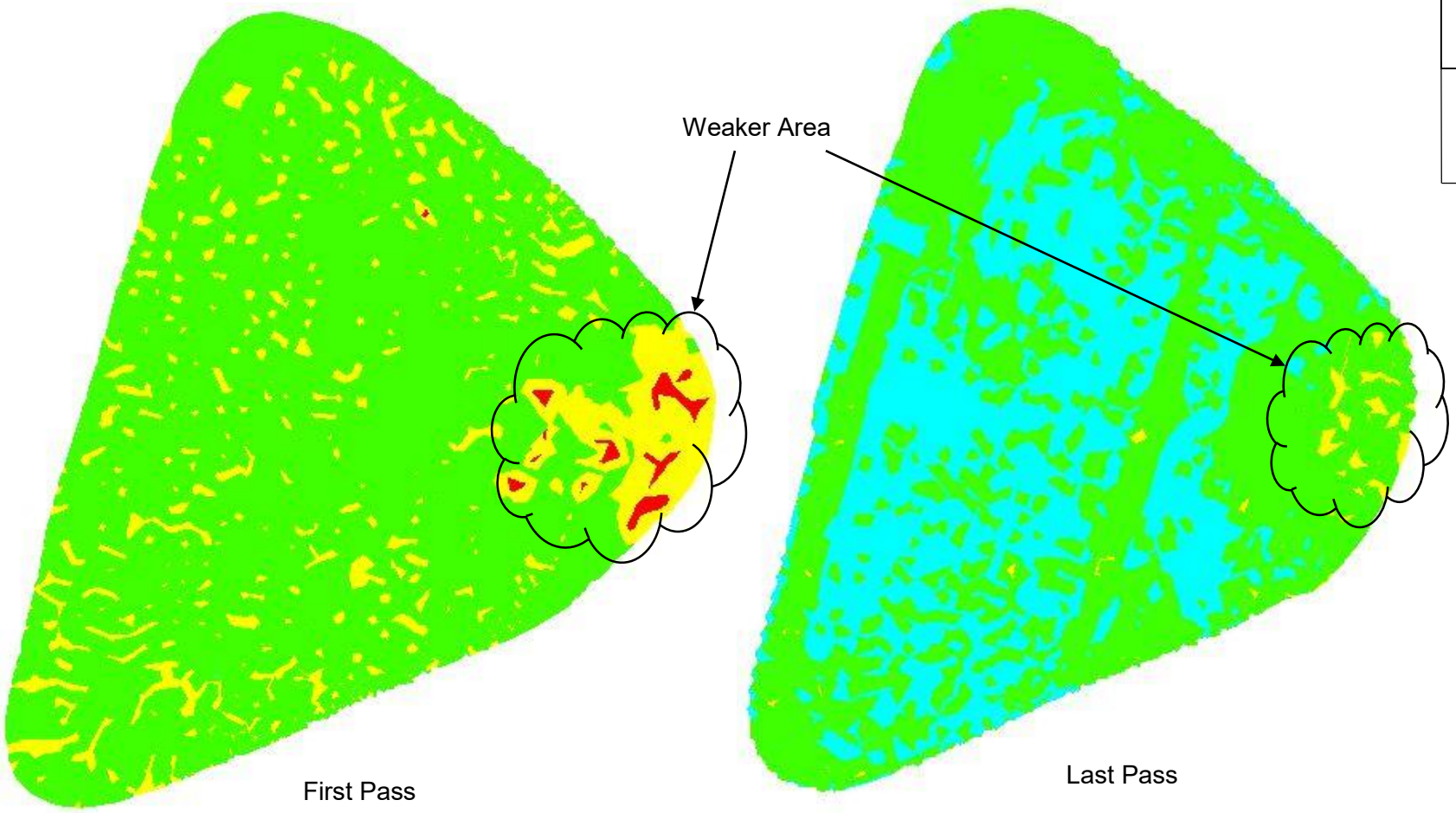
NOTE:
Soil Response is indicative only. Indicated **Low** and Medium soil response areas should be investigated further by a geotechnical engineer.

Project
Benedict Moorebank Ground Improvement Trial
Job No. P1044

Drawing Title
CIR Ground Response Monitoring Plot
AREA A

SOIL RESPONSE

- Low
- Medium
- High
- Very High



A.B.N. 12 069 528 696

LAND PAC
WORLD LEADER IN COMPACTION TECHNOLOGY

PO BOX 132, SEVEN HILLS, NSW 1730; PO BOX 454, OXENFORD, QLD 4210, Australia:
Tel 1300 237 045; +61 (0)2 9627 4599 info@landpac.com.au; www.landpac.com.au
DIRECTORS: K T McCANN, E J COOK, C DAVIS

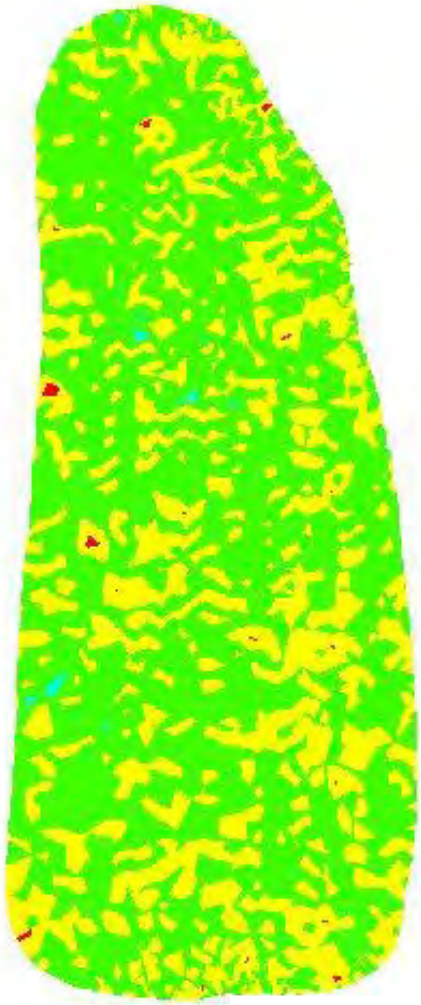
NOTE:
Soil Response is indicative only. Indicated **Low** and Medium soil response areas should be investigated further by a geotechnical engineer.

Project
Benedict Moorebank Ground Improvement Trial
Job No. P1044

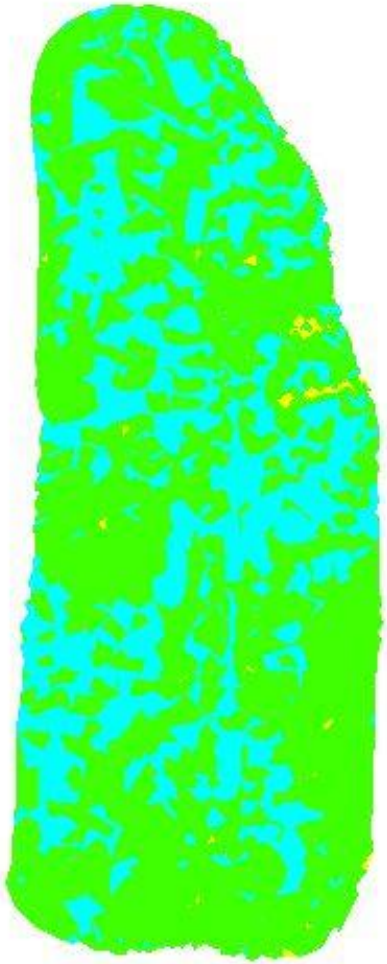
Drawing Title
CIR Ground Response Monitoring Plot
AREA B

SOIL RESPONSE

- Low
- Medium
- High
- Very High



First Pass



Last Pass

N

A.B.N. 12 069 528 696

LAND PAC
WORLD LEADER IN COMPACTION TECHNOLOGY

PO BOX 132, SEVEN HILLS, NSW 1730; PO BOX 454, OXENFORD, QLD 4210, Australia:
Tel 1300 237 045; +61 (0)2 9627 4599 info@landpac.com.au; www.landpac.com.au
DIRECTORS: K T McCANN, E J COOK, C DAVIS

APPENDIX 3

DCP Results

DCP RECORD SHEET

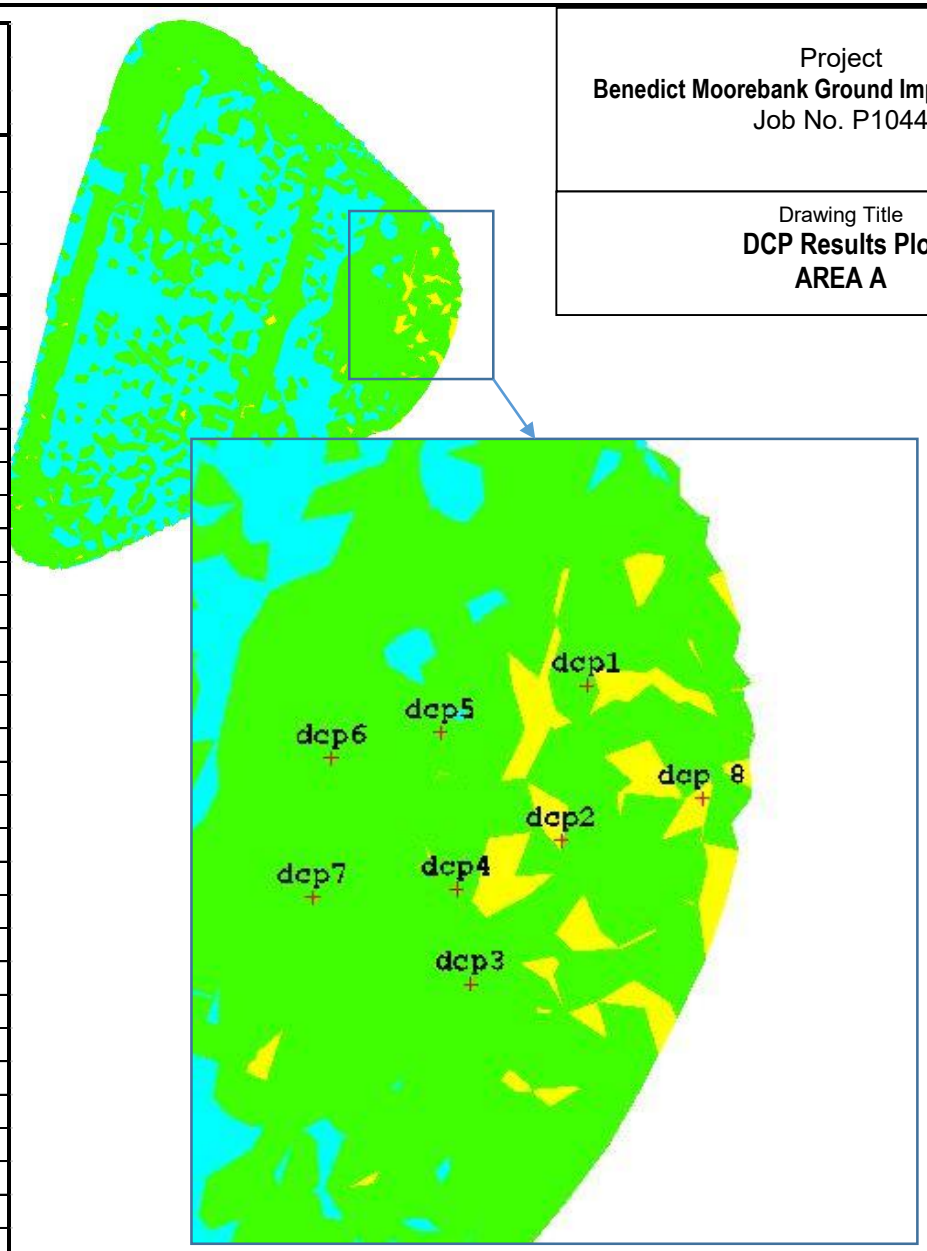
Landpac Technologies Pty Ltd
LAND PAC
Ground Engineering Contractors

PROJECT: Benedict Ground Improvement Trial | **REPORT NO:** LPDCPA1

CLIENT: Benedict Industries | **DATE:** 6/10/2015

TYPE OF WORK: DCP Area A | **DAY:** Tuesday

DCP #	1	2	3	4	5	6	7	8
100mm	10	5	15	6	6	15	20	5
200mm	9	4	3	2	6	9	19	3
300mm	3	2	6	2	4	5	11	5
400mm	8	5	12	3	4	5	20R	3
500mm	5	3	5	3	6	4		3
600mm	5	2	9	7	5	10		2
700mm	3	8	17	20R	5	7		3
800mm	4	16	19		5	5		3
900mm	3	16	22		6	6		3
1000mm	4	10	18		17	7		4
1100mm	6	5	16		9	7		3
1200mm	5	6			7	20R		4
1300mm	4	12			20R			20R
1400mm	2	8						
1500mm	3	5						
1600mm	3	5						
1700mm	5	5						
1800mm	4							
1900mm	5							
2000mm								
2100mm								
2200mm								
2300mm								
2400mm								
2500mm								
2600mm								
2700mm								
2800mm								
2900mm								



Project
Benedict Moorebank Ground Improvement Trial
Job No. P1044

Drawing Title
DCP Results Plot
AREA A

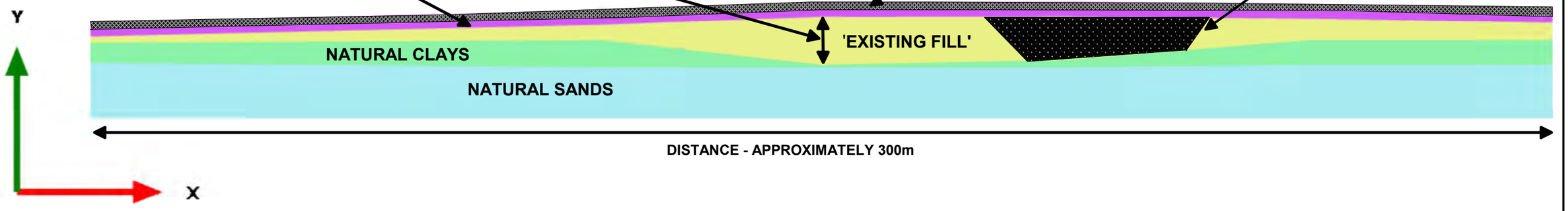
A.B.N. 12 069 528 696

LAND PAC
WORLD LEADER IN COMPACTION TECHNOLOGY

PO BOX 132, SEVEN HILLS, NSW 1730; PO BOX 454, OXENFORD, QLD 4210, Australia:
Tel 1300 237 045; +61 (0)2 9627 4599 info@landpac.com.au; www.landpac.com.au
DIRECTORS: K T McCANN, E J COOK, C DAVIS

APPENDIX D

Numerical Analyses Output



NOTES:

- REFER TO TEXT OF REPORT

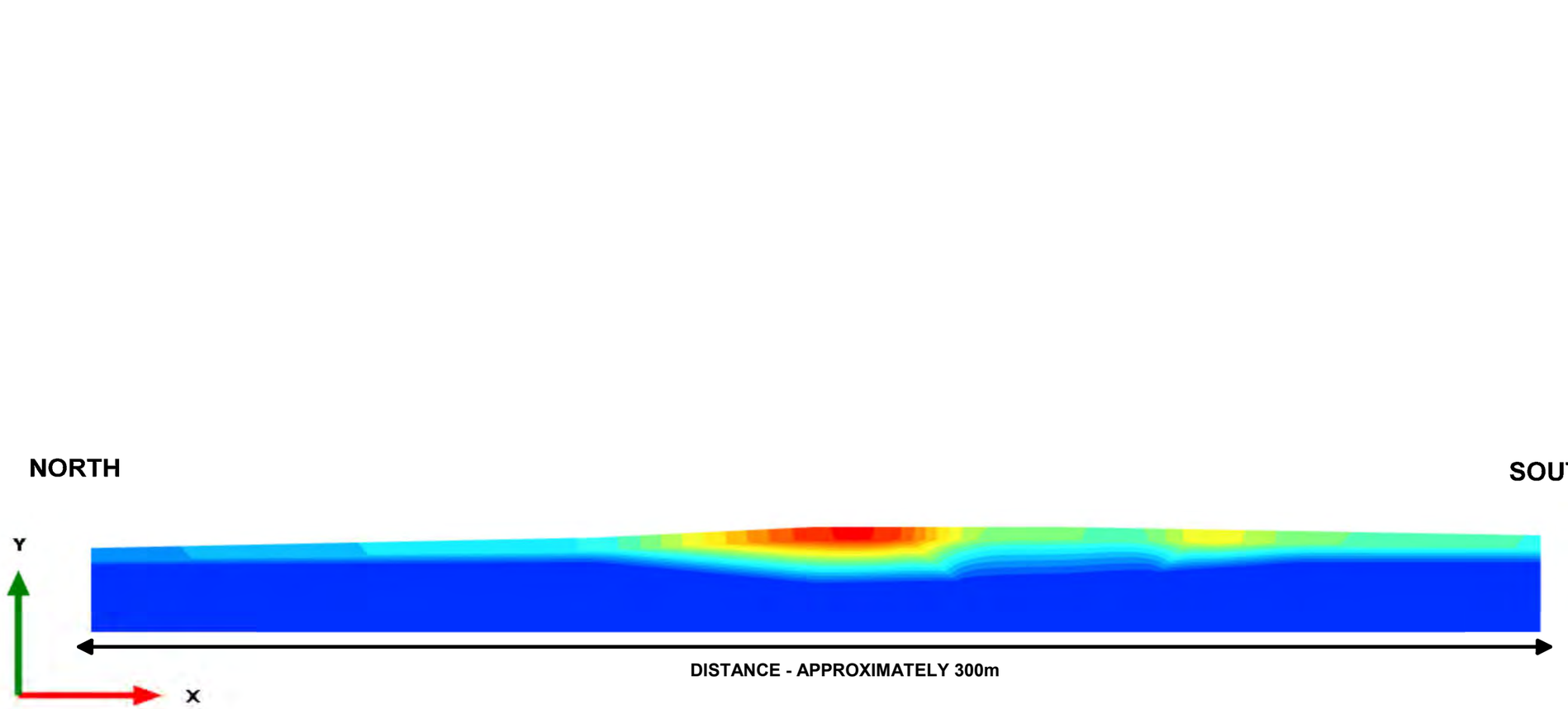
NOT TO SCALE

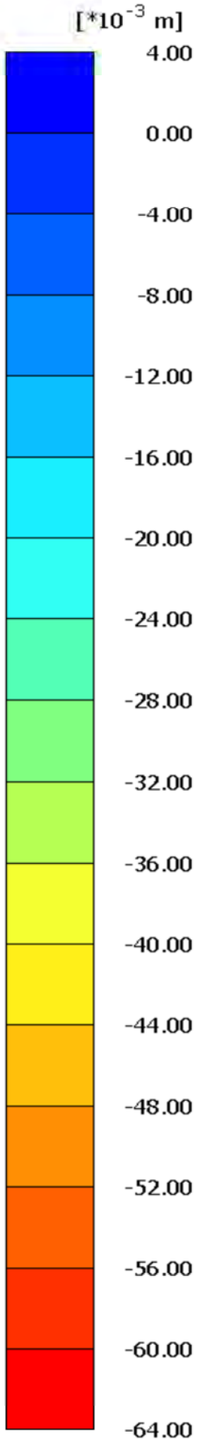
LONG SECTION THROUGH SITE
ADOPTED GEOTECHNICAL MODEL

JK Geotechnics
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

Report No. 26930Z Figure No. 3

COPYRIGHT





NOTES:

- REFER TO TEXT OF REPORT

NOT TO SCALE

LONG SECTION THROUGH SITE
ESTIMATED SETTLEMENTS - AT 50 YEARS

JK Geotechnics
GEOTECHNICAL & ENVIRONMENTAL ENGINEERS
Report No. 26930Z Figure No. 4

COPYRIGHT

Appendix J

Fill Management Protocol for Imported VENM Cap Construction

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Fill Management Protocol for Imported VENM Cap Construction

Proposed Residential Development
146 Newbridge Road, Moorebank

Prepared for
Benedict Industries Pty Ltd

Project 71459.07
April 2017



Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	71459.07	Document No.	R.003.Rev2
Document title	Fill Management Protocol for Imported VENM Cap Construction Proposed Residential Development		
Site address	146 Newbridge Road, Moorebank		
Report prepared for	Benedict Industries Pty Ltd		
File name	71459.07.R.003.Rev2.FMP		

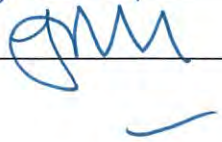
Document status and review

Status	Prepared by	Reviewed by	Date issued
Draft A	Paula Maurici	J M Nash	25 November 2016
Revision 0	Paula Maurici / John Russell	J M Nash	14 December 2016
Revision 1	Paula Maurici / John Russell	J M Nash	20 December 2016
Revision 2	Paula Maurici / John Russell	J M Nash	10 April 2017

Distribution of copies

Status	Electronic	Paper	Issued to
Draft A	1	0	Ernest Dupere
Revision 0	1	0	Ernest Dupere
Revision 1	1	0	Ernest Dupere
Revision 2	1	0	Ernest Dupere

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author		10 April 2017
Reviewer		10 April 2017

bsi. ISO 9001 Quality Management

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666
Fax (02) 9809 4095

Table of Contents

Page

1. Introduction 1
2. Site Information 1
3. Material Importation 2
4. Contamination Requirements 2
   - 4.1 Regulatory Requirements and Applicable Guidelines 2
   - 4.2 Imported Material Acceptance Criteria – Contamination 3
5. Salinity and Aggressivity Requirements 5
   - 5.1 Applicable Guidelines 5
   - 5.2 Background 5
   - 5.3 Imported Material Acceptance Criteria – Salinity and Aggressivity 6
6. Geotechnical Requirements 7
7. Fill Management Protocol 7
8. Approval/ Assessment 9
   - 8.1 Assessment/Approval of Source Sites 9
   - 8.2 Gate Check 9
   - 8.3 Check Samples 10
   - 8.4 Non-conformance 10
9. Final Validation Reporting 11
10. References 11
11. Limitations 12

Appendix A: About This Report

Appendix B: Drawings and Fill Plan

Appendix C: Department of Planning SEAR 1102

Appendix D: Threshold Values

Appendix E: Sampling Frequencies

Appendix F: Gate Check Forms and Material Acceptance Checklist

Appendix G: Materials Giving Rise to Load Rejection

Fill Management Protocol for Imported VENM Cap Construction
Proposed Residential Development
146 Newbridge Road, Moorebank

1. Introduction

Douglas Partners Pty Ltd (DP) was commissioned by Mr Ernest Dupere of Benedict Industries Pty Ltd (Benedict) to prepare this Fill Management Protocol (the FMP) to manage the importation of fill material during the bulk earthworks to be undertaken as part of the proposed developments at 146 Newbridge Road, Moorebank (the site).

DP understands that bulk earthworks will involve cut and fill of existing material with a net deficit of soil. The net deficit will require an average 1.6 m thickness of imported virgin excavated natural material (VENM) fill across the site.

This FMP details the requirements for assessing the VENM prior to importation to the site, with respect to contamination and (if required) salinity, and the procedures to be implemented during the course of VENM importation. A separate procedure will need to be adopted to cater for geotechnical aspects of fill suitability.

Application of the FMP to all soil and rock to be imported to the site will provide a consistent approach to the management of materials with respect to their suitability for use as the proposed cap.

The following should be considered with respect to the implementation of the FMP:

- The FMP is only for the materials imported for the bulk earthworks and does not apply to other materials imported to the site for the purpose of road construction or drainage works etc.;
- It is the responsibility of Benedict Industries Pty Ltd and its nominated qualified Geotechnical and Environmental Consultant to maintain compliance with the FMP; and
- The suppliers of the materials are required to provide the supporting documentation to verify that the subject material complies with the FMP. It is the suppliers' responsibility to ensure that the supporting documentation is complete and correct. In this regard, the suppliers of materials must be issued with a copy of the FMP.

The site is being audited by Dr Ian Swane, a NSW Environment Protection Authority (EPA) accredited site auditor, to facilitate the issue of a site audit statement (SAS) Part B confirming the land can be made suitable for the proposed development. The auditor has requested in auditors comments (26 July 2016) (comments 41, 47 and 52 that a Fill Management Protocol (FMP) be included in the RAP.

2. Site Information

The site comprises part (generally the northern half) Lot 7 in Deposited Plan 1065574. The street address is 146 Newbridge Road, Moorebank and the site has a total area of approximately 9 ha.

The site boundary is shown on Drawing 1, Appendix A. The drawing also shows land to the south of the 'site' which is the remainder of Lot 7 in Deposited Plan 1065574. It is understood that this southern portion is also proposed to be developed as a marina and that this development is the subject of a separate DA.

The site has been the subject of various previous reports including *inter alia*:

- Douglas Partners *Detailed Site Investigation 146 Newbridge Road, Moorebank NSW* Project 71459.03 dated March 2016 (DP, 2016); and
- Douglas Partners *Remediation Action Plan 146 Newbridge Road, Moorebank NSW* Project 71459.06 dated April 2017 (DP, 2017).

An extended list of references is provided in Section 10.

The proposed development of 180 residential dwellings will comprise a mix of terrace homes, duplex (semi-detached) homes and detached homes. The final lot layout may be subject to minor changes as detailed design progresses. The following drawings that depict the various aspects of the proposed development are provided in Appendix B:

- Drawing 14005-FILL2 Preliminary Fill Plan of the Residential Portion of Lot 7 DP1065574 Above the Bottom of the Capping Layer (i.e. 3 m below FSL), dated 1 September 2016;
- Drawing 14005E10 Overall Plan Showing Catchments, dated 20 November 2016; and
- Drawing MP01-B-01-12-2016 Concept Plan Reduced Site Area Option 20y, dated 21 November 2016.

3. Material Importation

The soil and rock materials to be imported to the site during bulk earthworks must satisfy the requirements detailed in Sections 4, 5 and 6 below. All materials to be imported must be accompanied by appropriate reports/ certifications from the qualified geo-environmental geotechnical consultants confirming the status of the material with respect to contamination, acid sulphate soils and salinity (and relevant geotechnical parameters where available). The materials to be imported should also be compatible with the salinity and aggressivity characteristic of the site.

4. Contamination Requirements

4.1 Regulatory Requirements and Applicable Guidelines

The NSW Department of Planning and Environment have outlined a list of Key Issues as part of the *Secretary's Environment Assessment Requirements (SEAR) 1102 (dated 16 November 2016)*. The relevant key issue is replicated below:

'Waste management – including:

- *Details of the type, quality and classification of waste to be received at the site;*

- *Details of the resource outputs and any additional processes for residual waste;*
- *Details of waste handling including transport, identification, receipt, stockpiling and quality control; and*
- *The measures that would be implemented to ensure that the proposed development is consistent with the aims, objectives and guidelines in the NSW Waste Avoidance and Resource Recovery Strategy 2014-21.'*

Liverpool Development Control Plan 2008 (DCP) Part 1 Section 10 outlines the requirements for the management of contaminated sites under the DCP. This has been addressed via the various site investigations and remediation action plan (RAP) (e.g. DP, 2016a; 2016b). Part 2.10 of the DCP is specific to the site and Section 3.5 of Part 2.10 is relevant to cut and fill works, specifically, Item 4. states that "*contaminated fill, either imported or found on site is not permitted*."

DP notes that in addition to satisfying the Council's requirements the importation of material onto the site must also comply with the provisions of relevant NSW environmental legislation, including, inter alia, the *Contaminated Land Management Act 1997* and *Protection of the Environment Operations Act 1997*. The following guidelines and documents are relevant for the purpose of material assessment for importation:

- NSW Environment Protection Authority (NSW EPA, 2014) *Waste Classification Guidelines: Part 1 Classifying Waste*;
- National Environment Protection Council (2013) *National Environment Protection (Assessment of Site Contamination) Measure* (NEPC, 2013);
- ANZECC/NHMRC (1992) *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites, Environmental Soil Quality Guidelines* - Background A (ANZECC, 1992); and
- Berkman (1989) *Field Geologists Manual* - Background Concentration Ranges for Metals.

For the purposes of this site materials classified under Resource Recovery Exemptions and Orders will not be accepted as imported bulk filling under this FMP.

4.2 Imported Material Acceptance Criteria – Contamination

The materials to be imported to the site must satisfy the following:

- All imported soil/rock materials must be geotechnically suitable as determined by a geotechnical engineer (refer to Section 0);
- All imported soil/rock materials must be VENM under the NSW EPA (2014) *Waste Classification Guidelines* and the *Protection of the Environment (POEO) Act*;
- No Excavated Natural Material (ENM) or other exempted waste material is to be accepted onto the site;
- No Acid Sulphate Soil / Potential Acid Sulphate Soil is to be accepted onto the site;
- As the NSW EPA has no specific VENM assessment criteria (in terms of contaminant thresholds), the VENM should be reviewed on the basis of the source site history, potential for acid sulphate soil conditions, material type and the site conditions observed during field assessment and the

assessment of VENM validation samples with reference to relevant guidelines/thresholds. The VENM validation assessment should include an appropriate number of sample analyses conducted for the analytes listed in Table D1, Appendix D at the sampling frequency as specified in Table E1, Appendix E. DP notes that the sampling frequencies to be adopted during VENM assessment are dependent on the past land use history of the source site and the potential for the contamination to be present at the source site. The supplier's Environmental Consultant should adopt the relevant sampling frequency (Criterion 1 or Criterion 2) as per Table E1, Appendix E based on the history of the source site and the potential for contamination when undertaking VENM assessment. If necessary, The Environmental Consultant should be contacted for advice in selecting the required sampling frequency for VENM assessment. The concentrations of heavy metals in the samples tested should be below the background ranges published in Berkman (1989) and/ or ANZECC (1992) for typical Australian soils, and the concentrations of organic analytes in the samples should be below the analytical practical quantitation limits (PQL). Similarly, the VENM should not contain any fill, anthropogenic material (including asbestos) or building demolition rubble;

- The imported VENM material must satisfy the requirements under section 4.3.7 of the NSW EPA *Contaminated Land Management – Draft Guidelines for the NSW Site Auditor Scheme (3rd Edition)* dated October 2016 or corresponding clause(s) in the final published version of this guideline;
- The thresholds to be adopted for VENM assessment are included in Table D1, Appendix D;
- All imported VENM must be placed in accordance with the Specification in J&K (2016) see Section 10). A separate procedure for verifying imported material from a geotechnical perspective is to be developed by the Geotechnical Consultant;
- All VENM to be imported must be accompanied by a VENM validation report (VENM certification) from a suitably qualified Environmental Consultant. The VENM validation report should include the following:
    - Details of the source site, past land use, site contamination history, surrounding land use and the potential for the occurrence of contamination and acid sulphate soil conditions;
    - Information on depth and the extent of excavation, geological profile at the source site and the VENM volume requiring disposal, including relevant test pit or borehole logs;
    - Site conditions at the time of validation assessment, a plan showing the proposed area of excavation and VENM sampling locations;
    - Site photographs showing the site conditions and geological profile within the test pits / investigation locations;
    - Analytical schedule (undertaken as per Table D1, Appendix D), the number of samples tested (as per the sampling frequency outlined in Table E1, Appendix E), sample collection depth and a summary table of laboratory analytical results compared against the criteria provided in Table D1, Appendix D;
    - A summary of recommendations/limitations of the VENM assessment (e.g. if VENM classification applies to certain soil strata or the *in-situ* soil throughout the site or to stockpiles only, if the segregation of material required etc.); and
    - The validity period (time frame) of the VENM report.

- In addition to the above, all VENM materials must also be validated to be suitable, from a contamination standpoint, for use on residential sites with access to soil. Whilst the proposed development at the site comprised residential dwellings with access to soil DP notes that the criteria for residential land use are the most conservative and protective of human health. In this regard, material to be imported to the site must also meet the assessment criteria specified in Schedule B1 of NEPC (2013) for residential land use as provided in Table D2, Appendix D; and
- With regard to the analytical testing, all laboratory analysis must be conducted by a laboratory that holds National Association of Testing Authorities (NATA) accreditation for the test methods performed.

Compliance with the above requirements must be met before VENM materials are imported to the site. Agreement of compliance by the Environmental Consultant represents a hold point on importation.

5. Salinity and Aggressivity Requirements

5.1 Applicable Guidelines

The following guidelines are considered relevant for the assessment of the suitability of material for importation with respect to their salinity and aggressivity-related properties:

- Department of Land and Water Conservation (DLWC, 2002) *Site Investigations for Urban Salinity*;
- *Western Sydney Salinity Code of Practice 2003;*
- Standards Australia (2009) *AS 2159 – 2009 Piling Design and Installation*;
- Standards Australia (2011) *AS 2870 – 2011 Residential Slabs and Footings*; and
- Standards Australia (2009) *AS 3600 – 2009 Concrete Structures*.

5.2 Background

According to the DIPNR (2002) *Salinity Potential in Western Sydney* map, the subject site is identified as having a moderate salinity potential. The site is covered by fill of varying thickness of up to approximately 11.5 m and the salinity potential of the fill is likely to be variable (i.e. consistent with the various sources of fill).

Establishing the salinity potential of the fill at the site has not been undertaken for the following reasons:

- The soils to be excavated largely comprise non-homogeneous fill and therefore establishing a salinity depth profile was not feasible;
- Soils that need to be excavated, screened and re-compacted as part of the as part of bulk earthworks will be such that their location / distribution will change from their current location / distribution; and
- The site will require final filling / capping involving a 1.6 m thick layer of VENM, likely to be crushed sandstone.

The most important aspect of any salinity management will be that any fill soils imported to form final design levels will ultimately be in contact with built infrastructure. This issue will be managed by implementing this Fill Management Protocol. This is on the premise that all foundations are high level footings founded in the imported fill layer. Should any structures involve piered foundations that contact the existing fill, then the salinity and aggressivity of the fill at the relevant area of the site should be confirmed to allow for appropriate design of those deep foundations.

5.3 Imported Material Acceptance Criteria – Salinity and Aggressivity

Crushed sandstone generally has characteristics of non-saline to slightly saline soil and therefore testing of crushed sandstone to confirm salinity characteristics is not required under this FMP.

Materials to be imported to the site must be assessed for salinity (excluding crushed sandstone) and aggressivity as per below:

- Analysis of the samples for the salinity and aggressivity related parameters (pH, EC, chloride, sulphate and texture) at the specified sampling frequency indicated in Table E2, Appendix E;
- Materials to be imported to the site should have a maximum salinity classification of non-saline to slightly saline salinity, based on EC, the electrical conductivity of saturated pore water. Refer to Table D3, Appendix D for the salinity scale; and
- Materials should be a maximum of mildly aggressive to concrete structures and non-aggressive to steel structures based on the aggressivity scale given in Tables D4 and D5, Appendix D.

The VENM reports provided to the Environmental Consultant for review must also include an assessment of salinity and aggressivity of VENM. The following information should be included in the VENM report in relation to salinity assessment:

- Visual clues of salinity potential at the site during site inspections (such as black greasy patches on the soil surface, salt crystals, scalds, stressed vegetation and salt damage to structures);
- Number of soil samples analysed for salinity and the depths of sample collection. Samples should be collected from various depths rather than just from the surface;
- A plan showing sample collection locations; and
- Comments on the soil salinity at the source site and the aggressivity of the soil to concrete and steel structures based on the analytical results of the samples tested.

Compliance with the above requirements must be met before VENM materials are imported to the site. Agreement of compliance by the Environmental Consultant represents a hold point on importation.

It is to be noted that the placement of imported materials may change the salinity and aggressivity characteristics of the site. Therefore, an assessment of site's salinity may be required post completion of bulk earthworks but prior to issuing of the subdivision certificates. The need for a post-earthworks salinity assessment shall be to be determined by the Environmental Consultant and be based on the number and nature of VENM source sites. The results of any the salinity mapping generated by a post-earthworks salinity assessment should be incorporated into the lot classifications.

6. Geotechnical Requirements

The materials to be imported to the site should have the following geotechnical characteristics:

- All imported soil/rock materials must be geotechnically suitable as determined by a geotechnical engineer;
- Materials should be free of topsoil, organic material, fill, refuse, building rubble and anthropogenic inclusions and should not be ASS/PASS;
- Materials should not contain particle sizes larger than 150 mm. If the materials contain particle sizes larger than 150 mm such materials should be breakable under the normal compaction conditions;
- Materials are not overly wet (greater than +4% of optimum moisture content) upon visual assessment; and
- All imported VENM must be placed in accordance with the Specification in J&K (2016) see Section 10).

Compliance with the above requirements and any other requirements and checking procedures imposed by the Geotechnical Consultant must be met before VENM materials are imported to the site. Agreement of compliance by the Environmental Consultant represents a hold point on importation.

7. Fill Management Protocol

The following procedures must be followed prior to and during the course of material importation:

- Prior to commencing construction of the 1.6 m capping in that area, the Environmental Consultant and the auditor should inspect the subgrade at an area;
- Prior to importation the suppliers must provide VENM validation reports to the site Environmental for review;
- The Environmental Consultant will review the VENM validation reports to assess the compliance of the VENM assessment with Sections 4, 5 and 6 of this FMP and the suitability of material for importation. Following review of the VENM validation reports, the Environmental Consultant will issue a memorandum for each source site with an approval for material importation and / or comments / recommendations that should be addressed before the material can be approved for importation. The Environmental Consultant, at its discretion, may approve the VENM reports (and the source sites) where the frequency of samples tested for contamination and salinity/aggressivity assessment varies from Tables E1 and / or E2 provided that the land use information is sufficiently robust and the analytical results indicate that the *in-situ* material at the source site has a low potential for contamination, is compatible with the salinity characteristic of the receiving site and all other requirements of this FMP have been complied with;
- An inspection of the source sites by the Environmental Consultant may be required (in the event of any dispute regarding the suitability or classification of the materials) on a case by case basis prior to material importation to assess the current conditions of the source site (i.e. absence of fill, topsoil, anthropogenic material or unassessed material stockpiles at the source sites). It is envisaged that under normal circumstances such inspections would not be required particular

under circumstances where the VENM was being imported from a single source site (e.g. tunnel construction);

- Provision of seven days' notice to the Auditor of the intention to import material to the site. Benedict (or nominated Contractor) must provide all supporting documents (e.g. VENM validation reports, salinity assessment reports, NATA endorsed laboratory certificates and the Environmental Consultant's report review memorandums) to the Auditor for approval to import and place the material at the site;
- The Suppliers (or nominated Contractor) must provide a list of source sites and the registration details of the trucks bringing materials into the site to the Environmental Consultant (and the Gate Keeper at the site) in advance;
- Provision of training to the Gate Keeper for the inspection of materials during the course of importation. The Environmental Consultant will provide information to the Gate Keeper in relation to the approved source sites and the volumes and descriptions of approved material for importation using Form F3 included in Appendix F;
- The Gate Keeper must verify the registration numbers of trucks bringing in the materials with the truck registration list provided by the Suppliers. The Gate Keeper should also cross-examine the imported material at the gate check point to ensure it matches with the description of the approved material and that it is free of visual / olfactory contamination and anthropogenic material;
- The Gate Keeper must keep records of trucks importing material to the site with a description of source site and material imported using Forms F1 and F2 included in Appendix F, and any loads rejected due to non-compliance using Form F4. Recording of the location of materials imported onto the site including photographs, and drawings are also required to be completed by the Gate Keeper in liaison with the earthworks contractor or field technician from the Environmental Consultant undertaking compaction test at the site. Refer to Section 8.2 for details on gate check;
- The Gate Keeper should provide a record of truck registrations and material imported to the site on a daily basis to the Environmental Consultant's project manager who will in turn provide this information to Benedict (or nominated Contractor) for record keeping purpose. Benedict (or nominated Contractor) should keep records of truck registrations and material imported to the site for future reference;
- The imported materials must be placed at the designated locations and compacted to the required standards as per the Council's Work Specification. Upon completion of material placement, Benedict's nominated Contractor should survey the depths and the extent of material placement at the site;
- All material imported to the site is tracked from cradle-to-grave;
- Material is only to be imported to the site when the Gate Keeper is present and certifies the loads being imported;
- The Gate Check Forms in Appendix F are to be completed by the Gate Keeper at the time the loads are received at the site and at a frequency not less than one per day;
- Inspection of the completed cap as soon as construction of the cap has been completed in an area by the Environmental Consultant and the auditor; and

- Preparation of a fill validation report by the Environmental Consultant for submission to the Council at the completion of material importation to the site. The report should be prepared with reference to Section 9 of this FMP.

Note: inspection by the Environmental Consultant does not constitute agreement of the geotechnical properties of the materials. Such inspections must be carried out by the Geotechnical Consultant.

Compliance with the approval for import of material must be met before further VENM materials are imported to the site. Agreement of compliance by the Environmental Consultant represents a hold point on importation.

8. Approval/ Assessment

8.1 Assessment/Approval of Source Sites

Prior to acceptance of material from an external source site, an assessment of the source site should be undertaken by the source site's consultant to determine the general acceptability of material from that site. Materials will be judged as suitable, or otherwise, by the Environmental Consultant based on the documentation provided by the source site's consultant, the apparent reliability, or otherwise, of the documentation and its conformance with this Protocol.

No material is to be imported to site that has not had prior written approval from the Environmental Consultant.

Compliance with the above requirements must be met before VENM materials are imported to the site. Agreement of compliance by the Environmental Consultant represents a hold point on importation.

The Environmental Consultant shall notify the Site Auditor of any non-compliant imported material without delay;

If the non-compliant material is found to be incompatible with the site requirements, no further material from that source is to be imported to the site until approved by the Environmental Consultant.

8.2 Gate Check

Material tracking and inspection should be undertaken to assess that the materials being imported are consistent with those approved for importation. The Gate Keeper must compare each load with the material description provided in the VENM validation report (and Environmental Consultant memorandum).

A record of truck movements providing the following information must be maintained by the Gate Keeper for trucks carrying material imported to the site:

- The date and time of truck arrival;
- The source location of the material;
- The truck registration details;

- Material type;
- Visual assessment of material at gate;
- Record of load acceptance/rejection; and
- The approximate location of material placement (on a daily basis not per truck load).

The Gate Keeper will reject any materials entering the site when:

- The registration numbers of trucks brining in the materials or the source site does not match up with the list of truck registrations provided by the Suppliers in advance and the approved source site lists;
- The material is deemed to be not consistent with that described in supporting documentation (and Environmental Consultant memorandum) based on a visual assessment of the material at the gate or the imported material contains unsuitable materials listed in Appendix G; or
- The supporting documentation has not been previously supplied and accepted.

Similarly, the Gate Keeper will reject materials from the source sites from which more material has been delivered than has been allowed for in the original assessment. A supplementary assessment may be undertaken by the source site's consultant to allow for importation of additional material, but the supplementary assessment report must be submitted to the Environmental Consultant for review in accordance with Section 4.2.

Compliance with the above requirements must be met before VENM materials are imported to the site. Agreement of compliance by the Environmental Consultant represents a hold point on importation.

8.3 Check Samples

As an additional level of control, check samples of imported material may be collected at the gate at the discretion of the Environmental Consultant if it is considered necessary. The check samples (if collected) will be assessed for contamination as per Table D1, Appendix D and for salinity and aggressivity parameters as per Table E2, Appendix E. As a minimum check samples will be collected in the following circumstances:

- The source sites had previous contamination history but have been remediated; and
- Contamination is suspected in the imported material based on visual/olfactory assessments.

Compliance with the above requirements must be met before VENM materials are imported to the site. Agreement of compliance by the Environmental Consultant represents a hold point on importation.

8.4 Non-conformance

The bulk earthworks contractors must notify the Environmental Consultant if contamination is suspected in the imported material during material placement. Such material should be segregated for assessment by the Environmental Consultant.

If the non-compliant material is found to be incompatible with the site requirements it will be removed at the cost of the Suppliers. A bond system is recommended to be put in place with the suppliers to address non-conformance matters.

Compliance with the above requirements must be met before VENM materials are imported to the site. Agreement of compliance by the Environmental Consultant represents a hold point on importation.

9. Final Validation Reporting

At the completion of importation of the materials to the site and prior to the commencement of construction the Environmental Consultant will prepare an imported fill validation report. The validation report should include the following:

- A review of source site documentation;
- Copies of Environmental Consultant memoranda (associated with reviews of VENM and salinity reports) for the approved source sites;
- A review of gate keeping records and the volumes of material imported from each source site;
- Site drawings/surveys identifying where the imported materials were placed within the site;
- A review of and discussion of check sampling (if undertaken);
- Records of non-conformances with this FMP; and
- An assessment of the overall compliance of imported material with the FMP.

The final imported fill validation report will also be submitted to Council to demonstrate compliance with the FMP.

10. References

DLWC (2002) Site Investigations for Urban Salinity

EPA (2014a) Waste Classification Guidelines, Part 1: Classifying Waste

EPA (2014b) Waste Classification Guidelines Part 2: Immobilisation of Waste

DEC (2006) Guidelines for the NSW Site Auditor Scheme

DIPNR (2002) Salinity Potential in Western Sydney

DP (2016) Detailed Site Investigation, Proposed Residential Development, 146 Newbridge Road, Moorebank

DP (2017) Remediation Action Plan, Proposed Residential Development, 146 Newbridge Road, Moorebank

J&K (2016) Geotechnical Evaluation for Proposed Residential Subdivision at 146 Newbridge Road, Moorebank, NSW

NEPC (2013) National Environment Protection (Assessment of Site Contamination) Measure 1999 amended 2013

Standards Australia (2009) AS 2159 – 2009 Piling Design and Installation

Standards Australia (2011) AS 2870 – 2011 Residential Slabs and Footings

Standards Australia (2009) AS 3600 – 2009 Concrete Structures

Western Sydney Salinity Code of Practice 2003

11. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 146 Newbridge Road, Moorebank in accordance with DP's proposal dated 26 April 2016 and acceptance received from Mr Ernest Dupere dated 20 May 2016. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Benedict Industries Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Asbestos has previously been detected by observation or by laboratory analysis at the site, either on the surface of the site, or in filling materials at the test locations sampled and analysed. Building demolition materials, such as concrete, brick, tile, timber, plastic, are ubiquitous throughout the fill at the site, and these are considered as indicative of the possible presence of hazardous building materials (HBM), including asbestos. It is therefore considered possible that HBM, including asbestos,

may be during bulk earthworks associated with the proposed development, and hence no warranty can be given that asbestos is not present.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards associated with future design aspects relevant to our input to the project, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the environmental components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix B

Drawings and Proposed Fill Plan



Douglas Partners Geotechnics / Environment / Groundwater	TITLE: Site Locality Remediation Action Plan 146 Newbridge Road, Moorebank, NSW		N MGA	OFFICE: Sydney DRAWN BY: MJC DATE: 29.04.2016
CLIENT: Benedict Industries Pty Ltd	PROJECT No: 71459.06	DRAWING No: 1	REVISION: A	SCALE: As shown



Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: Previous Test Locations
Remediation Action Plan
146 Newbridge Road, Moorebank, NSW

MGA

OFFICE: Sydney
DRAWN BY: MJC
DATE: 29.04.2016

CLIENT:	PROJECT No:	DRAWING No:	REVISION:	SCALE:
Benedict Industries Pty Ltd	71459.06	2	A	As shown

DP602988

208.6

310

'1118048

311

FUTURE RESIDEN

POCKET PARK
334.40 m²

POCKET PARK
1357.97 m²

AREA OF LOT 31
TO BE REZONED R3:
4190 SQM

TOTAL 179 LOTS

rev:	date:	amendment:
A	21.11.16	ISSUE FOR INFORMATION

project:
GEORGES COVE MARINA
Newbridge Road
Moorebank NSW 2170

Copyright of the design and other information shown here is owned by Mirvac Design pty. ltd. Reproduction or use of the design by any party for any purpose is expressly forbidden without the written permission of Mirvac Design pty. ltd.

architect:
MIRVAC DESIGN
architects
planners
interior designers

Level 26, 60 Margaret St.
Sydney, NSW, 2000
tel. 02 9080 8000
fax. 02 9080 8181
Mirvac Design Pty. Ltd.
ABN 78 003 359 153

mirvac

title:
CONCEPT PLAN
Reduced Site Area
Option 20y

drawn:
approved:

job no: .....

lot no: 0

date: 21-11-2016

drawing no: MP01-20y

scale @ A0:1:500

rev: B

AS DIRECTED BY BENEDICT, AN EXISTING SURFACE MODEL WAS CREATED USING A COMPILATION OF VARIOUS TOPOGRAPHIC SURVEYS OF THE STOCKPILES COMPLETED FOR BENEDICT IN 2014, 2015 & 2016.

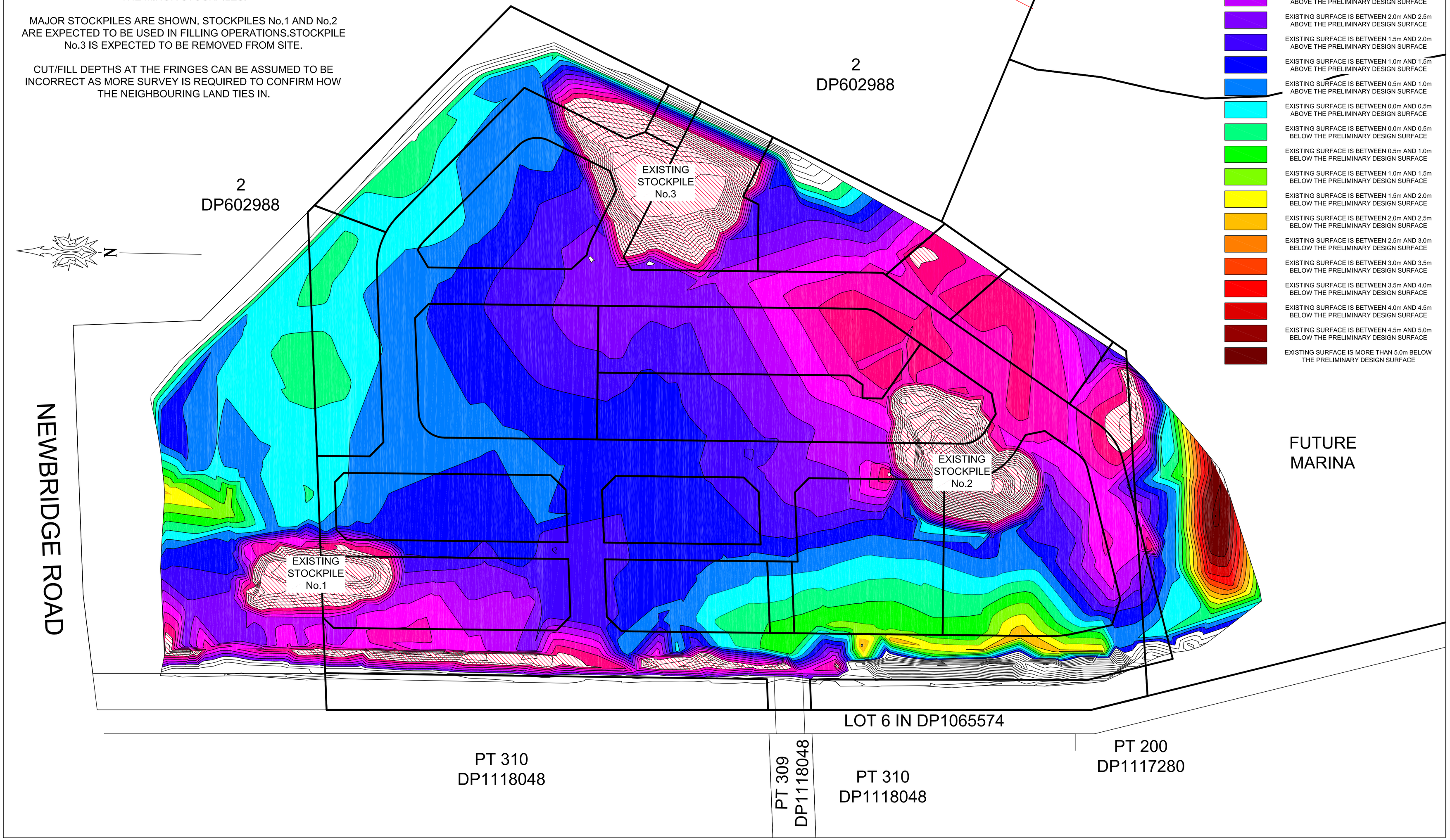
THE AREA BENEATH A NUMBER OF THE MINOR STOCKPILES WAS ASSUMED TO GRADE CONSISTENTLY BETWEEN THE BOTTOM OF THE MINOR STOCKPILES.

MAJOR STOCKPILES ARE SHOWN. STOCKPILES No.1 AND No.2 ARE EXPECTED TO BE USED IN FILLING OPERATIONS.STOCKPILE No.3 IS EXPECTED TO BE REMOVED FROM SITE.

CUT/FILL DEPTHS AT THE FRINGES CAN BE ASSUMED TO BE INCORRECT AS MORE SURVEY IS REQUIRED TO CONFIRM HOW THE NEIGHBOURING LAND TIES IN.

PRELIMINARY FILL PLAN BASED ON A FINISHED SURFACE THAT IS 3m BELOW THE FINISHED SURFACE LEVEL MODEL (i.e. BOTTOM OF THE CAPPING LAYER) PREPARED BY JMD FOR THE RESIDENTIAL DEVELOPMENT APPLICATION.

THE FINISHED SURFACE LEVEL USED IN THIS MODEL INCLUDES PRELIMINARY BULK EARTHWORKS LEVELS ALONG THE WESTERN RETAINING WALL.



Issue	App	Date	Description
A	T.H.	01-09-2016	PRELIMINARY FOR REVIEW

Client: MIRVAC HOMES (NSW) PTY LTD.

Designed by : S.G.

Date of Drawing : 01-09-2016

Ratio (A1) : 1:750

Datum : AHD

Origin of Levels :

Date of Survey : VARIOUS

JMD Development Consultants

John M. Daly & Associates PTY LTD
A.B.N. 88051977989
Surveying
Engineering
Project Management
Licensed Water Service Co ordinators

32 Iolanthe Street
P.O. BOX 25
CAMPBELLTOWN N.S.W. 2560

PH. (02) 4625 5055
FAX (02) 4628 2013
email: admin@jmd.com.au

Project : MOOREBANK COVE DEVELOPMENT
NEWBRIDGE ROAD, MOOREBANK

Sheet 1 of 1 sheets

PRELIMINARY FILL PLAN OF THE RESIDENTIAL PORTION OF LOT 7 DP1065574
ABOVE THE BOTTOM OF THE CAPPING LAYER (i.e. 3m BELOW PROPOSED FSL)

Ref: 14005-FILL2

Locality : MOOREBANK

L.G.A. : LIVERPOOL

CAD Ref: C:\USERS\SGRAY\DESKTOP\14005\14005FILL2

This ratio shown on this plan relates to the original plan, produced by JMD only. Any photocopying or printing from digital files provided (particularly PDF files) may significantly alter the ratio of the plan.

RAINGARDEN No.1 (NORTHERN RAINGARDEN)

NEWBRIDGE ROAD

LOT 1 CREATED UNDER STAGE 1 IS TO BE DEVELOPED AS COMMERCIAL DEVELOPMENT

SUPERLOTS 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 & 16 ARE TO BE FURTHER DEVELOPED INTO RESIDENTIAL LOTS.

LOT 17 MAY BE USED AS A FUTURE ROAD CONNECTION OR BE DEVELOPED INTO RESIDENTIAL LOTS.

LOT 18 IS TO BE A DEDICATED AS A DRAINAGE RESERVE

LOT 19 IS TO BE DEDICATED AS A DRAINAGE RESERVE

LOT 20 IS TO BE DEDICATED AS A PUBLIC RESERVE

12m (RADIUS) TEMPORARY CUL-DE-SAC TO BE CONSTRUCTED UNTIL WHICH TIME THE FUTURE COLLECTOR ROAD IS CONSTRUCTED

NORTHERN CATCHMENT AREA OF THE RESIDENTIAL DEVELOPMENT DRAINING TO RAINGARDEN No.2

CATCHMENT BOUNDARY

BRIDGE TO BE CONSTRUCTED UNDER DA1552/2006B

BRICKMAKERS DRIVE

SOUTHERN CATCHMENT AREA OF THE RESIDENTIAL DEVELOPMENT DRAINING TO RAINGARDEN No.2

PROPOSED DRAINAGE EASEMENT TO DRAIN MAJOR FLOWS TO RIVER

RAINGARDEN No.2 (SOUTHERN RAINGARDEN)

GEORGES RIVER

PROPOSED DRAINAGE EASEMENT TO DRAIN LOW FLOWS FROM RAINGARDEN TO RIVER

LOT 3 CREATED UNDER STAGE 1 IS TO BE SUBDIVIDED TO ALLOW THE CREATION OF ROAD No.2. RESIDUE LOT (LOT 21) IS TO BE DEVELOPED INTO A MARINA

1 DP (UNREG)

ROAD NO. 1, ROAD NO. 2, ROAD NO. 3, ROAD NO. 4, ROAD NO. 5, ROAD NO. 7, ROAD NO. 9, ROAD NO. 11, ROAD NO. 12

PROPOSED STAGE 2 WORKS

RATIO 1:1000

N

NEWBRIDGE ROAD

FUTURE B6 (COMMERCIAL) DEVELOPMENT TO BE COMPLETED BY OTHERS INCL. COLLECTOR RD CONNECTING TO LOT 2 DP602988

1 DP (UNREG)

2 DP602988

BRICKMAKERS DRIVE

PT 310 DP1118048

PT 309 DP1118048

PT 310 DP1118048

PT 200 DP1117280

201 DP1117280

PT 200 DP1117280

PT 310 DP1118048

6 DP1065574

POTENTIAL FUTURE RESIDENTIAL LOT LAYOUT SUBJECT TO CHANGE BASED ON FUTURE HOUSE & DA'S SITING

2 DP602988

GEORGES RIVER

PROPOSED FUTURE MARINA TO BE CONSTRUCTED UNDER DA 846/2012 TO BE DESIGNED & CONSTRUCTED BY OTHERS

GEORGES RIVER

FUTURE FORESHORE DEDICATION

6 DP1065574

SCALE :- 1 : 2000

SCALE :- 1 : 1000

OVERALL DEVELOPMENT PLAN

RATIO 1:2000

Issue	App	Date	Description
A	T.H.	20-11-2016	ISSUED FOR DA

Client: MIRVAC HOMES (NSW) PTY LTD.

Designed by : S.G.

Date of Drawing : 20-11-2016

Ratio (A1) : 1:1000/1:2000

Datum : AHD

Origin of Levels :

Date of Survey : N/A

JMD Development Consultants

John M. Daly & Associates PTY LTD
A.B.N. 88051977989
Surveying
Engineering
Project Management
Licensed Water Service Co ordinators
32 Iolanthe Street
P.O. BOX 25
CAMPBELLTOWN N.S.W. 2560
PH. (02) 4625 5055
FAX (02) 4628 2013
email: admin@jmd.com.au

Project : MOOREBANK COVE - STAGE 2
NEWBRIDGE ROAD, MOOREBANK

Sheet 1 of 3 sheets

OVERALL PLAN SHOWING CATCHMENTS

Ref: 14005E10

Locality : MOOREBANK

L.G.A. : LIVERPOOL

CAD Ref: S:\DATA\14\14005\14005 EMW\ENG\CAD\E10 RAINGARDEN SUPPORT\14005E10-PLAN

The ratio shown on this plan relates to the original plan, produced by JMD only. Any photocopying or printing from digital files provided (particularly PDF files) may significantly alter the ratio of the plan.

Appendix C

NSW Department of Planning (SEAR 1102) November 2016

NSW GOVERNMENT | Planning & Environment

Mr Phillip Towler
EMM Consulting Pty Ltd
Suite 1, 20 Chandos Street
ST LEONARDS NSW 2065

16/13470
SEAR 1102

Dear Mr Towler

Secretary's Environmental Assessment Requirements (SEAR) 1102
Proposed Contaminated Soil Treatment Works, 146 Newbridge Road, Moorebank
Liverpool Local Government Area

Thank you for your request for the Secretary's Environmental Assessment Requirements (SEARs) for the preparation of an Environmental Impact Statement (EIS) for the above development proposal. I have attached a copy of these requirements.

These SEARs have been provided on the basis that the site is not declared 'significantly contaminated land' by the Environment Protection Authority (EPA) under Section 11 of the *Contaminated Land Management Act 1997*. If the site is declared 'significantly contaminated land' by the EPA and the remediation works are to be carried out by a management order, the proposal would be considered State Significant Development under Schedule 1, Clause 24 of *State Environmental Planning Policy (State and Regional Development) 2011* for remediation of contaminated land. In the event that the proposal is considered SSD, the Minister for Planning would be the consent authority for the proposed development and Liverpool City Council would not have jurisdiction to determine the Development Application (DA).

In support of your application, you indicated that your proposal is both designated and integrated development under Part 4 of the *Environmental Planning and Assessment Act 1979* and requires an approval under the *Protection of the Environment Operations Act 1997* and the *Rural Fires Act 1997*.

In preparing the SEARs, the Department has consulted with the Environment Protection Authority, Department of Primary Industries, Rural Fire Service and the Office of Environment and Heritage. A copy of their requirements for the EIS are attached.

If other integrated approvals are identified before the DA is lodged, you must undertake direct consultation with the relevant agencies, and address their requirements in the EIS.

If your proposal contains any actions that could have a significant impact on matters of National Environmental Significance, then it will require an additional approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This approval is in addition to any approvals required under NSW legislation. If you have any questions about the application of the EPBC Act to your proposal, you should contact the Commonwealth Department of the Environment on (02) 6274 1111.

Should you have any further enquiries regarding SEAR 1102, please contact Thomas Piovesan, Planning Services, at the Department on (02) 9274 6356.

Yours sincerely

Chris Ritchie 16/11/16.
Director
Industry Assessments
as delegate of the Secretary

Environmental Assessment Requirements

Section 78A (8) of the *Environmental Planning and Assessment Act 1979.*

Designated Development

SEAR Number	1102
Proposal	Staged subdivision and infrastructure works for a residential subdivision, including contaminated soil treatment works
Location	146 Newbridge Road, Moorebank, Liverpool Local Government Area (Lot 7 DP 1065574)
Applicant	Mirvac Homes (NSW) Pty Ltd
Date of Issue	November 2016
General Requirements	The Environmental Impact Statement (EIS) must meet the minimum form and content requirements in clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.*
Key Issues	The EIS must include an assessment of all potential impacts of the proposed development on the existing environment (including cumulative impacts if necessary) and develop appropriate measures to avoid, minimise, mitigate and/or manage these potential impacts. As part of the EIS assessment, the following matters must also be addressed: • **strategic context** – including: – a detailed justification for the proposal and suitability of the site for the development; – a demonstration that the proposal is consistent with all relevant planning strategies, environmental planning instruments, development control plans (DCPs), or justification for any inconsistencies; and – a list of any approvals that must be obtained under any other Act or law before the development may lawfully be carried out; and – a description of any additional licence(s) or approval(s) required to carry out the proposed development. • **remediation action plan** – including: – a site audit statement from a site auditor accredited under the *Contaminated Land Management Act 1997* determining the appropriateness of and approving the Remediation Action Plan; – details of the nature and extent of contaminated material; – comprehensive program of the works proposed, including estimation of the surface area to be disturbed and excavation of contaminated material proposed to be undertaken; – details of the proposed measures to manage any disturbance of contaminated material; – justification for the proposed remediation approach; – details of the proposed remediation process, including equipment to be used and measures to dispose of contaminated material; – justification of the remediation criteria and process for the cleaning/verification of all equipment leaving the site (including workers clothing); – a detailed site validation plan; and – details of the consistency of the Remediation Action Plan with the relevant NSW Government legislation, environmental planning instruments, guidelines and standards. • **air quality** – including: – a description of all potential sources of air and odour emissions; – an air quality impact assessment in accordance with relevant Environment

	Protection Authority Guidelines; and – a description and appraisal of air quality impact mitigation and monitoring measures. • **soil and water** – including: – a description of local soils, topography, drainage and landscapes; – details of water usage for the proposal including existing and proposed water licencing requirements in accordance with the *Water Act 1912* and/or the *Water Management Act 2000*; – an assessment of potential impacts on the quality and quantity of surface and groundwater resources; – details of sediment and erosion controls; – the potential for further soil and/or groundwater contamination; – details of the proposed stormwater and wastewater management systems and water monitoring program to mitigate surface and groundwater impacts; and – a description and appraisal of impact mitigation and monitoring measures. • **waste management** – including: – details of the type, quantity and classification of waste to be received at the site; – details of the resource outputs and any additional processes for residual waste; – details of waste handling including, transport, identification, receipt, stockpiling and quality control; and – the measures that would be implemented to ensure that the proposed development is consistent with the aims, objectives and guidelines in the *NSW Waste Avoidance and Resource Recovery Strategy 2014-21*. • **noise and vibration** – including: – a description of all potential noise and vibration sources during construction and operation, including road traffic noise; – a noise and vibration assessment in accordance with the relevant Environment Protection Authority Guidelines; and – a description and appraisal of noise and vibration mitigation and monitoring measures. • **traffic and transport** – including: – details of road transport routes and access to the site; – road traffic predictions for the development during construction and operation; and – an assessment of impacts to the safety and function of the road network; and the details of any road upgrades required for the development. • **hazards and risk** – including: – the Environmental Impact Statement must include a preliminary risk screening completed in accordance with State Environmental Planning Policy No. 33 – Hazardous and Offensive Development and Applying SEPP 33 (DoP, 2011). • **biodiversity** – including: – accurate predictions of any vegetation clearing on site or for any road upgrades; – an assessment of the potential impacts on any threatened species, populations, endangered ecological communities or their habitats, groundwater dependent ecosystems and any potential for offset requirements; and – a detailed description of the measures to avoid, minimise, mitigate and offset biodiversity impacts.
Environmental Planning Instruments and other policies	The EIS must assess the proposal against the relevant environmental planning instruments, including but not limited to: • *State Environmental Planning Policy (Infrastructure) 2007*; • *State Environmental Planning Policy No. 33 Hazardous and Offensive Development*; • *State Environmental Planning Policy No. 55 Remediation of Land*;

	• *Liverpool Local Environmental Plan 2008*; and • relevant development control plans and section 94 plans.
Guidelines	During the preparation of the EIS you should consult the Department's Register of Development Assessment Guidelines which is available on the Department's website at planning.nsw.gov.au under Development Proposals/Register of Development Assessment Guidelines. Whilst not exhaustive, this Register contains some of the guidelines, policies, and plans that must be taken into account in the environmental assessment of the proposed development.
Consultation	During the preparation of the EIS, you must consult the relevant local, State and Commonwealth government authorities, service providers and community groups, and address any issues they may raise in the EIS. In particular, you should consult with the: • Environment Protection Authority; • Office of Environment and Heritage; • Department of Primary Industries; • Roads and Maritime Services; • Department of Primary Industries; • NSW Rural Fire Service; • WaterNSW; • SafeWork; • Liverpool City Council; and • the surrounding landowners and occupiers that are likely to be impacted by the proposal. Details of the consultation carried out and issues raised must be included in the EIS.
Further consultation after 2 years	If you do not lodge an application under Section 78A (8) of the *Environmental Planning and Assessment Act 1979* within 2 years of the issue date of these SEARs, you must consult with the Secretary in relation to any further requirements for lodgement.

Locked Bag 5123, Parramatta NSW 2124
Level 11, 10 Valentine Ave
Parramatta NSW 2150
www.waternsw.com.au
ABN 21 147 934 787

Contact: Wayne Conners
Phone: 02 8838 7531
Fax: 02 8838 7554
Email: wayne.conners@waternsw.com.au

Your ref: SEAR 1102

Via email: thomas.piovesan@planning.nsw.gov.au

Department of Planning & Environment
Industry Assessments
GPO Box 39
SYDNEY NSW 2001

Attention: Mr Thomas Piovesan

Dear Mr Piovesan,

Request for Secretary's Environmental Assessment Requirements – SEAR 1102 – Soil Contamination Treatment Works - 146 Newbridge Road, Moorebank (Lot 7 DP 1065574)

Thank you for your email of 12 October 2016 concerning the request for Secretary's Environmental Assessment Requirements for the above project.

Water NSW on behalf of DPI Water has reviewed the supporting documentation accompanying the request for Secretary's Environmental Assessment Requirements (SEAR's) and provides the following comments below, and further detail in **Attachment A**.

It is recommended that the EIS be required to include, where applicable:

- Annual volumes of surface water and groundwater proposed to be taken by the activity (including through inflow and seepage) from each surface and groundwater source as defined by the relevant water sharing plan.
- Assessment of any volumetric water licensing requirements (including those for ongoing water take following completion of the project).
- The identification of an adequate and secure water supply for the life of the project. Confirmation that water can be sourced from an appropriately authorised and reliable supply. This is to include an assessment of the current market depth where water entitlement is required to be purchased.
- A detailed and consolidated site water balance.
- Assessment of impacts on surface and ground water sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts.
- Full technical details and data of all surface and groundwater modelling.

- Proposed surface and groundwater monitoring activities and methodologies.
- Assessment of any potential cumulative impacts on water resources, and any proposed options to manage the cumulative impacts.
- Consideration of relevant policies and guidelines.
- A statement of where each element of the SEARs is addressed in the EIS (i.e. in the form of a table).

Should you have any enquiries about this matter, please contact Wayne Conners at Water NSW's Parramatta office on (02) 8838-7531.

Yours sincerely

Wayne Conners

Wayne Conners
Senior Water Regulation Officer
Water Regulation Coastal
27 October, 2016

ATTACHMENT A

Water NSW General Assessment Requirements for general projects

The following detailed assessment requirements are provided to assist in adequately addressing the assessment requirements for this proposal.

For further information visit the DPI Water website, www.water.nsw.gov.au

Key Relevant Legislative Instruments

This section provides a basic summary to aid proponents in the development of an Environmental Impact Statement (EIS), and should not be considered a complete list or comprehensive summary of relevant legislative instruments that may apply to the regulation of water resources for a project.

The EIS should take into account the objects and regulatory requirements of the *Water Act 1912* (WA 1912) and *Water Management Act 2000* (*WMA 2000*), and associated regulations and instruments, as applicable.

Water Management Act 2000 (WMA 2000)
Key points:

- Volumetric licensing in areas covered by water sharing plans
- Works within 40m of waterfront land
- SSD & SSI projects are exempt from requiring water supply work approvals and controlled activity approvals as a result of the *Environmental Planning & Assessment Act 1979 (EP&A Act)*.
- No exemptions for volumetric licensing apply as a result of the *EP&A Act*.
- Basic landholder rights, including harvestable rights dams
- Aquifer interference activity approval and flood management work approval provisions have not yet commenced and are regulated by the *Water Act 1912*
- Maximum penalties of $2.2 million plus $264,000 for each day an offence continues apply under the *WMA 2000*

Water Act 1912 (WA 1912)
Key points:

- Volumetric licensing in areas where no water sharing plan applies
- Monitoring bores
- Aquifer interference activities that are not regulated as a water supply work under the *WMA 2000*.
- Flood management works
- No exemptions apply to licences or permits under the *WA 1912* as a result of the *EP&A Act*.
- Regulation of water bore driller licensing.

Water Management (General) Regulation 2011
Key points:

- Provides various exemptions for volumetric licensing and activity approvals
- Provides further detail on requirements for dealings and applications.

Water Sharing Plans – these are considered regulations under the *WMA 2000*

Access Licence Dealing Principles Order 2004

Harvestable Rights Orders

Water Sharing Plans

It is important that the proponent understands and describes the ground and surface water sharing plans, water sources, and management zones that apply to the project. The relevant water sharing plans can be determined spatially at www.ourwater.nsw.gov.au. Multiple water sharing plans may apply and these must all be described.

The *Water Act 1912* applies to all water sources not yet covered by a commenced water sharing plan.

The EIS is required to:

- Demonstrate how the proposal is consistent with the relevant rules of the Water Sharing Plan including rules for access licences, distance restrictions for water supply works and rules for the management of local impacts in respect of surface water and groundwater sources, ecosystem protection (including groundwater dependent ecosystems), water quality and surface-groundwater connectivity.
- Provide a description of any site water use (amount of water to be taken from each water source) and management including all sediment dams, clear water diversion structures with detail on the location, design specifications and storage capacities for all the existing and proposed water management structures.
- Provide an analysis of the proposed water supply arrangements against the rules for access licences and other applicable requirements of any relevant WSP, including:
    - Sufficient market depth to acquire the necessary entitlements for each water source.
    - Ability to carry out a "dealing" to transfer the water to relevant location under the rules of the WSP.
    - Daily and long-term access rules.
    - Account management and carryover provisions.
- Provide a detailed and consolidated site water balance.
- Further detail on licensing requirements is provided below.

Relevant Policies and Guidelines

The EIS should take into account the following policies (as applicable):

- State Environmental Policy (Sydney Drinking Water Catchment) 2011
- NSW Guidelines for Controlled Activities on Waterfront Land (NOW, 2012)
- NSW Aquifer Interference Policy (NOW, 2012)
- Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW, 2012)
- Australian Groundwater Modelling Guidelines (NWC, 2012)
- NSW State Rivers and Estuary Policy (1993)
- NSW Wetlands Policy (2010)

- NSW State Groundwater Policy Framework Document (1997)
- NSW State Groundwater Quality Protection Policy (1998)
- NSW State Groundwater Dependent Ecosystems Policy (2002)
- NSW Water Extraction Monitoring Policy (2007)

The EIS will need to ensure that the project is consistent with Controlled Activity Approval guidelines and that any Controlled Activity Approval requirements are addressed. Guidelines for instream works on waterfront land can be found at:

http://www.water.nsw.gov.au/__data/assets/pdf_file/0020/547040/licensing_approvals_controlled_activities_instream_works.pdf

DPI Water policies can be accessed at the following links:
http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/default.aspx
http://www.water.nsw.gov.au/Water-licensing/Approvals/Controlled-activities/default.aspx

An assessment framework for the NSW Aquifer Interference Policy can be found online at: http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/Aquifer-interference.

Licensing Considerations

The EIS is required to provide:

- Identification of water requirements for the life of the project in terms of both volume and timing (including predictions of potential ongoing groundwater take following the cessation of operations at the site – such as evaporative loss from open voids or inflows).
- Details of the water supply source(s) for the proposal including any proposed surface water and groundwater extraction from each water source as defined in the relevant Water Sharing Plan/s and all water supply works to take water.
- Explanation of how the required water entitlements will be obtained (i.e. through a new or existing licence/s, trading on the water market, controlled allocations etc.).
- Information on the purpose, location, construction and expected annual extraction volumes including details on all existing and proposed water supply works which take surface water, (pumps, dams, diversions, etc).
- Details on all bores and excavations for the purpose of investigation, extraction, dewatering, testing and monitoring. All predicted groundwater take must be accounted for through adequate licensing.
- Details on existing dams/storages (including the date of construction, location, purpose, size and capacity) and any proposal to change the purpose of existing dams/storages
- Details on the location, purpose, size and capacity of any new proposed dams/storages.
- Applicability of any exemptions under the *Water Management (General) Regulation 2011* to the project.

Water allocation account management rules, total daily extraction limits and rules governing environmental protection and access licence dealings also need to be considered.

The Harvestable Right gives landholders the right to capture and use for any purpose 10% of the average annual runoff from their property. The Harvestable Right has been defined in terms of an equivalent dam capacity called the Maximum Harvestable Right Dam Capacity (MHRDC). The MHRDC is determined by the area of the property (in hectares) and a site-specific run-off factor. The MHRDC includes the capacity of all existing dams on the property that do not have a current water licence. Storages capturing up to the harvestable right capacity are not required to be licensed but any capacity of the total of all storages/dams on the property greater than the MHRDC may require a licence.

For more information on Harvestable Right dams, including a calculator, visit:
http://www.water.nsw.gov.au/Water-licensing/Basic-water-rights/Harvesting-runoff/Harvesting-runoff

Dam Safety

Where new or modified dams are proposed, or where new development will occur below an existing dam, the NSW Dams Safety Committee should be consulted in relation to any safety issues that may arise. Conditions of approval may be recommended to ensure safety in relation to any new or existing dams.

See www.damsafety.nsw.gov.au for further information.

Surface Water Assessment

The predictive assessment of the impact of the proposed project on surface water sources should include the following:

- Identification of all surface water features including watercourses, wetlands and floodplains transected by or adjacent to the proposed project.
- Identification of all surface water sources as described by the relevant water sharing plan.
- Detailed description of dependent ecosystems and existing surface water users within the area, including basic landholder rights to water and adjacent/downstream licensed water users.
- Description of all works and surface infrastructure that will intercept, store, convey, or otherwise interact with surface water resources.
- Assessment of predicted impacts on the following:
    - flow of surface water, sediment movement, channel stability, and hydraulic regime,
    - water quality,
    - flood regime,
    - dependent ecosystems,
    - existing surface water users, and
    - planned environmental water and water sharing arrangements prescribed in the relevant water sharing plans.

Groundwater Assessment

To ensure the sustainable and integrated management of groundwater sources, the EIS needs to include adequate details to assess the impact of the project on all groundwater sources.

Where it is considered unlikely that groundwater will be intercepted or impacted (for example by infiltration), a brief site assessment and justification for the minimal impacts may be sufficient, accompanied by suitable contingency measures in place in the event that groundwater is intercepted, and appropriate measures to ensure that groundwater is not contaminated.

Where groundwater is expected to be intercepted or impacted, the following requirements should be used to assist the groundwater assessment for the proposal.

- The known or predicted highest groundwater table at the site.
- Works likely to intercept, connect with or infiltrate the groundwater sources.
- Identification of any predicted impacts on groundwater resulting from proposed earthworks at the construction phase.
- Any proposed groundwater extraction, including purpose, location and construction details of all proposed bores and expected annual extraction volumes.
- Bore construction information is to be supplied to DPI Water by submitting a “Form A” template. DPI Water will supply “GW” registration numbers (and licence/approval numbers if required) which must be used as consistent and unique bore identifiers for all future reporting.
- A description of the watertable and groundwater pressure configuration, flow directions and rates and physical and chemical characteristics of the groundwater source (including connectivity with other groundwater and surface water sources).
- Sufficient baseline monitoring for groundwater quantity and quality for all aquifers and GDEs to establish a baseline incorporating typical temporal and spatial variations.
- The predicted impacts of any final landform on the groundwater regime.
- The existing groundwater users within the area (including the environment), any potential impacts on these users and safeguard measures to mitigate impacts.
- An assessment of groundwater quality, its beneficial use classification and prediction of any impacts on groundwater quality.
- An assessment of the potential for groundwater contamination (considering both the impacts of the proposal on groundwater contamination and the impacts of contamination on the proposal).
- Measures proposed to protect groundwater quality, both in the short and long term.
- Measures for preventing groundwater pollution so that remediation is not required.
- Protective measures for any groundwater dependent ecosystems (GDEs).
- Proposed methods of the disposal of waste water and approval from the relevant authority.
- The results of any models or predictive tools used.

Where potential impact/s are identified the assessment will need to identify limits to the level of impact and contingency measures that would remediate, reduce or manage potential impacts to the existing groundwater resource and any dependent groundwater environment or water users, including information on:

- Any proposed monitoring programs, including water levels and quality data.
- Reporting procedures for any monitoring program including mechanism for transfer of information.
- An assessment of any groundwater source/aquifer that may be sterilised from future use as a water supply as a consequence of the proposal.
- Identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency plans would be initiated (this may entail water level triggers or a beneficial use category).
- Description of the remedial measures or contingency plans proposed.
- Any funding assurances covering the anticipated post development maintenance cost, for example on-going groundwater monitoring for the nominated period.

Groundwater Dependent Ecosystems

The EIS must consider the potential impacts on any Groundwater Dependent Ecosystems (GDEs) at the site and in the vicinity of the site and:

- Identify any potential impacts on GDEs as a result of the proposal including:
  - the effect of the proposal on the recharge to groundwater systems;
  - the potential to adversely affect the water quality of the underlying groundwater system and adjoining groundwater systems in hydraulic connections; and
  - the effect on the function of GDEs (habitat, groundwater levels, connectivity).
- Provide safeguard measures for any GDEs.

Watercourses, Wetlands and Riparian Land

The EIS should address the potential impacts of the project on all watercourses likely to be affected by the project, existing riparian vegetation and the rehabilitation of riparian land. It is recommended the EIS provides details on all watercourses potentially affected by the proposal, including:

- Scaled plans showing the location of:
  - wetlands/swamps, watercourses and top of bank;
  - riparian corridor widths to be established along the creeks;
  - existing riparian vegetation surrounding the watercourses (identify any areas to be protected and any riparian vegetation proposed to be removed);
  - the site boundary, the footprint of the proposal in relation to the watercourses and riparian areas; and
  - proposed location of any asset protection zones.
- Photographs of the watercourses/wetlands and a map showing the point from which the photos were taken.
- A detailed description of all potential impacts on the watercourses/riparian land.
- A detailed description of all potential impacts on the wetlands, including potential impacts to the wetlands hydrologic regime; groundwater recharge; habitat and any species that depend on the wetlands.
- A description of the design features and measures to be incorporated to mitigate potential impacts.

- Geomorphic and hydrological assessment of water courses including details of stream order (Strahler System), river style and energy regimes both in channel and on adjacent floodplains.

Landform rehabilitation

Where significant modification to landform is proposed, the EIS must include:

- Justification of the proposed final landform with regard to its impact on local and regional surface and groundwater systems;
- A detailed description of how the site would be progressively rehabilitated and integrated into the surrounding landscape;
- Outline of proposed construction and restoration of topography and surface drainage features if affected by the project; and
- An outline of the measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation.

Stream rehabilitation

The Environmental Impact Statement should include:

- A Stream Rehabilitation Plan and Vegetation Management Plan with details on how the watercourse and riparian corridor within the site would be progressively rehabilitated to mimic a natural system from the local area. The riparian corridor should be planted with suitable native species from the local vegetation community.
- An outline of measures to minimise erosion and sedimentation impacts to the local stream environment,
- An outline of measures to minimise impacts to bed and bank stability.
- An outline of measures to be put in place to ensure that sufficient resources are available to implement the proposed stream rehabilitation.
- Guidelines for Vegetation Management plans on waterfront land can be found at:

http://www.water.nsw.gov.au/__data/assets/pdf_file/0010/547219/licensing_approvals_controlled_activities_veg_mgt_plans.pdf

Consultation and general enquiries

General licensing enquiries can be made to Advisory Services: water.enquiries@dpi.nsw.gov.au, 1800 353 104.

Assessment or state significant development enquiries, or requests for review or consultation should be directed to the Strategic Stakeholder Liaison Unit, water.referrals@dpi.nsw.gov.au.

A consultation guideline and further information is available online at:
www.water.nsw.gov.au/water-management/law-and-policy/planning-and-assessment

End Attachment A

RM8: OUT16/39132

Thomas Piovesan
Planning Officer Industry Assessment
Dept. of Planning and Environment
Level 22, 320 Pitt Street SYDNEY NSW 2000
GPO Box 39
SYDNEY NSW 2001
E thomas.piovesan@planning.nsw.gov.au

Dear Mr Piovesan

Request for Input - Secretary's Environmental Assessment Requirements 1102 - Soil Contamination Treatment Works - 146 Newbridge Road, Moorebank, Liverpool LGA

Thank you for your correspondence of the 12 October 2016. NSW Department of Primary Industries (DPI) - Agriculture has reviewed the proposal and provides the following advice.

The applicant should assess risk of spreading weeds particularly noxious weeds. The following text should be included in the SEARs:

- that weed management during construction and operation accord with existing State, regional or local weed management plans or strategies. Destruction or removal of Noxious Weeds may require a permit from Department of Primary Industries http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0015/170232/Application-for-noxious-weed-permit.pdf

Thank you for providing the opportunity to comment on the proposal. For further information contact Andrew Docking, Resource Management Officer, 98428607.

Yours sincerely

E Rogers

Liz Rogers
Manager Agricultural Land Use Planning
Department of Primary Industries
24 October 2016

Transport
Roads & Maritime
Services

PCU067801

24 October 2016

Roads and Maritime Reference: SYD16/01378/01 (A14874940)
DP&E Reference: SEAR 1102

Department of Planning
Received
27 OCT 2016
Scanning Room

Director
Industry Assessments
Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Attention: **Thomas Piovesan**

Dear Sir/Madam

SOIL CONTAMINATION TREATMENT WORKS
146 NEWBRIDGE ROAD, MOOREBANK

Reference is made to your email dated 12 October 2016 requesting Roads and Maritime Services (Roads and Maritime) to provide details of key issues and assessment requirements regarding the abovementioned development for inclusion in the Secretary's Environmental Assessment (EA) requirements.

Roads and Maritime require the following issues to be included in the transport and traffic impact assessment of the proposed development:

1. A strip of land has previously been resumed and dedicated as road along the Newbridge Road frontage of the subject property, as shown by grey colour on the attached Aerial – "X".

   All buildings and structure, together with any improvements integral to the future use of the site are to be wholly within the freehold property (unlimited in height or depth), along the Newbridge Road boundary.

2. Daily and peak traffic movements likely to be generated by the proposed development including the impact on nearby intersections and the need/associated funding for upgrading or road improvement works (if required).

3. Details of the proposed accesses and the parking provisions associated with the proposed development including compliance with the requirements of the relevant Australian Standards (ie: turn paths, sight distance requirements, aisle widths, etc).

4. Proposed number of car parking spaces and compliance with the appropriate parking codes.

5. Details of service vehicle movements (including vehicle type and likely arrival and departure times).

Any inquiries in relation to this Application can be directed to Malgy Coman on 8849 2413 or development.sydney@rms.nsw.gov.au.

Yours sincerely

Pahee Rathan
Senior Land Use Planner
Network and Safety Section


"X"
SP35737
12
DP17254
SP21647
101
DP864199
1
DP582009
NEWBRIDGE RD
NEWBRIDGE RD
310
DP1118048
6
DP1065574
7
DP1065574

NSW GOVERNMENT | Office of Environment & Heritage

DOC16/516094
SEARs ID No. 1102

Mr Thomas Piovesan
Planning Officer – Industry Assessments
NSW Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Dear Mr Piovesan

Request for Input: Soil Contamination Treatment Works - 146 Newbridge Road, Moorebank, Liverpool LGA - SEAR 1102

I refer to your 12 October 2016 email requesting input from the Office of Environment and Heritage (OEH) on the Environmental Assessment Requirements (EARs) for the above designated development.

OEH data indicates Shale Gravel Transition Forest vegetation, a listed Endangered Ecological Community under the NSW *Threatened Species Conservation Act 1995*, may be present on the site. It is therefore recommended the EARs include a biodiversity assessment to be undertaken in accordance with the draft *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (November 2004)* and *The NSW Guide to Surveying Threatened Plants (February 2016).* These guidelines can be downloaded from the OEH website.

If you have any queries regarding this matter please contact Richard Bonner on 9995 6917 or richard.bonner@environment.nsw.gov.au.

Yours sincerely

26/10/16

SAM HIGGS
Acting Senior Team Leader Planning
Greater Sydney Region

Contact officer: RICHARD BONNER
9995 6917

PO Box 644 Parramatta NSW 2124
Level 6, 10 Valentine Ave Parramatta NSW 2150
Tel: (02) 9995 5000 Fax: (02) 9995 6900
ABN 30 841 387 271
www.environment.nsw.gov.au

Our ref: DOC16/515581

Mr Thomas Piovesan
Planning Officer, Industry Assessments
NSW Department of Planning and Environment
thomas.piovesan@planning.nsw.gov.au

Dear Mr Piovesan

Request for Input: Staged Approval of works including Contaminated Soil Treatment Works – SEAR 1102

I refer to your email to the Environment Protection Authority (EPA) received 12 October 2016 requesting the EPA's input to the Secretary's Environmental Assessment Requirements (SEARs) in respect of the above proposal.

The EPA understands that the proposal involves the staged residential subdivision and development, including soil contamination treatment works at 146 Newbridge Road, Moorebank, Liverpool (Lot 7 DP 1065574).

The main issues of interest to the EPA are:

- suitability of the proposed remediation plan
- impacts on water quality and site water management
- waste management and disposal
- impacts on air quality and any potential odour emissions
- potential noise impacts.

The EPA has considered the details of the proposal. A summary of information to be included in the Environment Impact Statement has been outlined in Attachment A. If you require any further information regarding this matter please contact Tenille Lawrence on (02) 9995 6207.

Yours sincerely



25 October 2016

JAMES GOODWIN
Unit Head, Sydney Industry
NSW Environment Protection Authority

ATTACHMENT A

ENVIRONMENT PROTECTION AUTHORITY – REQUEST FOR ENVIRONMENTAL ASSESSMENT REQUIREMENTS FOR A STATE SIGNIFICANT DEVELOPMENT

CONTAMINATED SOIL TREATMENT WORKS - SEARS 1102

GENERAL INFORMATION

The following information must be provided in the Environmental Impact Statement (EIS) to enable the EPA to accurately assess the environmental implications of the proposed activity. The EIS must adequately describe the development proposal and the existing environment including air, noise, water, soil, chemicals and waste.

EPA STATUTORY REQUIREMENTS

On review of the activities outlined within the proposal, it is likely the site will require an Environmental Protection Licence under s48 Protection of the Environment Operations Act ("POEO Act") Schedule 1: Contaminated Soil Treatment where:

c15 (2) The activity to which this clause applies is declared to be a scheduled activity if:

(b) where it treats contaminated soil originating exclusively on site, it has a capacity:

(iii) to disturb more than an aggregate area of 3 hectares of contaminated soil.

The NSW EPA will be the Appropriate Regulatory Authority for the premises if a licence is required.

THE PROPOSAL

The objectives of the proposal should be clearly stated and refer to:

- the size and type of the operation
- the nature of the processes and the products, by products and waste produced
- the use or disposal of products or wastes
- the anticipated level of performance in meeting required environmental standards and cleaner production principles
- the staging and timing of the proposal and
- the proposals relation to any other industry or facility.

THE PREMISES

The EIS will need to fully identify all of the processes and activities intended for the site and during the life of the project. This will include details of:

- a site plan prepared by a registered surveyor clearly showing the boundaries of any proposed premises that will be subject to an Environment Protection Licence (EPL) and the proposed location of any discharge points covered by an EPL

- ownership and/or land use details of any premises and land likely to be affected by the proposed development

- maps and/or aerial photographs showing:

- the location of the proposed development and details of the surrounding environment
- the proposed layout of the site
- all equipment proposed for use at the site
- the location of any environmentally sensitive areas such as conservation areas, wetland, creeks or streams, watercourses and stormwater systems
- surface water management systems
- chemicals, including fuel used on the site and proposed methods for their transportation, storage, use and energy management
- methods to mitigate any expected environmental impacts of the development.

CONTAMINATION AND REMEDIATION

The EPA is not aware of any notices issued under the *Contaminated Land Management Act 1997* however the proponent must demonstrate that any potential land or groundwater contamination can be remediated to a level that preserves and protects the human health and the ecological value of the site.

A Stage 2 detailed site investigation must be conducted to adequately characterise all areas of the site. The detailed site investigation must provide certainty in relation to the suitability of the site for the intended purpose.

WATER MANAGEMENT

The EIS must provide sufficient information to demonstrate that the proposed development can be operated whilst complying with the POEO Act, in particular, the protection of water quality during construction and occupation of the area.

The methodology, data and assumptions used to design any pollution control works and assess the potential impact of the proposal on water quality (ground and surface waters), must be fully documented and justified.

The EIS must include an adequacy assessment of stormwater controls. This assessment must determine sediment basins are adequately sized based on relevant guidelines and that discharge to waters from any sediment basins or other treatment systems comply with the requirements of the POEO Act.

The EIS must identify any fuel or chemical storage areas to be established on the site and describe the measured proposed to minimise the potential for leakage or the migration of pollutants into the soil/waters or from the site.

NOISE AND VIBRATION IMPACTS

The EIS must include a noise assessment of the existing environment, potential impacts and proposed noise amelioration measures. The Noise Impact Assessment must take into consideration an:

- operational noise assessment from stationary aspects of the project (such as the staging area) in accordance with the *NSW Industrial Noise Policy* (EPA, 2000).
- construction noise associated with the project should be assessed using *the Interim Construction Noise Guideline* (EPA, 2009).

AIR QUALITY

The EIS must include an Air Quality Impact Assessment (AQIA). The AQIA must identify and describe in detail all possible sources of air pollution from any activities/processes, including those with the potential to cause odours and/or fugitive dust emissions beyond the boundary of any premises. The AQIA must cover both the construction and operational phases of the development. The AQIA must include the cumulative impacts associated with any existing development and any developments having been granted development consent but which have not commenced.

The EIS should demonstrate that the facility will operate within the EPA's objectives which are to minimise adverse effects on the amenity of local residents and sensitive land uses and to limit the effects of emissions on local, regional and interregional air quality.

The EIS must describe in detail the measures or controls proposed to mitigate air quality impacts and the extent to which the mitigation measures are likely to be effective in complying with the requirements specified in the *POEO Act* and the *Protection of the Environment Operations (Clean Air) Regulation 2010.*

The AQIA must be prepared in accordance with the EPA's Approved Methods and Guidance for the '*Modelling and Assessment of Air Pollutants in NSW'* and, with respect to the assessment of odour impacts, follow the principles outlined in the '*Technical framework for the assessment and management of odour from stationary sources in NSW* '. The AQIA must describe the methodology used and any assumption made to predict the impacts. Air pollutant emission rates, ambient air quality data and meteorological data used in the assessment must be clearly stated and justified.

DANGEROUS GOOD AND CHEMICAL TRANSPORT, STORAGE AND HANDLING

The EIS must outline all details regarding the transport, handling, storage and use of dangerous goods, chemicals and products, including fuel, both on-site and with ancillary activities and describe the measures proposed to minimise the potential for leakage or the migration of pollutants into the air, land or waters from the site.

MONITORING PROGRAMS

The EIS should include a detailed assessment of any noise, air quality, water quality or waste monitoring required during the on-going operation of the facility to ensure that the development achieves a satisfactory level of environmental performance and to demonstrate that any activity licenced by the EPA is carried out in an environmentally satisfactory manner. The evaluation should include a detailed description of any proposed monitoring locations, sample analysis methods and the level of reporting proposed.

WASTE FACILITIES

The EIS should include:

- details for the layout of any proposed waste facility, the treatment process and the environmental controls at the facility
- details of the quantity and type of liquid and/or liquid waste generated, handled, processed or disposed of at the premises. Waste must be classified according to EPA's *Waste Classification Guidelines*
- details of liquid waste and non-liquid waste management at the facility including:
    - the transportation, assessment and handling of waste arriving at or generated at the site
    - any stockpiling of waste or recovered materials at the site

    - any waste processing related to the facility including reuse, recycling, reprocessing or treatment both on-and off-site
    - the method for disposing of all wastes or recovered materials at the facility
    - the emissions arising from the handling, storage, processing and re-processing of waste at the facility
    - the proposed controls for managing the environmental impacts of these activities.
- details of procedures for the assessment, handling, storage, transport and disposal of all hazardous waste used, stored, processed or disposed of at the site, in addition to the requirement for liquid and non-liquid waste
- details of the quantity type and specification or all output products proposed to be produced at the facility. In documenting or describing the composition of the output products and/or wastes generated from the proposed facility reference should be made where relevant to the EPA resource recovery exemptions.
- details of the type and quantity of any chemical substances to be used or stored.

GENERAL WASTE

The EIS should:

- identify, characterise and classify all waste that will be generated on site through excavation, demolition or construction activities, including proposed quantities of waste

  Note: all waste must be classified in accordance with the EPA's *Waste Classification Guidelines*
- provide details on how waste will be handled and managed onsite to minimise pollution, including:
    - stockpile location and management
        - labelling of stockpiles for identification, ensuring that all waste is clearly identified and stockpiled separately from other types of material
        - proposed height limits for all waste to reduce the potential for dust and odour
        - procedures for minimising the movement of waste around the site and double handling
        - measures to minimise leaching from stockpiles into the surrounding environment
- erosion, sediment and leachate control including measures to be implemented to minimise erosion, leachate and sediment mobilisation at the site during works
- the proponent should provide detail how leachate from stockpiled waste will be kept separate from stormwater runoff
- any proposed transport and disposal of leachate off site

INCIDENT MANAGEMENT

The EIS should include a comprehensive assessment of the potential for incidents to occur at any stage of the project, the measures to be used to minimise the risk of incidents and the procedures to be employed in the event of an incident. In addition, information is required about contingency actions in the event that planned incident mitigation measures are inadequate.

COMMUNITY CONSULTATION

The EPA is not aware of community engagement activities for planning processes associated with the project to date. It is recommended that the proponent embark on a program of ongoing consultation throughout the project, from commencement until completion, and this should be detailed in the EIS.

NSW RURAL FIRE SERVICE

PCU067902

The Secretary
Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2000

Your reference: SEAR 1102
Our reference: D16/3430

25 October 2016

Attention: Thomas Piovesan

Dear Sir/Madam,

Proposed Staged Residential Subdivision Development – 146 Newbridge Road, Moorebank

Reference is made to your correspondence dated 12 October 2016 seeking input for the Secretary's Environmental Assessment Requirements (SEARs) for the subject proposal under Schedule 2 of the *Environmental Planning and Assessment Regulations 2000*.

The New South Wales Rural Fire Service (NSW RFS) recommends that the preparation of an Environmental Impact Statement (EIS) is to include a bush fire assessment report prepared by a suitably qualified bush fire consultant that addresses the requirements of *Planning for Bush Fire Protection 2006*.

If you have any queries regarding this advice, please contact Simon Derevnin, Development Assessment and Planning Officer, on 1300 NSW RFS.

Yours sincerely,

Nika Fomin
Manager Planning and Environment Services (East)

Department of Planning
2 NOV 2016
Scanning Room

Postal address
NSW Rural Fire Service
Records Management
Locked Bag 17
GRANVILLE NSW 2141

Street address
NSW Rural Fire Service
Planning and Environment Services (East)
42 Lamb Street
GLENDENNING NSW 2761

T 1300 NSW RFS
F (02) 8741 5433
E csc@rfs.nsw.gov.au
www.rfs.nsw.gov.au

Appendix D

Threshold Values

Table D1 – Reference Contaminant Values for Virgin Excavated Natural Material (VENM)

Contaminants [1, 4]	Criteria To Be Adopted [5]	
	Berkman (1989) [2]	ANZECC [3]
Metals		
Arsenic (total)	1-50	0.2-30
Cadmium	1	0.04-2
Chromium (III)	5-1000	0.5-110
Copper	2-100	1-190
Lead	2-200	<2-200
Mercury	0.03	0.001-0.1
Nickel	5-500	2-400
Zinc	10-300	2-180
TRH $C_6 – C_{10}$ $C_{10} – C_{16}$ $C_{16} – C_{34}$ $C_{34} – C_{40}$	For all organic analytes, the analytical practical quantitation limits are used as the reference levels for VENM assessment. Special consideration may be given to low levels of naturally occurring TRH or PAH in shale.	
BTEX Benzene Toluene Ethylbenzene Xylene		
Total Phenols		
PAH Benzo(a)Pyrene Benzo(a)Pyrene TEQ Naphthalene Total PAH		
PCB		
OPP		
OCP aldrin dieldrin aldrin + dieldrin chlordane DDT (including DDD, DDE, DDT) Heptachlor		
Asbestos	No asbestos present	

Notes:

1. Contaminant concentrations must also be evaluated against NEPC (2013) thresholds provided in Table D2 below.
2. Berkman (1989) Field Geologists Manual
3. Australian and New Zealand Environment and Conservation Council/National Health and Medical Research Council (ANZECC/NHMRC): Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (1992), Environmental Soil Quality Guidelines Background A [ANZECC A]
4. Threshold values in mg/kg
5. The threshold values should also not exceed the criteria given in Table 4 of the ENM Order 2014

Table D2 – Threshold Values Protective of Human Health and Ecology (NEPC, 2013)

Contaminants		Land Use Criteria HIL A	Vapour Intrusion Criteria HSL-A-B [2]	EIL / ESL Urban Residential and Public Open Space	Criteria To Be Adopted [6]
Metals	Arsenic	100	-	100	100
	Cadmium	20	-	-	20
	Chromium	100	-	450 [4]	100
	Copper	6000	-	230 [4]	230
	Mercury	40	-	-	40
	Nickel	400	-	300 [4]	300
	Lead	300	-	1100 [3]	300
	Zinc	7400	-	850 [4]	850
TRH	$C_6 – C_{10}$ (less BTEX) [F1]	-	45[2]	180	45
	$>C_6-C_{10}$	-	-	-	
	$>C_{10}-C_{16}$ (less Naphthalene) [F2]	-	110[2]	120	110
	$>C_{10}-C_{16}$	-	-	-	
	$>C_{16}-C_{34}$	-	-	300	300
	$>C_{34}-C_{40}$	-	-	2800	2800
PAHs	Benzo(a)pyrene TEQ1	3	-	-	3
	Benzo(a)pyrene	-	-	0.7	0.7
	Total PAH[1]	300	-	-	300
	Naphthalene	-	3 [2]	170	3
Phenols	Phenols	100 [5]	-	-	100
BTEX	Benzene	-	0.5 [2]	50	0.5
	Toluene	-	160 [2]	85	85
	Ethylbenzene	-	55	70	55
	Xylene	-	40 [2]	105	40
OPPs	Chlorpyrifos	160	-	-	160
PCB (total)	PCBs	1	-	-	1

Contaminants		Land Use Criteria HIL A	Vapour Intrusion Criteria HSL A &B [2]	EIL / ESL Urban Residential and Public Open Space	Criteria To Be Adopted
OCPs	DDT+DDE+DDD	240	-	180	180
	Aldrin+Dieldrin	6	-	-	6
	Chlordane	50	-	-	50
	Endosulfan (total)	270	-	-	270
	Endrin	10	-	-	10
	Heptachor	6	-	-	6
	HCB	10	-	-	10
	Methoxychor	300	-	-	300

Notes:

1 Sum of carcinogenic PAH.
2 HSL for sand 0 to <1 m have been adopted as a conservative screen.
3 The ACL for lead has been used as an initial conservative screen.
4 EIL derived using average pH, and CEC values reported during the DP (2016a) investigation.
5 HIL for pentachlorophenol has been adopted to screen for phenol.
6 Thresholds in mg/kg.

Table D3 – Salinity Scale

Salinity	Electrical conductivity (ECe)
Non Saline	<2 dS/m
Slightly Saline	2 – 4 dS/m
Moderately Saline	4 – 8 dS/m
Highly Saline	8 – 16 dS/m

Table D4 – Criteria for Aggressivity to Concrete

Sulphate as SO3* (mg/kg)	pH	Aggressivity To Concrete	
		High Permeability Soils Below Groundwater	Low Permeability Soils / All Soils Above Groundwater
<5,000	>5.5	Non-Aggressive	Non-Aggressive
5,000 – 10,000	4.5 – 5.5	Mild	Mild
10,000 – 20,000	4 – 4.5	Severe	Moderate
>20,000	<4	Very Severe	Severe

Source: AS 2159 2009

* Approximate 100 mg/kg of SO_4 = 80 mg/kg of SO_3

Table D5 – Criteria for Aggressivity to Steel

Chloride in Soil (mg/kg)	pH	Aggressivity To Steel	
		High Permeability Soils Below Groundwater	Low Permeability Soils / All Soils Above Groundwater
<5,000	>5	Non-Aggressive	Non-Aggressive
5,000 – 20,000	4 – 5	Mild	Non-Aggressive
20,000 – 50,000	3 – 4	Moderate	Mild
>50,000	<3	Severe	Moderate

Source: AS 2159 2009

Appendix E

Sampling Frequencies

Table E1 – Sampling and Analytical Requirements for VENM Validation

Natural Material	Material Quantity (m^3)	Minimum Sample Frequency for Source Site With Adequate Site History AND No Potential For Contamination (Criterion 1)	Minimum Sample Frequency for Source Site With Inadequate Site History and / or Potential for Contamination [2] (Criterion 2)	Analytical Suite [1, 2, 4, 5]
VENM	<5000	A minimum of three samples	One sample per 250 m^3	- Heavy metals - TRH - BTEX - PAH - Phenol - PCB - OPP - OCP - Asbestos
	5000-50,000	A minimum of three samples for the first 5000 m^3 and one additional sample per 5000 m^3 or part thereof	The minimum sampling frequency should vary from 20 samples plus one additional sample for each 1000 m^3 above 5000 m^3	
	>50,000	A minimum of 12 samples for the first 50,000 m^3 and one additional sample per 10,000 m^3 or part thereof	The minimum sampling frequency should vary from 65 samples plus one additional sample for each 2000 m^3 above 50000 m^3	

Notes:

1. Heavy metals = arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc. BTEX = benzene, toluene, ethylbenzene, total xylenes OCP = organochlorine pesticides (a scheduled chemical). PAH = polycyclic aromatic hydrocarbons. .PCB = polychlorinated biphenyls. TRH = total recoverable hydrocarbons (including total petroleum hydrocarbons).
2. Applicable for source sites with inadequate contamination history, or which have previously been remediated for contamination or have potential for contamination such as service stations, mechanical workshops, fuel depots, chemical storage facilities etc.
3. Environmental Consultant may request for testing of additional analytical suites as considered necessary based on the site history.
4. Selected hydrocarbon analytes can be eliminated if the site history showed there was no risk of contamination from that analyte.
5. The physical description and condition of each sample shall be documented.

VENM = Virgin Excavated Natural Material.

Table E2 – Sampling and Analytical Requirements for Salinity and Aggressivity Assessment

Assessment Type	Minimum Sample Frequency	Minimum Analyte Suite
Salinity and Aggressivity	A minimum of three samples for the first 5,000 m^3 and one additional sample per per 5000 m^3 or part thereof for material volume up to 50,000 m^3. A minimum of 12 samples and one additional sample per 10,000 m^3 for material volume greater than 50,000 m^3. A minimum of three samples or 25% of the samples, whichever is higher, to be analysed for chloride and sulphate.	EC, pH, sulphate, chloride, textural classification

Appendix F

Gate Check Forms and Material Acceptance Checklist

Table F1 – VENM Acceptance Checklist

VENM ACCEPTANCE CHECKLIST	Completed By:_____ Date:_____
Material/ Suppliers Details Supplier's Name: Source Site Address:	
Materials described in application/ approval documentation:	
Description of materials arriving at site:	
Do material descriptions match?	Yes / No Accept / Reject
Location placed on-site: Sketch attached:	Yes / No
Number of loads received:	

Appendix G

Materials Giving Rise To Load Rejection

Unsuitable Materials List

The following list contains materials that are unsuitable for use as fill. Any materials containing the following will be rejected. The list is not exhaustive.

- Acid sulphate soils;
- Asbestos (friable and bonded);
- Biocides;
- Chemical storage containers;
- Contaminated material;
- Excessively wet soils (greater than 4% of optimum moisture content);
- Explosives;
- Food waste;
- Fungicides;
- Herbicides;
- Household domestic waste;
- Liquid waste;
- Non-validated materials;
- Oil filters and rags;
- Paint;
- Pesticides;
- Radioactive waste;
- Sanitary waste;
- Tyres;
- Vegetative waste;
- Any material not corresponding to the NSW EPA definition of VENM and no soil containing anthropogenic material, odorous or stained material; and
- All other potentially contaminating materials.

Appendix K

Moorebank East Development Proposal Fact Sheet

MOOREBANK EAST
DEVELOPMENT PROPOSAL FACTSHEET

Dear Resident,

Mirvac Homes (NSW) Pty Limited (Mirvac) proposes to develop a residential masterplanned community in the central portion of the site currently identified as Lot 7 in DP 1065574 (Lot 7) being No.146 Newbridge Road Moorebank. You have been sent this factsheet as your place of residence is within proximity to the subject site.

The site has most recently been used for the extraction of sand via dredging and dry extraction methods. These extractive industries are nearing the end of their economic life with final extraction operations due to be completed in the near future.

Mirvac's current intention is to develop the site in keeping with the surrounding residential area. The creation of a new residential community by Mirvac of approximately 180 future residential homes, is in accordance with Liverpool City Council's strategic planning framework and is consistent with the relevant objectives of the R3 Medium Density Residential zoning of the site.

Proposed Development

The development proposal will seek approval for the following works in two stages, including:

Stage One:

- Subdivision of Lot 7 into three lots that are consistent with the boundaries of the existing land use zones of the site being; Lot 1 - B6 Enterprise Corridor, Lot 2 - R3 Medium Denisty Residential and Lot 3 - RE1 & RE2 Public and Private Recreation.

Stage Two:

- Subdivision of Lot 2 created in Stage 1 into the following:
  - a) residue lots for future residential development,
  - b) drainage reserves that will be dedicated to Council, and
  - c) open space that will be dedicated to Council,
- Lot 3 created in Stage 1 will form a residue lot for the future development of the proposed Georges Cove Marina (DA-781/2015),
- Bulk earthworks including:
  - a) site remediation works consistent with the recommendations of the detailed contamination site investigation,
  - b) cut and fill works,
  - c) import and placement of virgin excavated natural material (VENM), and
  - d) the extension of the retaining wall on the west of the site (DA-510/2016),
- Construction of roads to be dedicated to Council,
- Construction of stormwater infrastructure, including raingardens, in accordance with the Voluntary Planning Agreement already agreed with Liverpool City Council; and
- Construction of infrastructure and services.

Please note the development proposal may be subject to change, and both future residential subdivision and dwelling construction will be the subject to a further Development Application and do not form part of the scope of this proposal.

Environmental Impact Statement

The project has been classified under Schedule 3 of the EP&A Regulation 2000 as being 'designated development'. Accordingly, an Environmental Impact Statement (EIS) is being prepared to accompany the development application (DA) for the proposal under Part 4 of the NSW Environmental Planning and Assessment Act 1979. Liverpool City Council is the consent authority for the development application.

The EIS provides a comprehensive assessment of the subject proposal's impacts and addresses the requirements of Liverpool City Council and the relevant NSW government agencies, including the Secretary's Environmental Assessment Requirements (SEARs) issued by the Department of Planning and Infrastructure for the project.

Mirvac is working to ensure the project design and proposed environmental management measures will mitigate any adverse impacts to the subject and adjoining properties. The EIS and associated specialist studies will include detailed assessment of community matters raised during this consultation.

Want More Information?

If you would like additional information, provide comment on this proposal or register your interest regarding the development at Moorebank East by Mirvac, please contact by:

Email: moorebankeast@mirvac.com
Phone: (02) 9080 8848

MOOREBANK EAST
DEVELOPMENT PROPOSAL
FACTSHEET

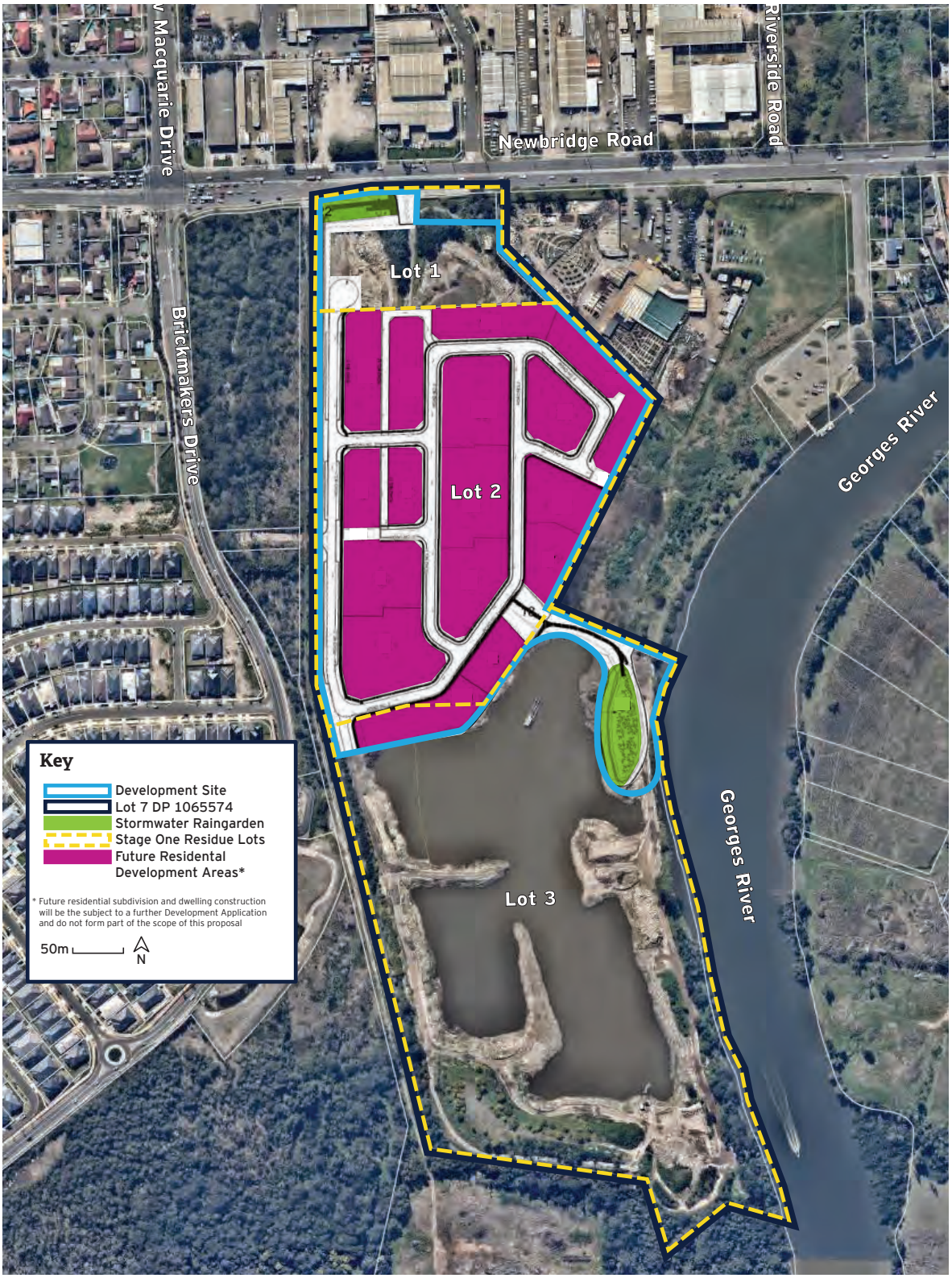


Figure 1: Indicative Site Plan of Moorebank East Development Proposal by Mirvac (Nearmap September 2016)

Mirvac Homes (NSW) Pty Limited
ABN 22 006 922 998
Level 28, 200 George Street
Sydney NSW 2000 Australia

Appendix E

Flood impact assessment

TOOKER+ ASSOCIATES

GEORGES COVE VILLAGE

MODIFIED PLANNING PROPOSAL

146 NEWBRIDGE RD MOOREBANK

FLOOD IMPACT ASSESSMENT AND

FLOOD EMERGENCY RESPONSE PLAN

JULY 2023

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

TABLE OF CONTENTS

		Page
1.	Introduction	1
2.	Background	1
3.	Site Description	2
4.	Flood Characteristics	3
5.	Proposed Development	3
6.	Flood Impact Assessment	3
7.	Molino Stewart	7
8.	Conformance to Flood Policy	8
9.	Liverpool DCP	11
10.	Section 117 Directions	13
11.	Considering Flooding in Landuse Planning	15
12.	Planning Circular PS 21-006 14 July 2021	15
13.	DPE Draft Shelter in Place Guidelines	16
14.	DPE Support for Emergency Management Planning 2022	16
15.	2022 Flood Enquiry Report Recommendations	17
16.	Flood Emergency Response Plan	18
17.	Conclusion	23

FIGURES

ATTACHMENTS

ATTACHMENT A	TOOKER AND ASSOCIATES REVIEW OF MOLINO STEWART REPORT
ATTACHMENT B	RISK-E BUSINESS REVIEW OF MOLINO STEWART REPORT
ATTACHMENT C	FLOOD SAFE PLAN

1. Introduction

The proposed Georges Cove Village (Site A) site is located at 146 Newbridge Road, Moorebank (refer Figure 1).

2. Background

The Georges Cove Village site is one of three development sites under the same land ownership in the Moorebank East precinct. The two other sites are the Georges Cove Residences (R3-zoned lands) currently being developed by Mirvac and the Georges Cove Marina site. These sites were recently nominated by Liverpool Council as site A (Georges Cove Village), C (Georges Cove Residences) and D (Georges Cove Marina) – see Figure 2 below.

Figure 2 Moorebank East Precinct



m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

Given the one ownership of sites A, C and D, we have been working with Liverpool Council since 2012 on the flooding issues considering these three sites as an integrated site. Cardno (now Stantec) have undertaken all the flood modelling for these three developments, and the sites are interrelated for wider flood modelling purposes.

The benchmark pre-development land ground levels were formulated by Council and adopted in the Cardno 29 January 2013 flood assessment as the base landform for the pre-development flood modelling of the three sites. The details of this landform are shown on Figure 3. Council required that this base had to be used for the flood impact assessment by Cardno of the three developments and all future flood models.

As a result, Liverpool Council required that there be no reduction in flood storage capacity over the combined area of the three developments for the 100yr ARI flood event.

In the 13 April 2018 Cardno flood impact report, integrated flood impact modelling was undertaken for the proposed development on the three sites incorporating changes to landforms and works to ensure the required no change in flood storage. On the Georges Cove Village site (site A), some existing fill was to be removed to compensate for fill elsewhere over the integrated sites and the proposed building on the Georges Cove Village site was designed to have a void at lower levels to accommodate the extra flood storage. The Cardno flood report and the modelling and design results were then accepted by Liverpool Council.

3. Site Description

This Planning Proposal site (site A) has frontage to Newbridge Road and it's entry is south of Brickmakers Drive. There is a Council drainage channel along the western boundary of the site, the Mirvac Georges Cove Residences residential development (site C) is bordering to the south and there is a proposed mixed use development to the east, on the Flower Power site (Site B-refer Figure 1).

The benchmark pre-development site ground levels (see Figure 3) had previously been agreed with Council in which the ground levels rose quickly from the Newbridge Road entry to levels above the flood planning level (which is RL 6.1m AHD) for the Georges River located nearby to the south east. The existing road level on the site entry from Newbridge Road is about RL 2.5m AHD.

In the proposed integrated development of the three sites, the post development ground levels were lowered to RL 3m AHD for the Moorebank Cove Village site (site A) to accommodate flood storage within and below the building void. Council has accepted the Cardno flood impact report (13 April 2018) in which there is no flood storage loss over the integrated three sites (sites A, C and D).

4. Flood Characteristics

The predicted benchmark pre development flood levels for the Moorebank Cove Village site (site A) are (Cardno 29 Jan 2013):-

- 20 year ARI RL 4.6m AHD
- 100 year ARI RL 5.6m AHD
- Probable Maximum Flood (PMF) RL 10.2m AHD
- Flood Planning Level (FPL) RL 6.1m AHD

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

A PMF flood event is estimated (by Cardno) to occur on average **every 1,600,000 years.**

The benchmark pre-development 20 year and 100 year ARI flood extents are depicted on Figures 4 and 5 for the site (Cardno 29Jan2013). The pre-development site had a low flood hazard with only a small strip along the Newbridge Rd frontage being flood affected. Flooding on the site is a combination of flood storage and flood fringe.

5. Proposed Development

The proposed development consists of a supermarket and retail specialty shops on Level 3 and commercial/light industrial on Level 4 and associated parking on Levels 2, 3 and 4. The dock loading area is on Level 1 (refer Figures 6 – 11).

Except for the Loading dock level (Level 1), the rest of the site's proposed built form (parking and commercial spaces) is above the 100 year ARI or PMF flood levels.

The loading dock access on Level 1 is only accessed from Newbridge Road at a level of RL 2.5m. On Level 1, from the Newbridge Road entrance level of RL 2.5m it then ramps up to an elevated loading dock at RL 3.4m AHD and to an open area creating extra flood storage. In times of flood, obviously the Loading dock will not be required or be in use during flood events. Light vehicle (but not Heavy Vehicle) access is normally available from Level 1 to the retail car parking at Level 2 above at a level of RL 7m AHD, which is well above the 100 year ARI and above the Flood Planning Level of RL 6.1m AHD. Level 3 contains the supermarket and retail shops as well as further retail carparking at a level of RL 10.2m AHD. This level is at the Probable Maximum Flood (PMF) level and is, as such, considered flood free. Level 4 has the commercial/light industrial uses which are two storey units at a floor level of RL 15.2m AHD which is 5m above the PMF flood level and as such, also flood free.

Car access to the proposed development will be from Newbridge Road on the northern frontage and from the Mirvac Georges Cove Residences development (site C) and from Newbridge Rd (entry only). The car ingress/egress in a flood emergency will be via the DCP Road into the Mirvac Georges Cove Residences (site C) residential area (which is higher than the 100 year ARI) and then onto the existing high level road bridge leading to Brickmakers Drive (RL 6.0m AHD) and then onto Maddecks Ave and Nuwarra Road. Nuwarra Road is above the Probable Maximum Flood (PMF) level. Normal Commercial Heavy Vehicle access to the Village site is proposed to be only available from Newbridge Rd via a left in and left out entry from Newbridge Road.

Pedestrian access/egress in a flood emergency will be via the DCP Road into the Mirvac Georges Cove Residences (site C) residential area and via the high level pedestrian bridge leading to Paine Park and then to flood-free land along Horizon Circuit towards Nuwarra Rd.

6. Flood Impact Assessment

6.1 Flood Levels and Velocity

The flood assessment by Cardno (13 April 2018) compared the benchmark pre development flood conditions with the integrated development of the three sites A (Georges Cove Village), C (Georges Cove Residences) and D (Georges Cove Marina). The development

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

included the assessment of flood storage to ensure there was no loss of storage. This included incorporation of the flood storage void in the Georges Cove Village development (site A).

The findings of the extensive Cardno flood modelling (13 April 2018) were that there were no significant adverse impacts on flood levels and velocities caused by this Planning Proposal (Georges Cove Village development -site A) compared to the Councils benchmark pre development case.

All proposed parking areas are at levels above the FPL and the retail parking on Level 3 is flood free at the PMF level. All the proposed habitable floor levels including the supermarket, retail shops and commercial/light industrial uses are flood free with floor levels at or above the PMF level.

The areas below the FPL will be constructed using flood compatible materials (such as concrete) which will minimise any flood damage to the building.

6.2 Flood Storage

The Cardno flood assessment (13 April 2018) determined that the proposed integrated development over sites A, C and D would increase the flood storage available in the area thereby improving flood behaviour. The flood void to be incorporated in the proposed Georges Cove Village development (site A) provides extra flood storage as part of the overall integrated developments.

6.3 Flood Risk

The proposed development has the benefit of providing all commercial areas at or above the PMF flood level and will be flood free. All parking areas are above the flood planning level (FPL). All of the areas of the building below the FPL will be built with flood compatible materials to minimise any flood damage. A Flood Safe Plan has been devised within Sections 6.4, 16 and Attachment C to further minimise the risk to life by providing a three stage flood evacuation plan adequate for the three developments on Sites A, C and D.

The requirements of the *NSW State Government Floodplain Development Manual 2005* are designed to minimise risk to life and flood damage and this document has been considered when assessing this PP.

Flood damage will be minimised by locating all commercially habitable areas at or above the PMF level and are as such, flood free. All of the building structure below the Flood Planning Level will be constructed with flood compatible materials. Flood damages will therefore be minimised. The risk to life due to flooding has been minimised by having all habitable floor levels which are flood free and a Flood Safe Plan for evacuation.

6.4 Flood Emergency Response Plan

Risk to life will be minimised by having all habitable areas at or above the PMF flood level and by engaging a flood emergency response plan (refer Section 16 and Attachment C). This

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

plan has a three-stage response to a flood warning alert. Although there is no residential component to this Georges Cove Village (site A) proposal, the same three stage evacuation plan has been approved by Liverpool Council for the Mirvac Georges Cove Residences development (site C) adjacent to this Georges Cove Village development. The evacuation routes and flood signs for the Georges Cove Residences development are detailed on Figure 16.

The first stage evacuation of the Georges Cove Village (site A) (shopping centre and commercial/light industrial) is by car via the Mirvac Georges Cove Residences (site C) development to Brickmakers Drive, up Maddecks Ave to Nuwarra Rd and to the regional flood refuge or local flood refuges. If this evacuation were to become impossible at some point, then a second stage pedestrian flood evacuation will be possible via the elevated pedestrian bridge over Brickmakers Drive to Paine Park and up Horizon Circuit to flood free land and local refuges. The third stage is shelter in place on flood free floor levels (PMF) with access to all amenities, should for some reason, people refuse to leave the development. This third stage will not be encouraged but will be there as a fall-back, extreme emergency response during a PMF event.

The BOM currently provide a 12 hour warning for floods likely to rise above RL 4m AHD in the Georges River and there is a further 1.6 hours until floodwaters reach the 100 yr ARI flood level (RL 5.6m AHD). If it rises further, to say RL 6m AHD, it will eventually hinder the vehicle evacuation on Brickmakers Drive. This provides a minimum total of 13.6 hours advance warning to evacuate the site by vehicle. However, a further time of 1 hour (a total of 14.6 hours) is available for the pedestrian evacuation because the pedestrian bridge allows access to land at RL 7m AHD which is equivalent to a 1 in 2000yr ARI flood.

Using the very conservative SES flood evacuation model, the SES allow evacuation to commence 8 hours **after the flood warning** to account for mobilising of SES door knockers to alert people (6 hours) and a further 2 hours for people to act. For the subject development being a shopping centre/light industry, a digital flood warning alert would be sent to the supermarket manager/flood warden and the light industrial flood warden so that flood evacuation actions could start immediately - far sooner than the 8 hours nominated by SES.

The vehicular flood evacuation via the road crossing to Brickmakers Drive would be used by the three Benedict-related developments being the Georges Cove Village (site A), Mirvac Georges Cove Residences (site C) and the Georges Cove Marina (site D). The total number of car parking spaces in these developments will be 1356 (marina – 637, residences – 358, village – 361). The SES recommend that the very conservative road carrying capacity in a flood evacuation would be 600 vehicles per land per hour. At this very conservative SES rate (versus road design that is required to allow for 1400 vehicle/lane/hr) and taking the very conservative view that the number of cars onsite to be 100% (all spaces full), then the time to evacuate the three developments would be 2.3 hours. The SES however, require that a safety factor of 1 hour be added, to give a total time required for car evacuation of 11.3 hours (8+2.3+1) **for the entire 3 Benedict/Mirvac Sites(A/C/D).** This represents a very conservative required time for vehicular evacuation, yet, it is still appreciably less than the SES's nominated available time of 13.6 hours.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

If a pedestrian flood evacuation was required (because the vehicular flood evacuation failed at some point), it would be via the elevated pedestrian bridge over Brickmakers Drive from the Mirvac Georges Cove Residences development (site C). The number of people using the pedestrian bridge has been very conservatively estimated as equal to that of all of the cars possible to be parked in the development, with a conservative two people, in each car. This provides a very conservative estimate of 2,712 people on foot, because it theoretically assumes that **no** people leave the three sites in cars and **all** of them instead walk out.

For the pedestrian evacuation, the SES uses the same 6 hours for door knocking and 2 hours for people to leave the development. The SES assumes that people walk at a rate of 2km/hour in an evacuation. The pedestrian bridge would be the logical pinch point for this evacuation. It is approximately 230m long and using a conservative walk rate, and that they cross the bridge in single file (although the bridge is actually some 3.4m wide), then 230 people would cross the bridge in 7 minutes. As such, 2,712 people would cross the bridge in 1.4 hours. If the people were exiting two abreast on the bridge (the bridge is easily wide enough), the travel time for the entire population to walk across the bridge would be 0.7 hours.

The people would then complete the remaining average walking distance of 970m (1200m minus 230m) in 0.5 hours leading to a total walking time (again using the very conservative single file exiting across the bridge) of 1.9 hours. The SES require that a safety factor of 1 hour be added, to give a total time required for pedestrian evacuation of **all three of the Benedict/Mirvac sites** of 10.9 hours (ie.8+1.9+1). This very conservative required time for pedestrian evacuation of the entire three developments (sites A, C and D) is still significantly less than the SES available time of 14.6 hours. This does not include the data from the NSW State Government surveys that suggest that some 20% of dwellings are unoccupied at any given time due to travel/holidays/work, etc.

This analysis, using the overly conservative SES methodology, indicates that the infrastructure provided in the three developments have adequate infrastructure and plans which are capable of minimising the risk to life from flooding.

The Molino Stewart Flood Evacuation Analysis report prepared for Liverpool Council examined the evacuation capacity for the Moorebank East precinct. This report had many conservative assumptions (that in our view are not tested nor supported by modern urban demographic data) leading to predictions of possible evacuation issues for the precinct. The Tooker and Associates and Risk-e assessments and critiques of this report and its findings is contained at Attachments A and B.

The Molino Stewart report recommended the provision of the elevated pedestrian bridge over Brickmakers Drive to enable pedestrian evacuation and this bridge installation is currently being completed.

A flood emergency response plan has been prepared (see Section 16 and Attachment C) for the proposed B6 development which incorporates the following:-

- Flood signs directing people from Level 1 and 2 to Level 3;
- Audible and visual alarms in Levels 1 and 2 when flood waters reach RL 3m AHD;
- Flood emergency response plan attached to leases and body corporate documents;

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

- Nomination of wardens to organise people at times of floods;
- Annual training of wardens and tenants on flood emergency response activities;
- A Plan which will include a three stage evacuation strategy including vehicle and pedestrian evacuation and an absolute last case option to shelter in place;
- The nomination of the supermarket area (located at RL 10.2m AHD) as flood refuge area when alarm is activated for Levels 1 and 2.

The building will be designed to structurally withstand the flood flow and debris loads.

In summary, the design of the proposed B6 development readily exceeds the flood risk management requirements of both Council and the State government.

7 Molino Stewart

Since the approval of the R3-Zoned Mirvac Georges Cove Residences (DA-24/2017), the *Georges River Regional Flood Evacuation Study* (**Molino Stewart**) was finalised by Council in consultation with the Department of Planning & Environment (DPE), Planning Delivery Unit (PDU) and relevant state agencies. The *Flood Evacuation Study* was completed by Molino Stewart on behalf of Council and titled '*Georges River Evacuation Modelling – Flood Evacuation Analysis, Final*', being Version 4 and dated 17/03/2022.

A summary of the main issues raised in the Tooker + Associates peer review of the Molino Stewart report are noted below:

The Molino Stewart Flood Evacuation Studies' evacuation capacity is a flawed assessment which grossly underestimates the designed vehicle evacuation capacity for the Moorebank East Precinct in the following ways:

1. That the Georges Cove Residences (site C) site has an approved evacuation strategy that has been designed to accommodate the Georges Cove Marina Proposal,
2. In their *Study*, Molino Stewart has artificially reduced the lane capacity to **below half** capacity (600cars/lane/hr) of the standard 1400cars/lane/hr capacity required by Council's design rules for all of the sites' built roads. This is despite Molino Stewart having the technical capability to instead utilise a more accurate/realistic dynamic traffic model to determine the actual road capacity, and **therefore determine if there was any actual reduction of capacity**. Instead, Molino simply applied an outdated SES rural road criteria which is less than half of the as-built actual design road capacity;
3. Molino Stewart has adopted unrealistic assumptions of full residential occupation, i.e. that no one is away from their homes (traveling/holidays/away for work), and that 100% of people working in the precinct are still coming to work (regardless of days of inclement weather or flood warnings), and all cars in every household are used in the flood evacuation for the car usage numbers, and that all residences own cars(contrary to recognised survey data);
4. Molino does not factor in that the warning time available to residents to evacuate via car is in excess of 12 hours,
5. Molino Stewart makes no allowance for pedestrian evacuation even though they recognise that up to 30% of households in some areas do not have cars (particularly apartment dwellers). Obviously, people will walk out should they decide to leave but importantly, therefore, will obviously not create vehicle traffic that reduces the car carrying capacity of the roads;

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

6. Molino Stewart does not account for flood evacuation orders which can be provided more quickly and efficiently in residential developments by both electronic means (SMS) and door knocking by Community Management (such as the Georges Cove Residences community site C and Marina management – site D), so that evacuation proceeds much faster than public stand-alone residential subdivisions,
7. Molino Stewart's basis for this evacuation assessment is the PMF flood which has a probability of occurring in **1 in 1,600,000 years,** which is the most extreme of flood conditions and compounding this extreme is the unjustified more-than-halving of the designed road lane vehicle capacity.
8. Molino Stewart uses an impossibly unrealistic rapid rate of flood level rise above 1:100 to PMF, thereby understating the actual period that people will have to evacuate during a greater than 1:100 year flood. The reality is that the rise of waters rise slower as the flood magnitude grows above the 100 year ARI due to the widening of the floodwater flow path.

The Risk-e Business peer review report concluded:

*It is our expert opinion that as it currently stands, the Molino Stewart Report is based on either overly conservative or unrealistic assumptions, and incomplete/out of date data, that mainly have been provided by the NSW SES (our understanding). Our expert opinion is that the report **did not accurately** consider the following:*

- *A phased approach to evacuation considering pedestrian, vehicle, occupancy vacancies, and shelter in place.*
- *Assumptions made by the NSW SES (and adopted unquestioned by Molino) indicate that they appear to be out of touch with the realities of urban living in a city that must be designed to cater for future population growth, based on the modes of transport that the growing population is adopting (alternates to owned-vehicular transport).*
- *Traffic lane capacity based on an unreasonably conservative figure of 600 per lane/hour when they are well aware that the roads around the proposed development are not rural and will be familiar to the majority of road users.*
- *Referring to expected traffic delays caused by vehicles making their way north on the M7 to Homebush when their own comments, supported by independent research, clearly indicate that only a small proportion of residents would follow this path. Also, they have not factored into the modelling, the Liverpool evacuation centre or travelling to or sheltering with nearby family and friends.*
- *100% evacuation compliance is a known fallacy that cannot be achieved, yet Molino Stewart used this as a base assumption.*

It is in our expert opinion that had the correct assumptions, along with current evacuation triggers, been provided to Molino Stewart by the NSW SES (and adopted) and consideration was given to the phased approach to evacuation modelling, different, more realistic conclusions would have been reached.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

8. Conformance to Flood Policy

8.1 NSW Government Flood Policy

The NSW Government's Flood Prone Land Policy and Floodplain Development Manual support the wise and rational development of flood prone land. The policy acknowledges that flood prone land is a valuable resource that should not be sterilized by unnecessarily precluding its development and that development should be treated on its merits rather than through the application of rigid and prescriptive criteria.

The aim of the policy is to appropriately manage the risk to personal safety and damages from floods. These aims are adopted in the Liverpool Local Environmental Plan 2008. The way in which the proposed development conforms to these aims and objectives is discussed in Section 8.2.

8.2 Liverpool LEP 2008

8.2.1 Clause 5.21 LEP Objectives for Flood Planning

The Liverpool Local Environmental Plan 2008 (LEP) specifies the following objectives of flood planning (italics).

5.21 Flood planning

(1) The objectives of this clause are as follows—
(a) to minimise the flood risk to life and property associated with the use of land,

Risk to life has been addressed by locating all commercially habitable uses in this Georges Cove Village PP (site A) at or above the PMF – they are flood free. Risk to property has been addressed by use of flood compatible materials below the FPL and locating habitable areas in flood free areas.

(b) ***to allow development on land that is compatible with the flood function and behaviour on the land, taking into account projected changes as a result of climate change,***

The benchmark per development landform specified by Liverpool Council for the Georges Cove Village site was that it was above the Flood Planning Level (100yr ARI flood level plus 0.5m freeboard) over the majority of the site except for a small area along Newbridge Road. Access to the site is from both Newbridge Road and the Mirvac Georges Cove Residences development (site C) so that access/egress is always available when Newbridge Road is flooded. The development is located outside of the major flood flow conveyance area and is subject to flood storage and flood fringe. The proposed development is therefore compatible with the flood function.

(c) to avoid adverse or cumulative impacts on flood behaviour and the environment,

The development has a positive impact on flood behaviour by providing a significant increase in flood storage.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

(d) to enable the safe occupation and efficient evacuation of people in the event of a flood.

The commercially habitable areas of the development are flood-free and efficient evacuation of the site is possible by both vehicle and foot.

(2) Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development—

(a) is compatible with the flood function and behaviour on the land, and

The site has only minor flood fringe and flood storage along the Newbridge Rd frontage on the site with the majority of the built form located above the flood planning level (100 year ARI). As such, the development is compatible with flood function and behaviour.

(b) will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties, and

The proposed development will add considerable flood storage thereby improving flooding conditions on the site. It will not adversely impact on existing flood conditions on adjacent sites or development.

(c) will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood, and

This report identifies that the addition of this Georges Cove Village development (site A) will not adversely impact the safe evacuation by vehicle or pedestrian means of the Georges Cove Marina (site D) or the Mirvac Georges Cove Residences (site C), even based on the very conservative SES assessment methodology. The infrastructure of the road to Brickmakers Drive and elevated pedestrian bridge to cross Brickmakers Drive have adequate capacity for the flood evacuation strategies for the three developments.

(d) incorporates appropriate measures to manage risk to life in the event of a flood, and

A Flood Emergency Response Plan has been prepared for the development and will be implemented by the Supermarket Manager and light industrial Flood Warden.

(e) will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.

The proposed development will not adversely impact on erosion or stability of river banks.

(3) In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters—

(a) the impact of the development on projected changes to flood behaviour as a result of climate change,

The proposed development has a minimum habitable floor level (Level 3) at RL 10.2m AHD. This will be 4.6m above the existing 100 yr ARI flood level and will readily cater for climate change impacts on flood levels to the year 2100.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

(b) the intended design and scale of buildings resulting from the development,

The design and scale of the development is compatible with the site and surrounding development.

(c) whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood,

This report identifies that the addition of this Georges Cove Village development (site A) will not adversely impact the safe evacuation by vehicle or pedestrian means of the Georges Cove Marina (site D) or the Mirvac Georges Cove Residences (site C) based on the very conservative SES assessment methodology. The infrastructure of the road to Brickmakers Drive and elevated pedestrian bridge to cross Brickmakers Drive are adequate for the three developments.

(d) the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.

The surrounding area is impacted by flooding and the flood emergency response plan caters for this flooding in terms of safe evacuation plans. The surrounding sites are not affected by coastal erosion.

9. Liverpool DCP

9.1 Merits Based Approach

The Liverpool DCP identifies in Section 9 that the NSW government Floodplain Development Manual 2005 is based on a merit based approach to flood-prone land planning. It recognizes that it is about risk management in terms of personal safety and flood damages. The aim is to minimize these risks within acceptable bounds and the flood planning level (100yr flood level plus 0.5m freeboard-RL 6.1m AHD) is recommended as the acceptable bound for management of flood damages and the need for adequate evacuation above the PMF level for personal safety.

The DCP is a guideline document prepared for a broad range of developments. The flood planning matrix takes these broad land uses and provides guidelines for acceptable land uses in three flood hazard categories. The aim is to achieve the above objectives.

The proposed development is on a site Council specifies in the agreed benchmark predevelopment landform as being above the 100 year ARI flood level and above the flood planning level except at the entrance off Newbridge Road. Hence the site is defined as a Low Flood Hazard category.

The proposed development conforms to the nine flood planning objectives as listed in Section 9 of the DCP. In Section 9.2 below, there is discussion as to how the proposed development, based on its merits, conforms to the flood planning objectives in the DCP.

9.2 Flood Planning Objectives

a) to minimize the potential impact of development and other activity upon the aesthetic, recreational and ecological value of the waterways corridors.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

The development site is not located within a waterway corridor however it minimizes the potential aesthetic, recreational and ecological impacts.

b) to ensure essential services and land uses are planned in recognition of all potential floods.

There are no essential services for the broader community incorporated into the development however the proposed uses of the development have been planned in recognition of all potential floods.

c) to reduce the risk to human life and damage to property caused by flooding through controlling development on land affected by potential floods

The proposed development complies with this objective and goes further by reducing the flood risks to below that normally accepted in floodplains in the following manner:-

- the open area above Level 1 would be constructed with flood compatible materials to reduce flood damages;
- all habitable floor levels are at or above the PMF flood level;
- all parking floor levels are either above the FPL or above the PMF level;
- internal access is available to floor levels above the PMF level;
- there is pedestrian and vehicular flood evacuation access on routes above the 100yr flood level to areas external to the site above the PMF; and
- the building will be designed to withstand the hydraulic forces due to a PMF flood.

As such, the proposed development readily conforms to this objective.

d) to ensure that the economic and social costs which may arise from damage to property due to flood is minimized and is not greater than that which can be reasonably managed by the property owner and general community.

All habitable uses are located at or above the PMF level and are flood free. All parking is located above the FPL and the building will be constructed of flood compatible materials below the FPL. This exceeds the Council's DCP requirements. Because the proposed development is designed to be beyond that typically conforming to the DCP (as described above for c), the economic and social costs are minimized beyond that normally considered acceptable.

As such, the proposed development conforms to this objective.

e) to limit developments with high sensitivity to flood risk (eg critical public utilities) to land with minimal risk from flooding

The proposed development does not have uses with a high sensitivity to flood risk.

f) to prevent intensification of inappropriate use of land within high flood risk areas or floodways.

The proposed development is located in a low flood risk site and not in a floodway or high flood risk area. All habitable land uses will be located on floor levels above the PMF flood level and will be flood free. On this basis, there is no intensification of inappropriate land use.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

As such, the proposed development conforms to this objective.

g) to permit development with a lower sensitivity to the flood hazard to be located within the floodplain, subject to appropriate design and siting controls.

The proposed development conforms to this objective because it is located in a low flood hazard zone. The access to the site will not be overtopped by the 100yr ARI flood and all the habitable floors will be above the PMF level. All retail and commercial uses will be located above the PMF and will be flood free. There is a Flood Safe Plan should the site need to be evacuated.

As such, the development will have appropriate land uses given the low flood hazard and the appropriate design and siting controls.

h) to ensure that development should not detrimentally increase the potential flood affectation on other development or properties either individually or in combination with the cumulative impact of development that is likely to occur in the same floodplain.

The proposed development site will not have significant adverse impacts on flooding behaviour on adjoining sites. Extensive flood modelling of these three development sites (A, C and D) has demonstrated that no adverse flood impacts would occur and thereby conforms to this objective.

i) to ensure that development does not prejudice the economic viability of any Voluntary Acquisition Scheme.

The proposed development would not affect or prejudice the economic viability of a voluntary acquisition scheme.

In summary, the proposed development conforms to all of the Council's DCP flood planning objectives and hence, based on a merits-based approach as recommended in the NSW Government's Floodplain Development Manual and Council's DCP, the Georges Cove Village development (site A) should be permitted.

10. Section 117 Directions

The proposed development is located on land zoned E3, Productivity Support. Section 4.1 Flooding of the Section 117 Ministerial Directions issued in March 2022 does not allow a significant increase in development within flood planning areas.

The Liverpool flood planning area maps indicate that a component of the subject site along the Newbridge Road frontage is in the flood planning area. The majority of the site in its Council designated benchmark pre development state is above the flood planning level. The Section 117 Direction allows inconsistencies with this Direction if the inconsistency is of a minor significance. It is considered that the proposed inconsistency is of minor significance because it only involves a minor part of the site frontage along Newbridge Road which falls into the flood planning area. The majority of the site is not affected by this Direction.

Notwithstanding this justification, further justification is given below based on the proposed design of the development which ensures that the development conforms to the State and Council flood

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

policies such that the risks to personal safety and flood damages are appropriately managed and even managed beyond the requirements of these policies. Liverpool Council has also given development approval for the developments on sites C and D. It is argued that because of this level of flood risk management, any inconsistency with the Direction will be of minor significance in terms of flood risk.

The significance is measured in terms of its impact on the objectives of the planning of flood prone land. These are outlined in the Section 4.1 Flooding Clauses (1) to (5). The degree to which the rezoning would conform to these clauses is discussed as follows.

(1) shall be consistent with the NSW Flood Prone Land Policy and principles of the Floodplain Development Manual 2005

The proposed development does conform to these documents/policies in that it minimizes the potential flood risk to personal safety and property damages. It is to be located in a low flood risk area as per the Council DCP which is compatible with retail and commercial development.

(2) not rezone the land

The Planning Proposal is not seeking to rezone the land.

(3)(a) does not permit development in floodways.

The development would not be located within a Floodway. It is located in an area of Flood Storage and Flood Fringe.

(3)(b) not permit development that will result in significant flood impacts to other properties.

Extensive flood modelling by Cardno (now Stantec) which has been accepted by Liverpool Council has demonstrated that the development would not have any adverse flood impacts on other properties. In fact, the development by design would provide additional flood storage which would assist to reduce the flood risks in the local area.

(3)(c) not permit residential accommodation in high flood hazard areas.

The proposed development does not include dwellings and is not in a high flood hazard area.

(3)(d) not permit a significant increase in the development and/or dwelling density of that land.

No dwellings are proposed in the development of the Georges Cove Village development (site A). The site is now Zoned E3 Productivity Support. The proposed LEP amendment (the PP) for this land therefore would not increase the development of that land beyond its present zoning. Importantly from a flood risk point of view, this risk would be managed in accordance with Council and State government flood policies.

(3)(e) not permit flood sensitive uses where the occupants of the development cannot effectively evacuate.

The development does not propose any sensitive uses of the site for which occupants cannot effectively evacuate.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

(3)(f) not permit development without consent.

The proposed development requires Development Consent.

(3)(g) not impose significantly increased requirement government spending on flood management.

The proposed development does not impose significant increase in government spending of flood management. The development has been specifically designed to mange the flood risk and has a detailed Flood Safe Plan to manage any flood evacuation required for the site.

(3)(h) not permit hazardous materials that cannot be effectively contained in a flood

All the habitable floor levels are at or above the PMF flood level and as such, are flood free. No hazardous materials will be stored at lower levels.

(5) not determine a flood planning level that is inconsistent with the Floodplain Development Manual 2005.

The flood planning level adopted for this development is consistent with the *Floodplain Development Manual 2005*.

The proposed development therefore conforms with requirements for flooding in the Section 9.1 Ministerial Directions which commenced on 1 March 2022.

11. Considering Flooding in Land Use Planning Guideline

This guideline provides recommendations to Council's to adopt revised flood related development guidelines under two headings into their Local Environment Plan. The first heading is Flood Planning Areas and this has been adopted into the Liverpool LEP. The proposed development complies with these requirements as detailed in Section 8.2 above.

The second heading recommended to Council was for Special Flood Considerations. This was related to requirements for flood sensitive and hazardous landuses such as hospitals, child care centres etc. Council has not adopted these Special Flood Considerations into the LEP, however, the proposed development does not contain any of the listed sensitive or hazardous land uses listed under the Special Flood Considerations in the guideline and as such, is not relevant to this development.

12. Planning Circular PS 21-006 14 July 2021

This circular provides advice on Council adoption of the revised Clauses 5.21 and 5.22 into their LEPs. Liverpool Council has adopted Clause 5.21 but not Clause 5.22. The requirements of Clause 5.21 have been dealt with in Section 8.2 of this report. Clause 5.22 deals with requirements for flood sensitive uses which make flood management and evacuation difficult. The proposed development does not have any of these flood sensitive uses.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

The other recommendation in the Planning Circular is for Councils to use the Considering Flooding in Land Use Planning Guideline. The requirements of the guideline have been dealt with in Section 11 of this report.

13. DPE Draft Shelter in Place Guidelines

The DPE draft guidelines for *flood shelter in place* recommend that use of shelter in place for flash flooding which the guideline recommends should be for an elevated flood level duration not longer than 6 hours in which evacuation is not possible from the site.

The proposed development could experience flood durations longer than 6 hours however, would nevertheless comply with this draft guideline in that the recommended flood evacuation strategy is for use of cars as the first stage and if for some reason this method fails, then pedestrian evacuation would be initiated as a second stage response. The use of a third stage, shelter place is not recommended but is readily and abundantly available on site should this be required. The light industrial floor level is at RL 15.2m AHD. This is **5 metres above the worst-case RL 10.2m AHD PMF level** and has availability to all amenities.

14. DPE Support for Emergency Management Planning 2022

This Flood Risk Management Guide EM01 from 2022 sets out seven principles for Flood Emergency Management (EM). The proposed development complies with the guiding principles in the following ways.

Principle 1 Any proposed EM strategy should be compatible with any existing community EM strategy

The proposed development flood emergency response plan integrates into the regional response plan with vehicular evacuation and integrates into the local pedestrian evacuation strategy approved for the Mirvac Georges Cove Residences (site C) development.

Principle 2 Decisions should be informed by understanding the full range of flood EM risks to the community

The proposed development and the flood emergency response plan has been informed by a knowledge of the behaviour of all floods up to the PMF, the inclusion of a three-stage flooding response to cater for all eventualities and a development design which will minimize flood damage.

Principle 3 Development of the floodplain does not impact on the ability of the existing community to safely and effectively respond to a flood

The proposed development uses the same vehicular and pedestrian evacuation routes and infrastructure as for the evacuation of the Mirvac Georges Cove Residences (site C) and Georges Cove Marina (site D) and these have been provided to service these three developments. Liverpool Council has approved the flood evacuation strategy for the Georges Cove Residences (site C). There will be no adverse impacts on the ability of existing communities to safely and effectively respond to a flood (refer Section 16).

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

Principle 4 Decisions on redevelopment within the floodplain are supported by an EM strategy that does not increase risk to life from flooding

The development provides a three-stage flood response plan which has been approved for two other developments (sites C and D) with infrastructure with sufficient capacity to accommodate the proposed development. As such, the proposed development will not increase the risk to life from flooding.

Principle 5 Risks faced by the itinerant population need to be managed

All people onsite are considered in the Emergency Response Plan, including itinerant people. There are no dwellings proposed for the Village which reduces the risk of the number of itinerant people being onsite. The development is a commercial-only development and the plan is instigated and managed by business related managers whose responsibility will be to ensure that all people respond appropriately to the warnings and instructions.

Principle 6 Recognize the need for effective flood warning and associated limitations

There will be regular training of the flood wardens and workers so that they are familiar with the flood warnings and timing to leave the proposed building. The BoM and SES will issue digital warnings which provide significant durations for the flood response. The Flood Wardens will be trained to initiated the first stage response in cars and if this appears to fail, then to initiate the second stage response which is a pedestrian evacuation. There will be information available regarding flood refuges and the potential dangers to people who do not initially wish to evacuate the site.

Principle 7 Ongoing community awareness of flooding is critical to assist effective emergency response

Regular training of all flood wardens and people working onsite will be undertaken along with practice evacuations so that all workers on site can assist with an evacuation in a flood.

15. 2022 Flood Enquiry Report Findings

There were 28 recommendations from the 2022 Flood Enquiry. The majority of these recommendations related to government and community agencies. The recommendations which relate more directly to the subject development were related to essential services and flood education.

The development will need to provide essential services such as power, water and sewerage services during a flood. This can be achieved through design and appropriate location of these services. A backup generator may be considered necessary to ensure power to the Levels 3 and 4 and the provisions of potable water dispensers on these levels as well.

With regard to flood education, the supermarket, retail shops and light industrial premises will each have a copy of the Flood Emergency Response Plan and Flood Safe Plan and the lease will require training of the flood wardens and annual training of all workers on the site in terms of flood behaviour and managing the flood evacuations. These requirements will be similar to the requirements for fire management.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

These inclusions in the proposed development will address the relevant flood recommendations from the 2022 Flood Enquiry.

16. Flood Emergency Response Plan

16.1 Flood Protection Measures

A Site Manager will be appointed by the building owner to be responsible for the site operations and maintenance. The Site Manager will have an office on site and will be responsible for the management, training and implementation of the flood responses on the site. This person will be the Chief Flood warden. The Site Manager on behalf of the building owner, will appoint two Flood Wardens (one for each of Levels 3 and 4) and Assistant Flood Wardens should any of the Flood Wardens be unavailable during a flood event. These wardens would be drawn from the supermarket Store Manager and tenant principals of the small retail/light industrial areas on each floor.

The Site Manager and Wardens would be trained by flood engineers as organised by the building owner as to the flood behaviour and flood response. The site manager would also be trained as to the building electrical and maintenance operations. People suited to this work are available from the large real estate companies who manage many different types of commercial and industrial buildings.

Training of the Site Manager and Wardens would be repeated on an annual basis so that they were familiar with any revisions or updates to the flood responses on the site.

All habitable floor levels and most of the car parking areas in the development are at or above the PMF and therefore are flood free. During a PMF flood, the flood level would be RL 10.2m AHD. The only non-PMF level carpark is on Level 2 with a floor level of RL 7m AHD which 0.9m above the Flood Planning Level (FPL) – 100yr ARI flood level plus freeboard of 0.5m.

Vehicle access to the site is available from the existing Mirvac Georges Cove Residences (site C) development onto Brickmakers Drive at RL 6m AHD or from Newbridge Rd at Level 1 with a level of RL 2.5m AHD.

There will be a remote-controlled gate installed across the driveway at the RL 2.5m AHD Newbridge Rd entrance to prevent vehicles from entering or leaving the site when the flood hazard in Newbridge Road is unsuitable for small cars ie more than 300mm depth. A flood depth marker will be installed at the driveway so that flood depths can be monitored to ensure the driveway gate was closed at the appropriate time. In addition, a water activated alarm will be installed to provide an audible and flashing light warning once flood waters reach RL 2.7m AHD ie 200mm deep on Newbridge Rd. Once the alarm is activated, the gate closing will be automatically activated. There will also be a manual override so that flood wardens can manually close the gate across the driveway. Once this gate is closed, all vehicles will be directed through the Mirvac Georges Cove Residences (site C) exit.

There will be a backup generator/battery storage system which will activate if there is any power failure on the site especially to the flood warning alarm and gate closing.

The site occupants will have full-time access available to their own office/warehouse units during all floods to access water, sanitation, food and emergency kits. The site manager would also have access in their office to water, sanitation and emergency kits in the site managers cupboards/storage units.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

Signage will be provided near the car parking spaces to warn that during significant storms, cars may be prevented from leaving the site via the Newbridge Rd exit due to the unsafe flood hazard. The cars would then be directed to the Mirvac Georges Cove Residences (site C) evacuation route. Signage for the flood evacuation will be provided in the Mirvac Georges Cove Residences development indicating vehicular and pedestrian flood evacuation routes (refer Figure 16).

16.2 Flood Warning Actions

The BoM will provide a 12 hour flood warning for floods likely to rise above RL 4m AHD. This warning would be provided digitally to the Chief Flood Warden who would forward the warning to all Flood Wardens onsite. An alarm would then be activated to initiate a flood evacuation according to the Flood Emergency Response Plan. A message over the loudspeakers would be given over Levels 2 to 4 for people to return to their cars and evacuate the site by both the Newbridge Rd and Mirvac Georges Cove Residences (site C) access to Brickmakers Drive. The Flood Wardens would ensure that people were directed out of the retail and light industrial areas to the carparks and out of the development.

If flood levels rise more quickly than anticipated, the exit to Newbridge Rd shall be closed automatically by the flood gate. This will be obvious as the visible and audible alarm will indicate that this exit is closed. The flood wardens will then direct cars to the Mirvac Georges Cove Residences exit to Brickmakers Drive. This enacts the first stage of the FERP which is vehicle evacuation.

There would be some 13.6 hours warning time until flood waters would be expected to impact on access to Brickmakers Drive (100 yr flood level RL 5.6m AHD). As such, the time available for the vehicular evacuation from the site would be 13.6 hours. The exit of all the cars from the Georges Cove Village (site A) carpark and the other two developments (Mirvac Georges Cove Residences – site C and Georges Cove Marina – site D) would rely on the same flood infrastructure and should take no longer than 2 – 3 hours which provides considerable extra time for the evacuation based on the 13.6 hour warning time (refer Section 6.4). This duration is based on the very conservative SES evacuation road half-capacity for vehicular evacuation, rather than the actual design/as-built rating for these roads.

If the vehicle evacuation fails for some reason during the 2 - 3 hour period, the Chief Flood Warden would review the situation and if necessary, would instigate the pedestrian flood evacuation. There would be 14.6 hours warning for flood waters to reach RL 7m AHD which is the level in Paine Park at the end of the elevated pedestrian bridge over Brickmakers Drive.

The pedestrian flood evacuation would involve people walking from the Village to the elevated pedestrian bridge over Brickmakers Drive and north up Horizon Circuit until the ground levels are above the PMF flood level. This distance is approximately 1.2km and at the very conservative SES walking rate (2km/hr) and allowing for the bridge to be a pinch point, would take approximately 1.9 hours to evacuate all people from the local area including the Village (site A), Marina (site D) and Mirvac Georges Cove Residences (site C). This leaves considerable time (9.7 hours) for safe evacuation (based on the SES evacuation methodology) even if it starts after a failed vehicular evacuation say after 3 hours for the initiation of the flood evacuation.

It should be remembered that each of the three Benedict/Mirvac developments (sites A, C and D) have design levels that provide fall back emergency for everyone to shelter in place above the PMF however, this will not be recommended.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

16.3 Other Sources of Flood Information

16.3.1 Observation of Local Rainfall

An important indication of likely imminent flood activity would be intense local rainfall over a long duration.

16.3.2 Bureau of Meteorology

As discussed above, the Bureau of Meteorology does provide flood predictions for the subject area.

Severe Thunderstorm Warnings are issued together with maps indicating the current location and predicted path of thunderstorms. Severe Weather Warnings are for severe weather not related to thunderstorms, cyclones or fire, such as "east coast lows" or other causes of intense rainfall or storm surge.

These warnings are available at http://www.bom.gov.au/nsw/warnings/. The warnings for the Georges River would be provided digitally via a SMS to the flood wardens on site.

16.3.2 The NSW SES

The SES issues Local Flood Advices. These are issued on the basis of localized valley watch information for locations for which the BoM does not issue Flood Warnings. They normally predict which class of flooding (minor, moderate or major) will occur, and must not contradict any Flood Warnings provided by the BoM for other gauges on the same river. Local Flood Advices are to be clearly identified as being issued by the SES.

16.3.3 Flood Warning Actions

A. Heavy rainfall is experienced

During heavy rainfall a designated Flood Warden to commence visual monitoring of the entry on Newbridge Road.

B. The alarm sounds or flashes to confirm BoM or SES warnings

The Flood Wardens commence movement of people to their cars and directing them to the exits. The Flood Wardens monitoring car evacuation to ensure it occurs smoothly. If Newbridge Rd exit is closed by flood waters, then cars are to be directed to the Mirvac Georges Cove exit route. The Chief Flood Warden to decide after three hours if the pedestrian evacuation should be initiated. If so, then Flood Wardens manage pedestrian evacuation to the elevated pedestrian bridge over Brickmakers Drive. The Wardens are to ensure that all people leave the site.

16.3.4 Local Emergency Management

Liverpool Council works in collaboration with emergency service organisations to ensure the safety of the community. Council is required to appoint a Local Emergency Management Officer (LEMO) who in the event of an emergency in the Liverpool Local Government Area will act as the coordinator who will liaise with other emergency services such as NSW Police, Fire & Rescue and State Emergency Services.

Council's LEMO also acts as the chair of the Local Emergency Management Committee. Council provides executive support to the committee which facilitates an effective communication network with all emergency response agencies and ensures that resources will be available to respond to emergencies if the need arises.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

16.3.5 Local Television and Radio Stations

Local television and radio stations would disseminate warnings from the Bureau of Meteorology, SES and other relevant sources. Increasingly, mass SMS messaging is used to quickly communicate with nearly everyone.

16.4 Flood Response

16.4.1 Flood Awareness

Workers, visitors and shoppers on site will be made aware of the flood hazard and evacuation procedures through a combination of measures.

Signage will be placed at key locations to raise flood awareness among all people on site. The signage is to raise awareness to flooding on site and flood evacuation procedures.

Evacuation plans detailing the evacuation procedures will be provided to each shop, office, and light industrial premises along with placement at other key locations.

Flood warning signs may be provided to raise awareness of flooding during dry times, but also to alert visitors and workers to the depth of floodwaters during flood events.

16.4.2 Flood Safe Plan

A *Flood Safe Plan* for the property has been prepared and supplied as Attachment C. The Flood Safe Plan will need updating with relevant information following occupation of the buildings and annually in the future as appropriate. This review would be arranged by the Site Manager.

This includes the first aid training of Flood Wardens including the use of a battery-operated defibrillator.

16.4.3 Hazardous Materials

Possible hazardous materials should only be stored on Levels 3 and 4, above flood levels. The hazardous materials might include:

- Cleaning chemicals eg chlorine bleach; disinfectants, etc and
- Petrochemical fuels eg petrol, oil, diesel.

16.4.4 Utilities

The following items have been identified as infrastructure relevant in flood emergencies: electricity and water. During significant storms, interruptions may be experienced to electricity and pumps for water supply. Local substations may be affected by floodwaters in extreme events approaching the PMF. A backup generator is proposed for the site to provide emergency power supply to Levels 3 and 4 should there be a blackout in the area during a flood.

Water and gas may also become unavailable during severe flood events due to offsite network issues.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

16.4.5 Operations and Responsibilities

Flood Wardens will co-ordinate the emergency response to flooding at all times. There will be up to 3 designated Flood Wardens for each floor on the building, plus a Site Manager, who is the Chief Flood Warden.

Flood Wardens will be trained by the Site Manager with assistance from flood engineers. A training register will be maintained by the Site Manager with annual audits to ensure that sufficient Flood Wardens are trained in the procedures.

Notwithstanding warnings and orders given by the SES, Police or other authorities, Flood Wardens are responsible for issuing directions and warnings to all workers and visitors.

A copy of this FERP or future version(s) will be stored on site in hardcopy in a weather proof, easily accessible location that is clearly marked and available to emergency services. Additional copies will be given to each office/warehouse and will be available for staff training and reference in an emergency.

16.4.6 Emergency Procedure

16.4.6.1 Informal Monitoring

Weather conditions can be monitored informally at http://www.bom.gov.au/nsw/warnings/ and the BoM also provides real time rain radar coverage for Sydney at http://www.bom.gov.au/products/IDR713.loop.shtml.

16.4.6.2 Flood Warden Actions

In accordance with the flood warnings, the following actions must be co-ordinated by the Flood Wardens.

A. *Heavy rainfall is experienced*

During heavy rainfall a designated flood warden to commence visual monitoring of the entry on Newbridge Road.

B. *The Flood alarm sounds or flashes*

The Flood Wardens instruct shops to cease trading and commence movement of people to their cars and directing them to the exits. The Flood Wardens monitoring car evacuation to ensure it occurs smoothly. If Newbridge Rd exit is closed by flood waters, then direct cars to the Mirvac Georges Cove exit route. The Chief Flood Warden to decide after three hours or sooner if the pedestrian evacuation should be initiated. If so, then Flood Wardens manage pedestrian evacuation towards the elevated pedestrian bridge over Brickmakers Drive. Wardens must ensure that all people leave the B6 site.

16.4.7 Recovery

Following a flood event, people on site should notify family and friends of their location. The Site Manager and/or the Flood Wardens will inspect the site to organise any repairs, removal of debris and other works to ensure safe operations.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

17. Conclusions

The proposed E3-zoned retail and light industrial/commercial development proposed in this PP for site A has been designed to exceed the State and Local Government requirements for flood management including considering the recent recommendations for the 2022 Flood Enquiry and revisions to the flood-related State and Council Planning requirements. It also complements the adjacent and recently approved development sites at Georges Cove Marina (site D) and Mirvac Georges Cove Residences (site C). There is sufficient vehicular and pedestrian infrastructure to provide safe flood evacuation. There is also a fall-back emergency, the shelter-in-place option available above PMF flood levels (if required) and additionally, the same option is provided in the approved Georges Cove Marina (site D) and Mirvac Georges Cove Residences (site C) developments.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

FIGURES

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

FIGURE 1



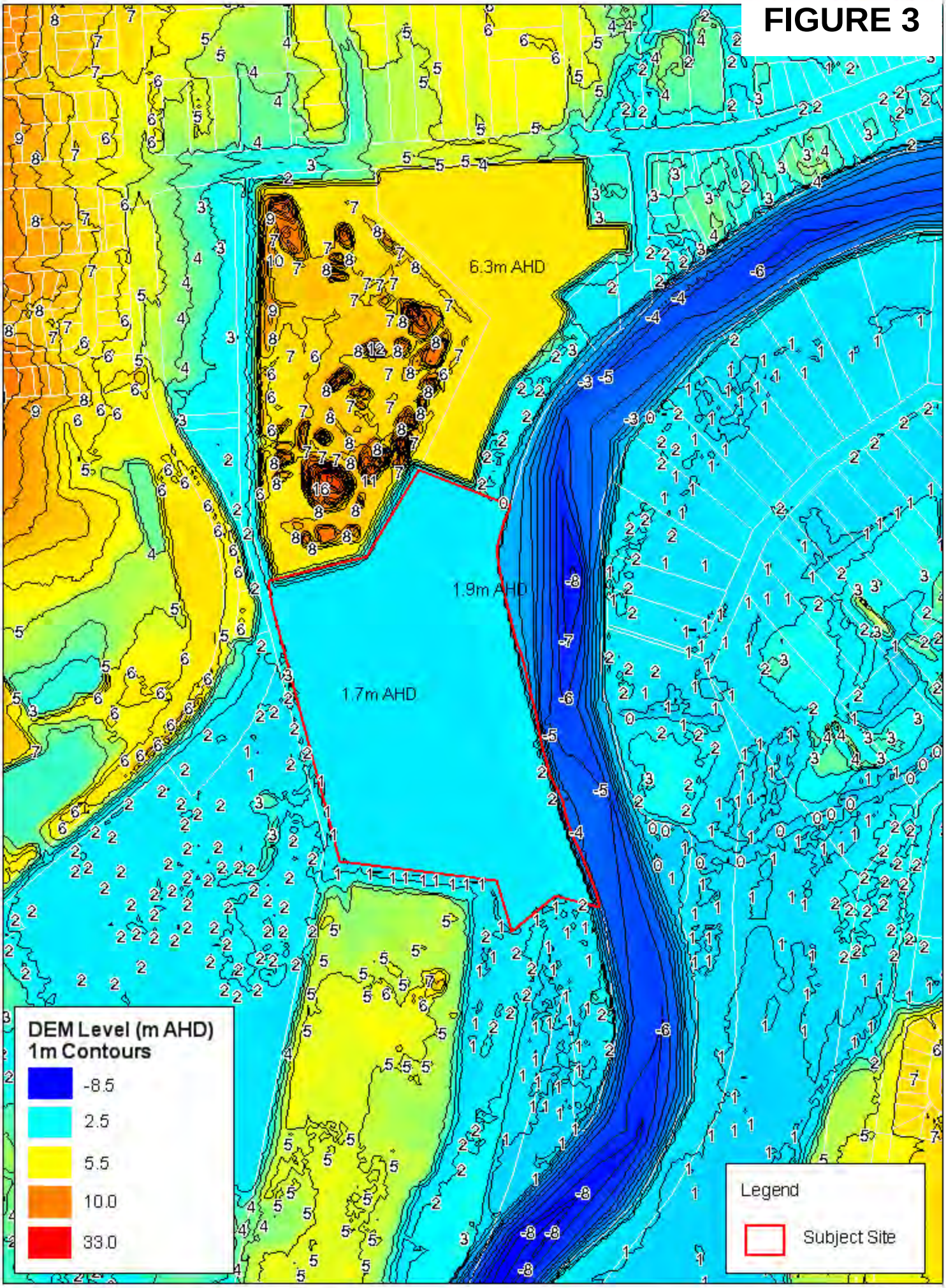
Proposed Georges Cove Village
Locality Plan

FIGURE 2



MOOREBANK EAST PRECINCT

FIGURE 3



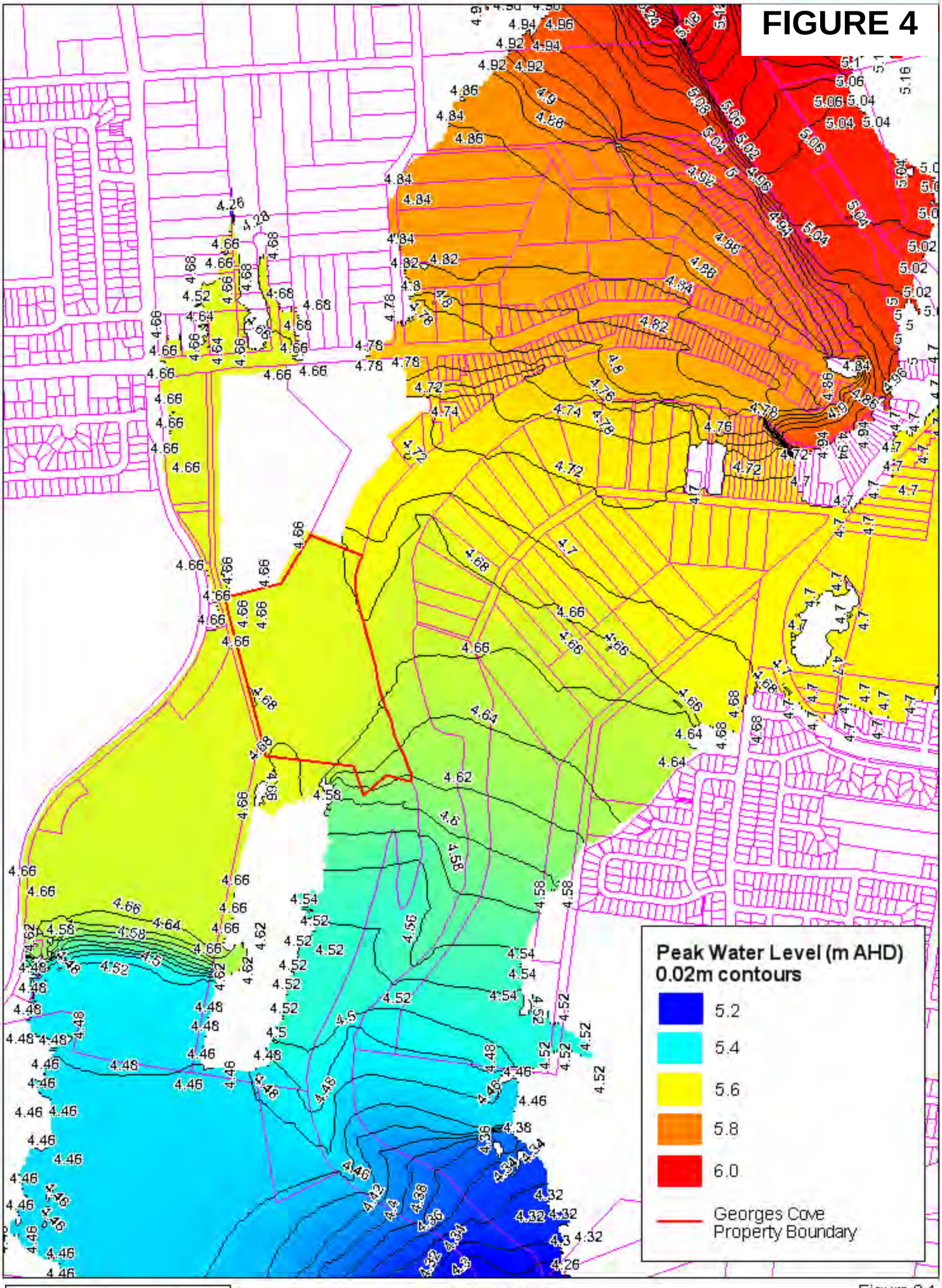
Cardno

Georges Cove
Flood Impact Assessment

Figure 2-5
Benchmark (Pre-Development) DEM

NA49913037
January 2013

FIGURE 4



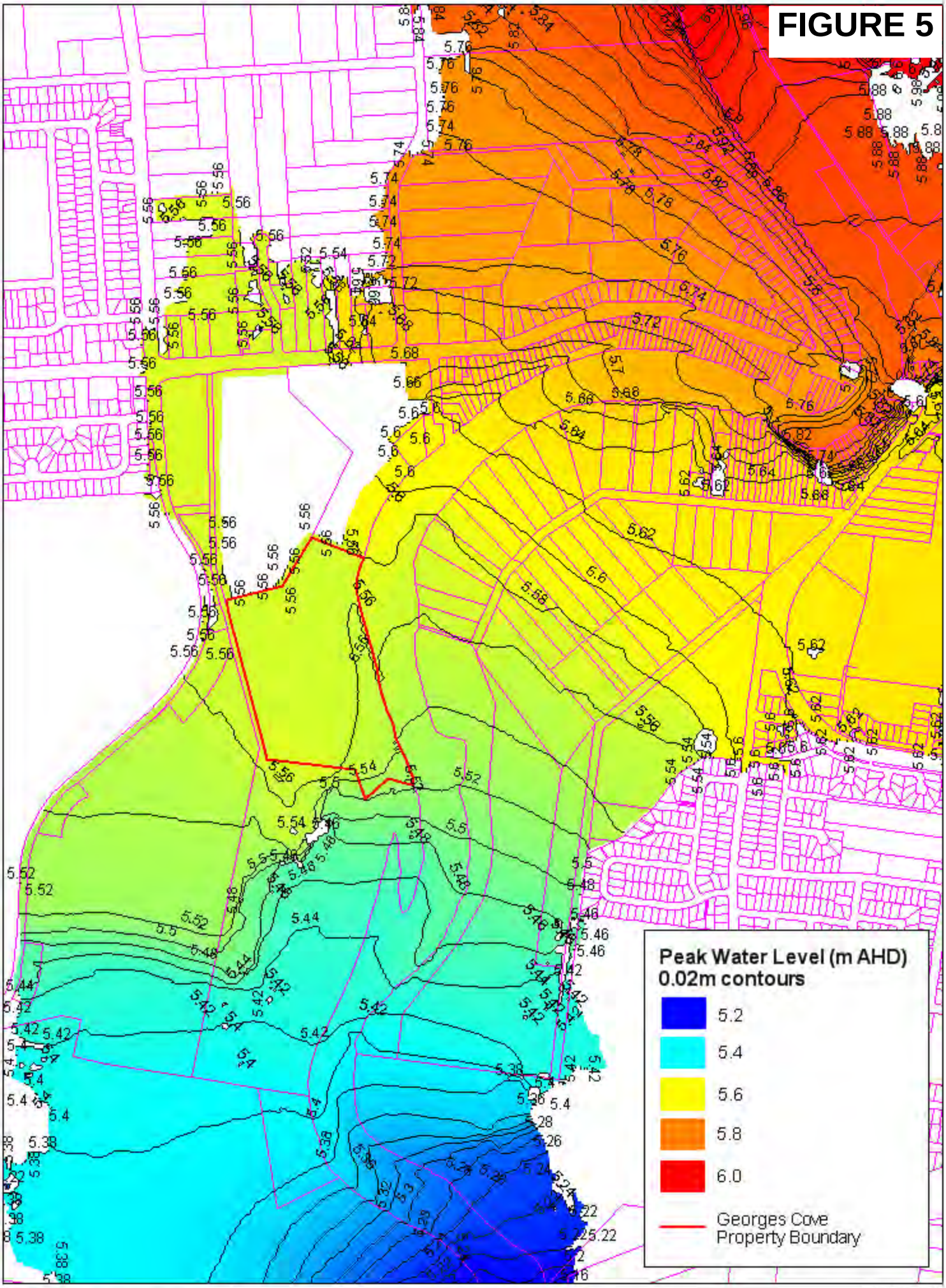
Cardno

NA49913037
January 2013

Georges Cove
Flood Impact Assessment

Figure 3-1
20 year ARI
Peak Water Level
Pre-Development

FIGURE 5



Cardno

NA49913037
January 2013

Georges Cove
Flood Impact Assessment

Figure 3-6
100 year ARI
Peak Water Level
Pre-Development

DEVELOPMENT SUMMARY

LEVEL	PARKING	NLA COMMERCIAL	NLA RETAIL	CIRCULATION/ SERVICES
LEVEL 1 - DOCK	0.0 m²	0.0 m²	0.0 m²	216.9 m²
LEVEL 2 - PARKING	5786.1 m²	0.0 m²	0.0 m²	479.3 m²
LEVEL 3 - SUPERMARKET	2794.6 m²	3809.2 m²	1045.0 m²	862.7 m²
LEVEL 4 - INDUSTRIAL	4382.1 m²	3864.7 m²	0.0 m²	141.8 m²
LEVEL 5 - INDUSTRIAL MEZZANINE	0.0 m²	1251.9 m²	0.0 m²	0.0 m²
	12962.8 m²	8925.8 m²	1045.0 m²	1700.7 m²

GFA SCHEDULE

NAME	AREA
Core	83.0 m²
GFA_Office	4691.6 m²
GFA_Retail/Commercial	1585.0 m²
GFA_Supermarket	3797.6 m²
Services	230.2 m²
	10387.4 m²

GFA SUMMARY

LEVEL	GFA
LEVEL 1 - DOCK	83.0 m²
LEVEL 2 - PARKING	376.7 m²
LEVEL 3 - SUPERMARKET	5388.0 m²
LEVEL 4 - INDUSTRIAL	3264.2 m²
LEVEL 5 - INDUSTRIAL MEZZANINE	1275.6 m²
	10387.4 m²

AREA	PERMISSIBLE FSR	PERMISSIBLE GFA
17218.4 m²	0.75	12913.8 m²

Area Schedule (NLA - RETAIL)

Level	Area
LEVEL 3 - SUPERMARKET	5326.7 m²
	5326.7 m²

Area Schedule (NLA - INDUSTRIAL)

Level	Area
LEVEL 4 - INDUSTRIAL	3627.5 m²
LEVEL 5 - INDUSTRIAL MEZZANINE	1275.6 m²
	4903.0 m²

PARKING SCHEDULE

LEVEL	CARPARKS				CAR PARKING	MOTORBIKE PARKING
	INDUSTRIAL	INDUSTRIAL (ACCESSIBLE)	RETAIL	RETAIL (ACCESSIBLE)		
LEVEL 2 - PARKING	0	0	182	4	182	5
LEVEL 3 - SUPERMARKET	0	0	97	4	97	5
LEVEL 4 - INDUSTRIAL	72	2	0	0	72	0
	72	2	279	8	351	10

Area Schedule (NLA - RETAIL PARKING RATE)	
Area	Parking Rate (RETAIL)
5326.7 m²	266

Area Schedule (NLA - INDUSTRIAL PARKING RATE)	
Area	Parking Rate
4903.0 m²	140

Area Schedule (NLA - FACTORY PARKING RATE)	
Area	Parking Rate
4903.0 m²	65

Liverpool DCP:

1 disabled parking per 100 retail/commercial

Current Industrial LFA: 4923.5m^2

1 carpark per **35m^2** of **Office LFA**

1 carpark per **75m^2** of **Factory/Warehouse LFA**

Current Retail LFA: 5331.7m^2

1 carpark per **20m^2** of **Retail LFA**

LINK:
https://eplanning.liverpool.nsw.gov.au/Pages/Plan/Book.aspx?exhibit=OnlineControls&hid=4992&s=b6+enterprise+corridor

Liverpool Development Control Plan 2008 > Part 1 (General Controls for all Development) > 20 (Car Parking and Access) > 20.3 (On site parking)



SHEET LIST

No.	TITLE	REV.
SK00.00	DEVELOPMENT SUMMARY	P2
SK00.01	SITE PLAN	P6
SK01.01	LEVEL 1 - DOCK	P6
SK01.02	LEVEL 2 - CARPARK	P6
SK01.03	LEVEL 3 - RETAIL	P6
SK01.04	LEVEL 4 - LIGHT INDUSTRIAL	P2
SK01.05	LEVEL 5 - MEZZANINE OFFICE	P2
SK01.06	LEVEL 6 - ROOF	P2
SK02.01	SECTIONS	P2
SK03.01	WINTER SOLSTICE	P2
SK03.02	EQUINOX	P2
SK05.01	GFA PLANS	P4
SK05.02	NLA PLANS	P4

FIGURE 6

PLANNING PROPOSAL

Revisions
P1 20.12.22 FOR CLIENT REVIEW DM
P2 31.03.23 FOR CLIENT REVIEW DM

31/03/2023 11:57:16 AM

Project: **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing: **DEVELOPMENT SUMMARY**

Project No: **214205** Date: **20.12.22** Author: **DM** Scale: @ A1

Drawing No.: **SK00.00 P2**

Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman

Brisbane, Melbourne, Sydney
www.rothelowman.com.au

FIGURE 7

NEWBRIDGE ROAD

TITLE BOUNDARY 28.573m

TITLE BOUNDARY 84.237m

TITLE BOUNDARY 48.671m

TITLE BOUNDARY 98.02m

ACCESS ROAD

DRAINAGE CHANNEL (NOMINAL LOCATION) BY OTHERS

DESIGNED MAINTANENCE TRACK

EXIST. GABION WALL

RAIN GARDEN

BUILDING OVER

BOOM GATE

BUILDING OVER

BOOM GATE

TRUCK EXIT

6000

PUBLIC THROUGH SITE LINK

UP

PUBLIC LIFT

RL 2.500

BUILDING OVER

RL 2.500

1:10

RL 2.700

1:8

BENCHED GROUND LEVEL

RL 3.400

19.5m ARCTIC

19.5m ARCTIC

RL 2.500

DOCK LEVELERS

LOADING DOCK
104.9 m²

RL 3.400

GOODS LIFT
14.3 m²

GOODS LIFT
14.7 m²

3500

3500

4600

PLANT
83.0 m²

TITLE BOUNDARY 83.417m

TITLE BOUNDARY 83.417m

FLOWER POWER FUTURE DEVELOPMENT

TITLE BOUNDARY 15.335m

TITLE BOUNDARY 151.525m

2

1

PLANNING PROPOSAL

Revisions			
P2	20.06.19	FOR CLIENT REVIEW	JLi
P3	19.08.19	FOR CLIENT REVIEW	JLi
P4	28.08.19	FOR CLIENT REVIEW	JLi
P5	20.12.22	FOR CLIENT REVIEW	DM
P6	31.03.23	FOR CLIENT REVIEW	DM

31/03/2023 11:57:31 AM

Project: **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing: **LEVEL 1 - DOCK**

Project No: **214205**

Date: **20.12.22**

Author: **DM**

Scale: @ A1 **1 : 250**

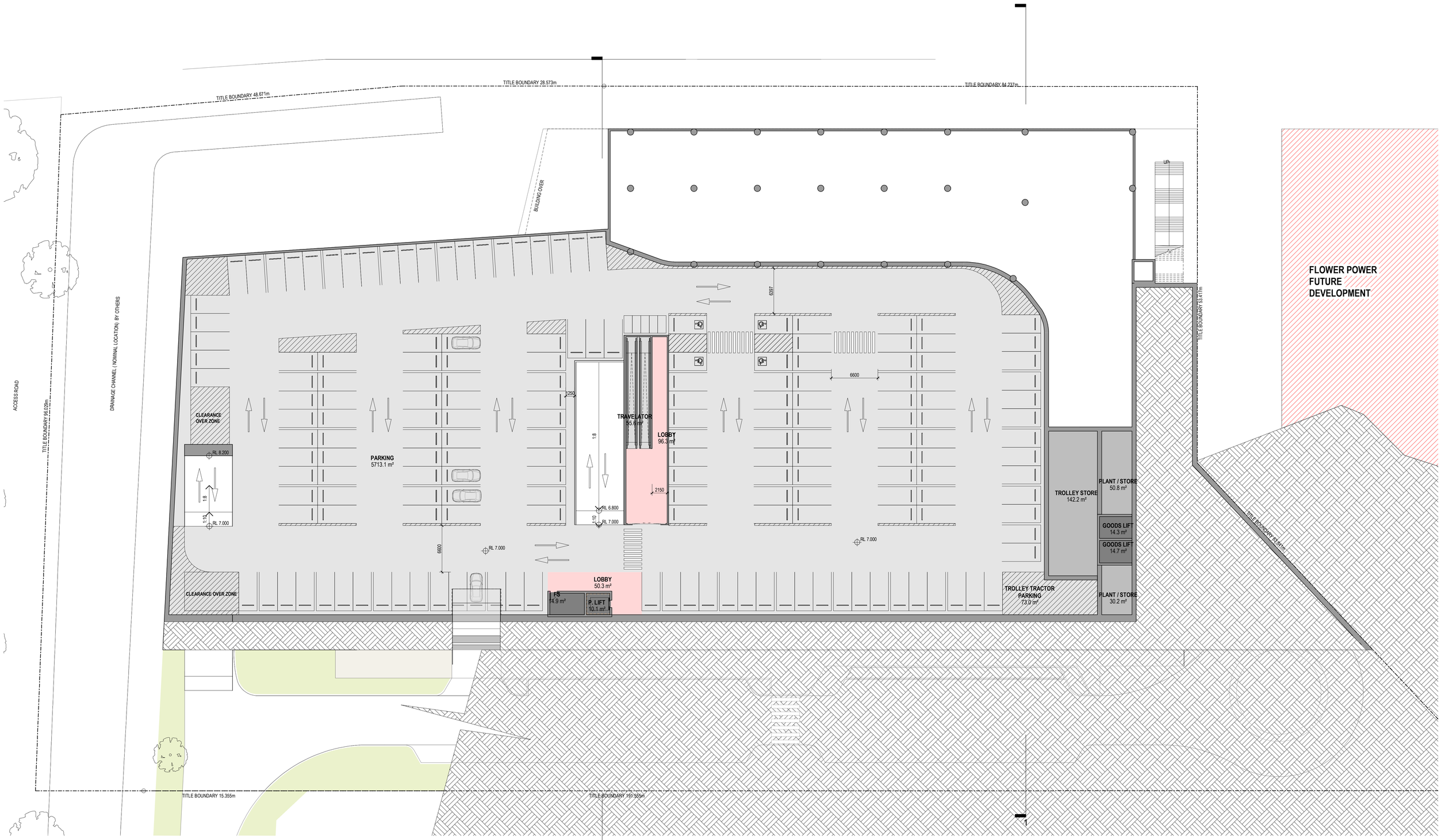
Drawing No.: **SK01.01 P6**

Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman

Brisbane, Melbourne, Sydney
www.rothelowman.com.au

FIGURE 8



PLANNING PROPOSAL

Revisions			
P2	20.06.19	FOR CLIENT REVIEW	JLi
P3	19.08.19	FOR CLIENT REVIEW	JLi
P4	28.08.19	FOR CLIENT REVIEW	JLi
P5	20.12.22	FOR CLIENT REVIEW	DM
P6	31.03.23	FOR CLIENT REVIEW	DM

31/03/2023 11:57:35 AM

Project: **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

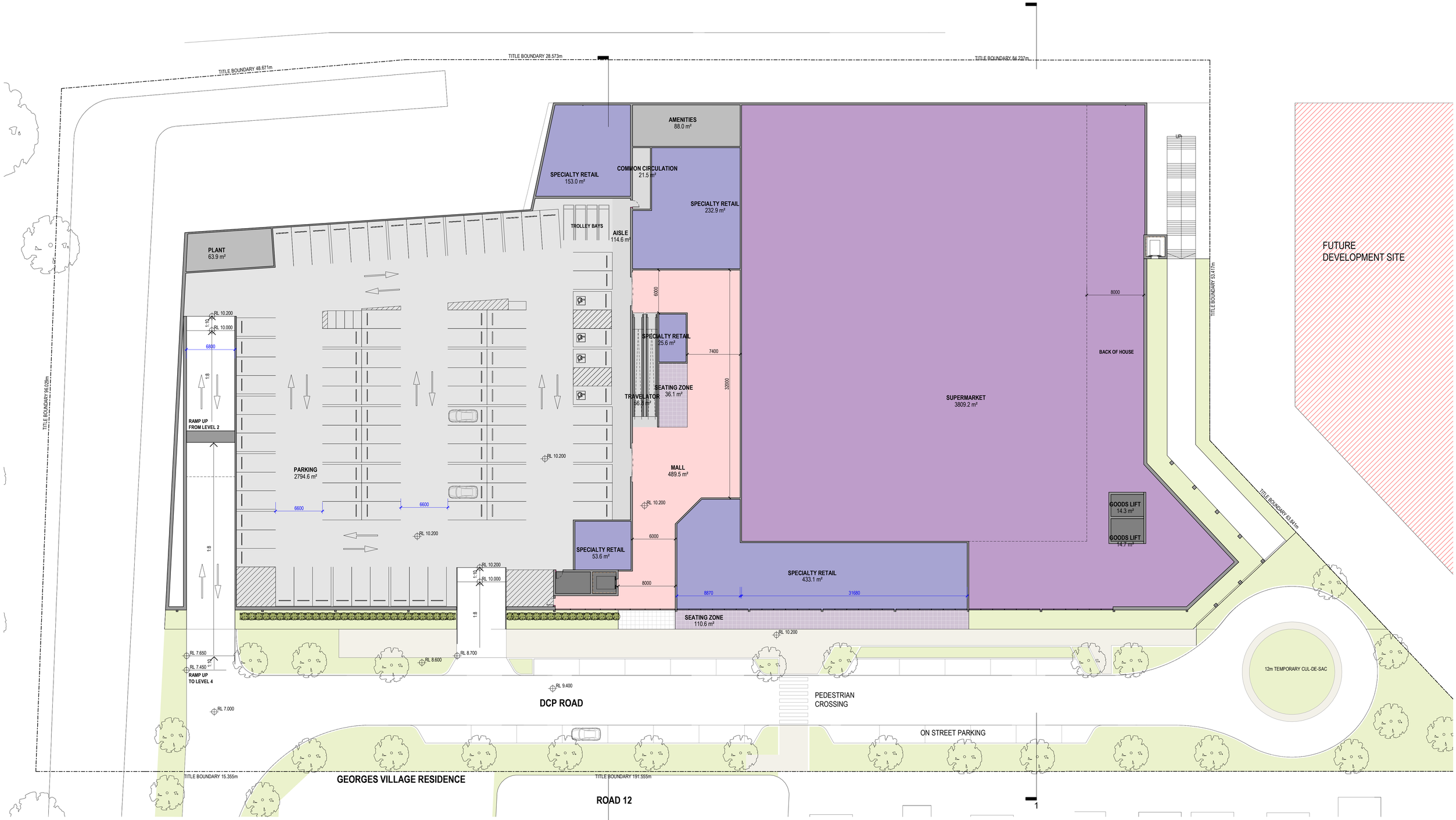
Drawing: **LEVEL 2 - CARPARK**
Project No: **214205**
Date: **20.12.22**
Author: **DM**
Scale: @ A1 **1 : 250**
Drawing No.: **SK01.02 P6**

Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman

Brisbane, Melbourne, Sydney
www.rothelowman.com.au

FIGURE 9



PLANNING PROPOSAL

Revisions			
P2	20.06.19	FOR CLIENT REVIEW	JLi
P3	19.08.19	FOR CLIENT REVIEW	JLi
P4	28.08.19	FOR CLIENT REVIEW	JLi
P5	20.12.22	FOR CLIENT REVIEW	DM
P6	31.03.23	FOR CLIENT REVIEW	DM

31/03/2023 11:57:42 AM

Project: **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing: **LEVEL 3 - RETAIL**

Project No: **214205**

Date: **20.12.22**

Author: **DM**

Scale: @ A1 **1 : 250**

Drawing No.: **SK01.03 P6**

Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman

Brisbane, Melbourne, Sydney
www.rothelowman.com.au

FIGURE 10



PLANNING PROPOSAL

Revisions

P1	20.12.22	FOR CLIENT REVIEW	DM
P2	31.03.23	FOR CLIENT REVIEW	DM

31/03/2023 11:57:48 AM

Project: **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing: **LEVEL 4 - LIGHT INDUSTRIAL**

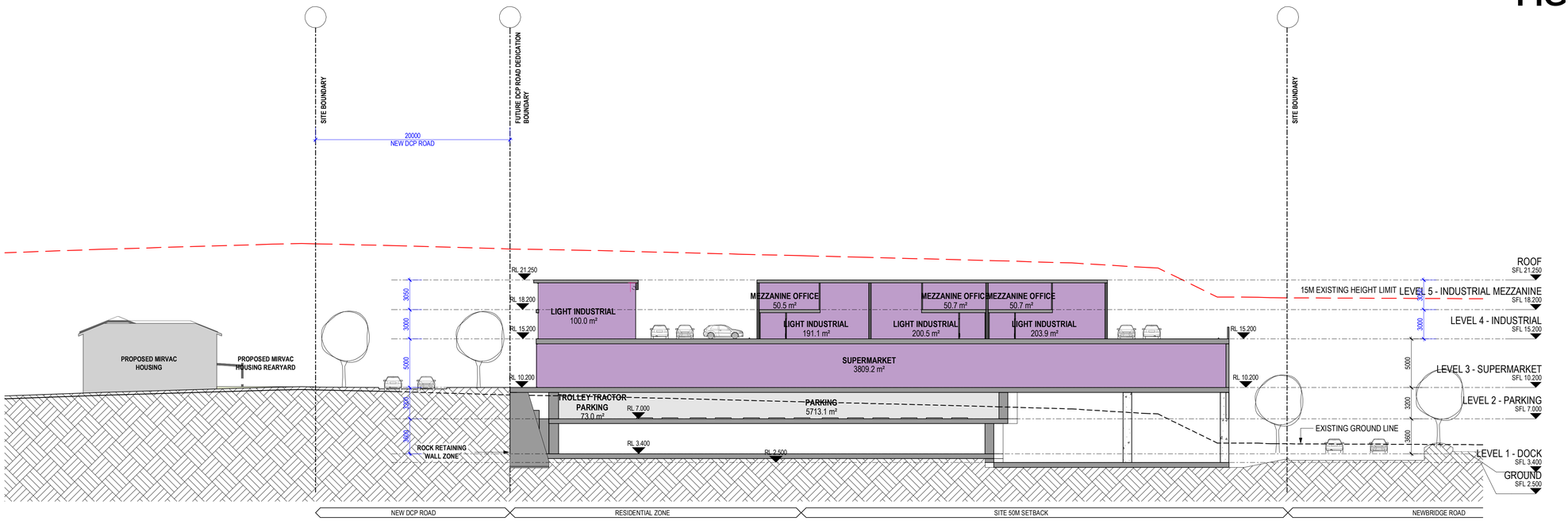
Project No: **214205** Date: **20.12.22** Author: **DM** Scale: @ A1 **1 : 250** Drawing No.: **SK01.04 P2**

Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

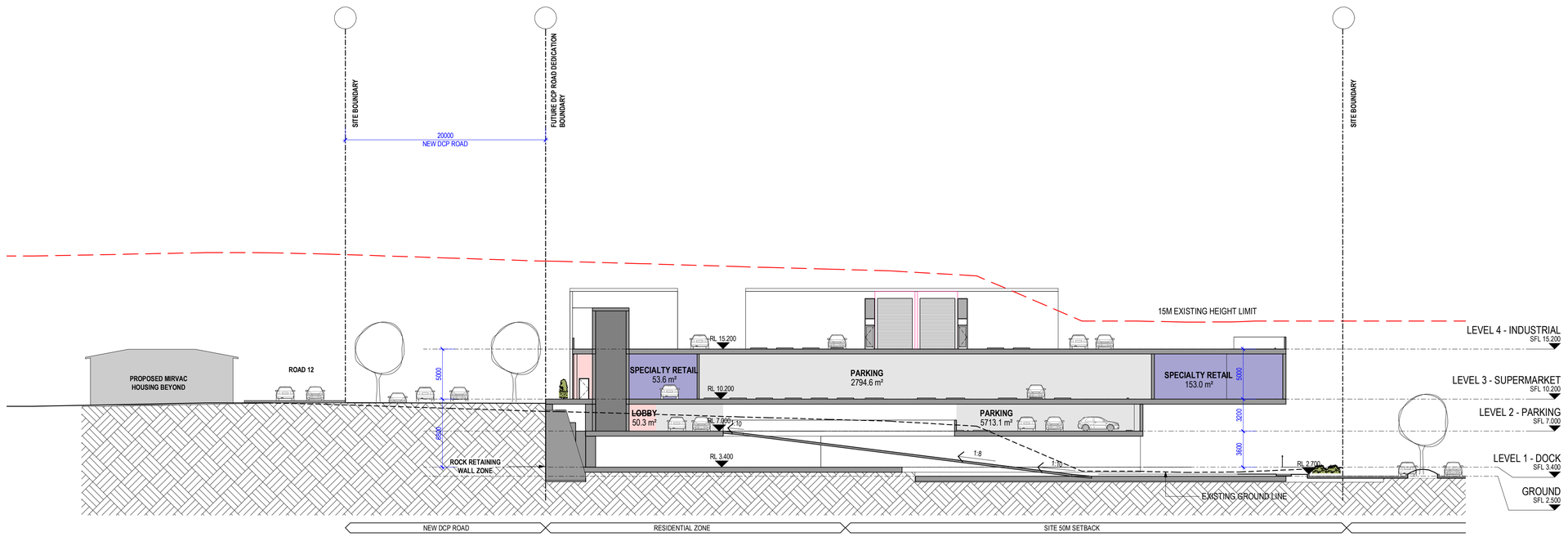
rothelowman

Brisbane, Melbourne, Sydney
www.rothelowman.com.au

FIGURE 11



SECTION_1



SECTION_2

PLANNING PROPOSAL

Revisions			
P1	20.12.22	FOR CLIENT REVIEW	DM
P2	31.03.23	FOR CLIENT REVIEW	DM

31/03/2023 11:57:59 AM

Project: **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing: **SECTIONS**

Project No: **214205**

Date: **20.12.22**

Author: **DM**

Scale: @ A1 **1 : 250**

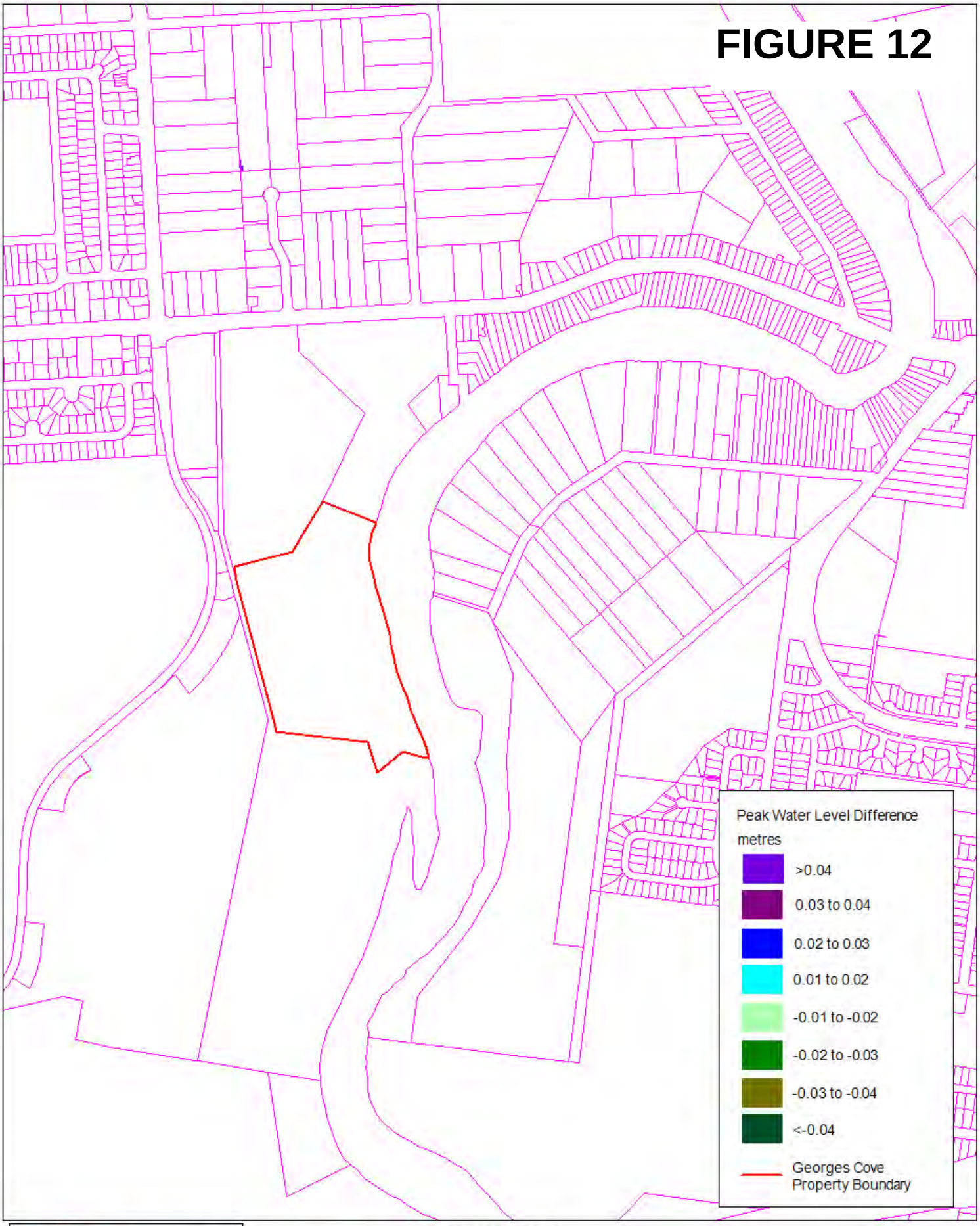
Drawing No.: **SK02.01 P2**

Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman

Brisbane, Melbourne, Sydney
www.rothelowman.com.au

FIGURE 12



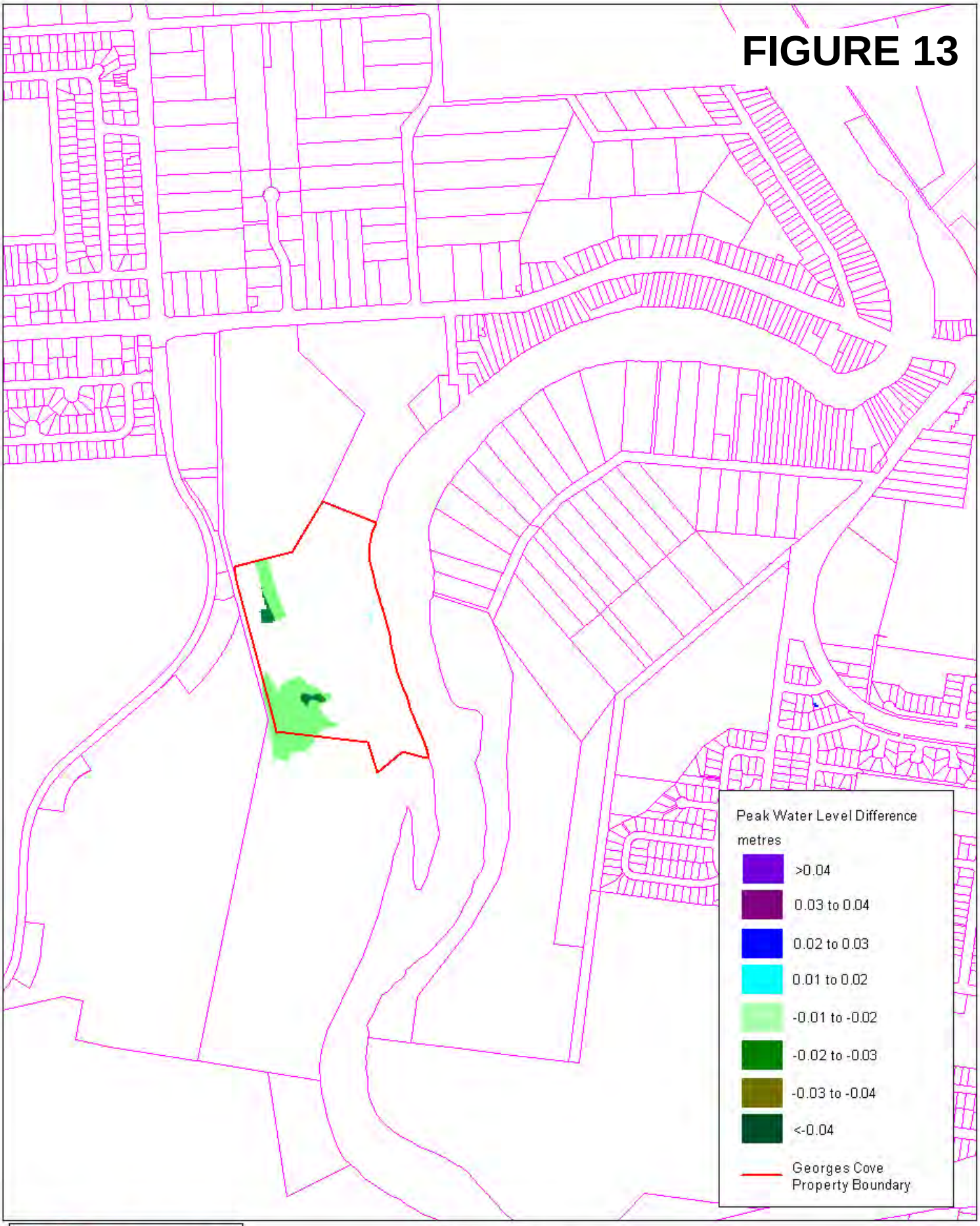
Cardno

Georges Cove
Flood Impact Assessment

Figure
20 year ARI
Peak Water Level Difference
Design (Jan18) Less Approved Design

NA49913037
January 2018

FIGURE 13



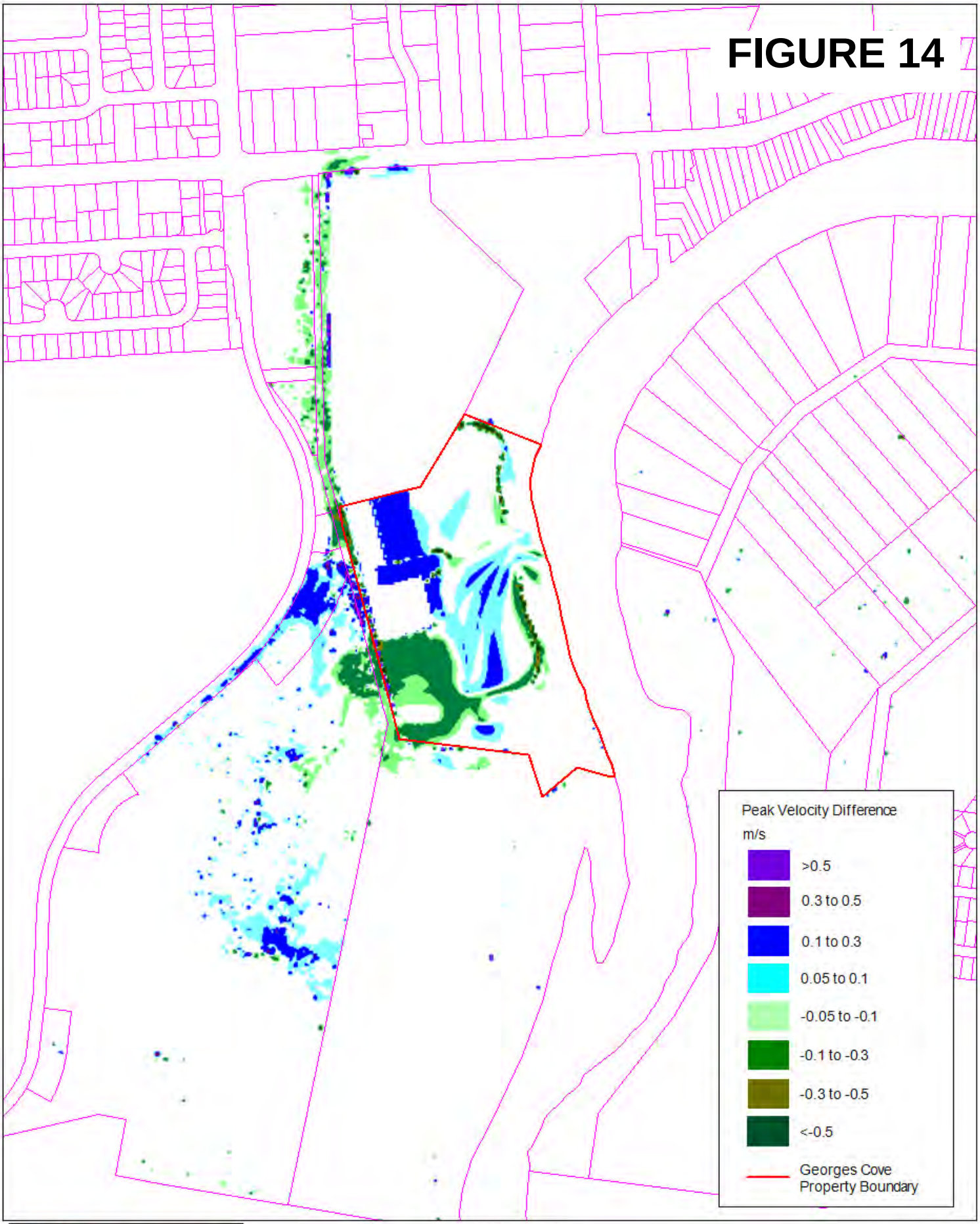
Cardno

Georges Cove
Flood Impact Assessment

Figure
100 year ARI
Peak Water Level Difference
Design (Jan18) Less Approved Design

NA49913037
January 2018

FIGURE 14



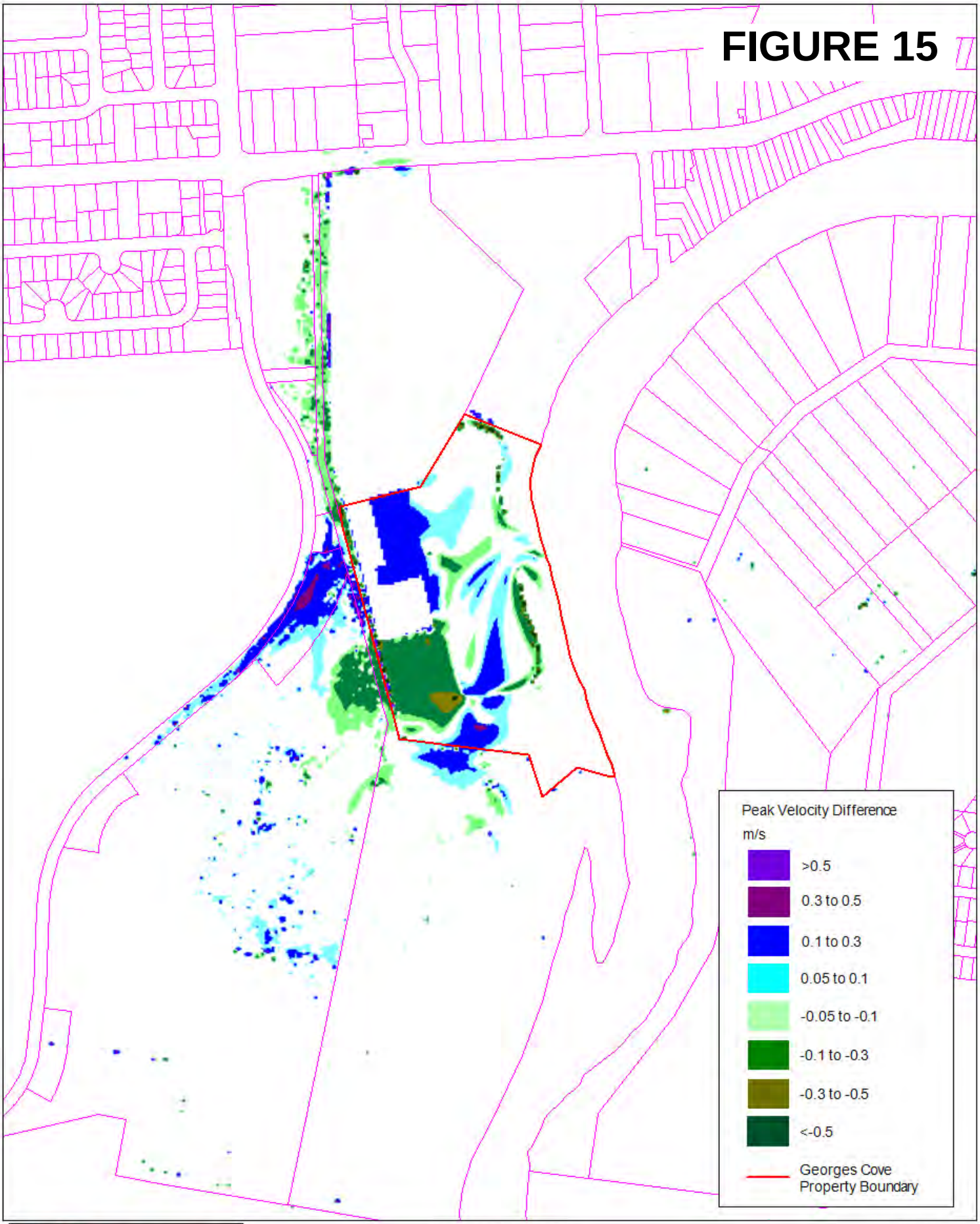
Cardno

Georges Cove
Flood Impact Assessment

Figure
20 year ARI
Peak Velocity Difference
Design (Jan18) Less Approved Design

NA49913037
January 2018

FIGURE 15



Cardno

Georges Cove
Flood Impact Assessment

Figure
100 year ARI
Peak Velocity Difference
Design (Jan18) Less Approved Design

NA49913037
January 2018

FIGURE 16

LEGEND

DENOTES EMERGENCY FLOOD EVACUATION ROUTE & DIRECTION

9.14 X — DENOTES PROPOSED DESIGN LEVEL

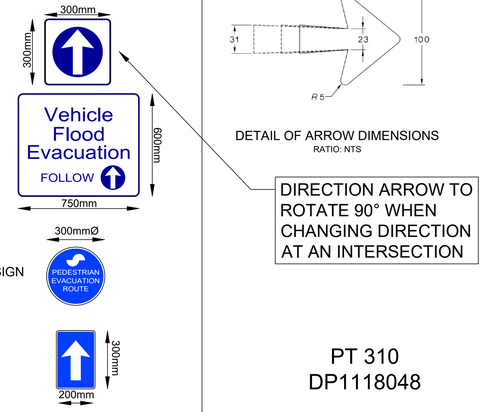
DENOTES VEHICULAR FLOOD EVACUATION ROUTE

VEHICULAR FLOOD EVACUATION DIRECTIONAL SIGN & DIRECTION OF VIEWING (160mm LONG ARROW)

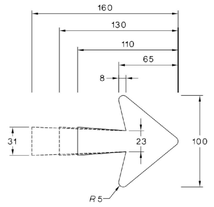
VEHICULAR FLOOD EVACUATION START SIGN & DIRECTION OF VIEWING

PEDESTRIAN FLOOD EVACUATION INFORMATION SIGN (SIGN TO BE PLACED ABOVE DIRECTIONAL SIGN)

PEDESTRIAN FLOOD EVACUATION DIRECTIONAL SIGN & DIRECTION OF VIEWING (160mm LONG ARROW)



DIRECTION ARROW TO ROTATE 90° WHEN CHANGING DIRECTION AT AN INTERSECTION



DETAIL OF ARROW DIMENSIONS
RATIO: NTS

PT 310
DP1118048

PEDESTRIAN BRIDGE

PAINE PARK

ROAD NO. 1

13

12

PT1

MAINSTAY STREET

11

10

9

2
DP602988
(FLOWER POWER)

N

X 7.30

15

14

MULLOWAY LANE

MAINSTAY STREET

ANGLER AVENUE

SPINNAKER DRIVE

PT 19

17

2

KETCH LANE

5

STREET

6

SHORELINE ROAD

MAINSTAY STREET

X 10.25

X 11.53

X 11.53

11.04 X

X 10.35

X 10.04

PT1

MAST PLACE

X 8.46

PROMONTORY WAY

X 11.46

X 10.48

X 9.47

X 8.86

X 8.60

X 8.37

X 8.16

X 8.00

X 7.12

ROAD

HORIZON

CIRCUIT

BRICKMAKERS DRIVE

HORIZON CIRCUIT

MARBLE

PT 310
DP1118048

PT 19

SPINNAKER DRIVE

3

MAINSTAY

8

X 6.39

18

LOWEST LEVEL IN THE SOUTHERN PORTION OF THE SITE

X 7.20

X 7.08

4

7

X 9.01

TRAVERS STREET

NUVO STREET

X 8.33

X 7.63

SHORELINE ROAD

16

LOT 3 (Stage 1)
(FUTURE MARINA)

MADDECKS AVENUE

DIRECTION ARROW TO ROTATE 90° WHEN CHANGING DIRECTION AT AN INTERSECTION

PT 200
DP1117280

PRELIMINARY PRINT
NOT FOR CONSTRUCTION

© COPYRIGHT All rights reserved
Beveridge Williams & Co. Pty Ltd has granted a licence to the principle to use this document for its intended purpose. No unauthorised copying is permitted

REV	DESCRIPTION	DATE	DRN.	APP.
E	SIGNAGE AMENDED	24-08-2022	J.O.	S.G.
D	SIGNAGE ADDED	10-08-2022	J.O.	S.G.
C	REISSUED WITH MINOR NOTES AMENDMENTS	07-03-2020	S.G.	S.G.
B	ISSUED FOR INFORMATION	06-03-2020	S.G.	S.G.
A	ISSUED FOR INFORMATION	26-08-2020	S.G.	S.G.
G	AMENDED SIGN LOCATIONS	08-09-2022	S.G.	S.G.
F	ISSUED FOR INFORMATION	31-08-2022	S.G.	S.G.

Client:
MIRVAC HOMES
(NSW) PTY LTD.

0 16 32 48 64
SCALE 1:800 AT A1 SIZE

Designed S.GRAY 26-03-2020
Drawn S.GRAY
Approved -
Date -
PS Number

Beveridge Williams
32 Iolanthe Street
Campbelltown NSW 2560
ph: 02 4625 5055
www.beveridgewilliams.com.au

Project Details: MOOREBANK COVE
NEWBRIDGE ROAD, MOOREBANK

Drawing Title: FLOOD EMERGENCY EVACUATION ROUTE

Sheet 1 of 1
Scale 1:800 @ A1

Project Ref	Stage No	Drawing No	Rev
14005	E45	350	E

S:\JOBS\14\14005\14005 EMW\ENG\CAD\E45 - FLOOD EVAC\14005E45-FLOOD EMERGENCY.dwg

ATTACHMENT A
Tooker and Associates Review

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

TOOKER+ ASSOCIATES

Liverpool City Council
Attn: Cameron Jewell
ostel@liverpool.nsw.gov.au

4 February 2022

JewellC@liverpool.nsw.gov.au

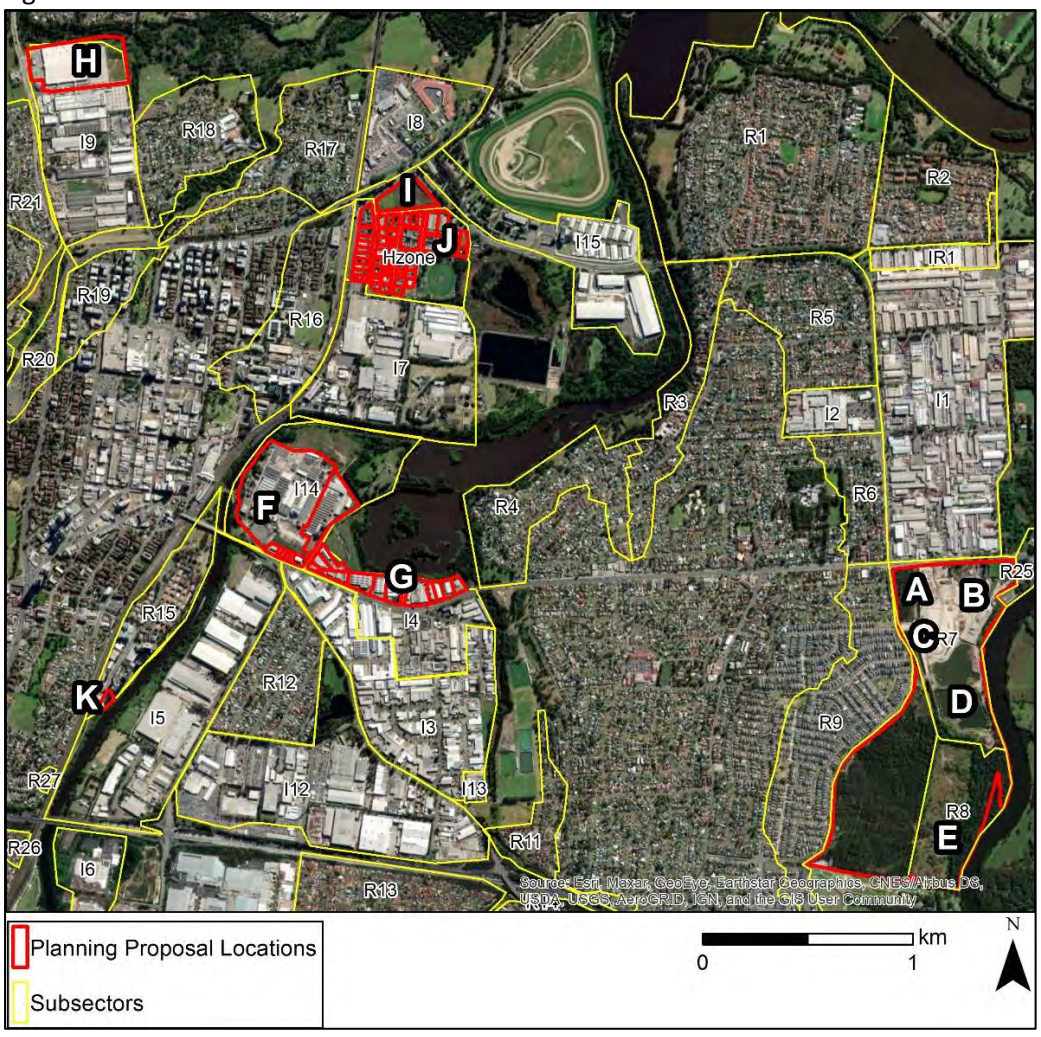
Dear Sir,

Re: Review of Georges River Evacuation Modelling, Flood Evacuation Analysis Draft, December 2021, Molino Stewart – Mirvac Review

With reference to your email dated 17 December 2021, we are pleased to provide an initial response to the above Molino Stewart report on behalf of Mirvac who are the developer for sites C and D in the Moorebank East precinct (see Figure 1).

This report has been created to bring attention to the assumptions made in the Molino Stewart Report and model that are either incorrect, incorrectly applied or create an unrealistically conservative outcome when combined with other overly conservative assumptions in the same model that ultimately impacts the development capacity for the Moorebank East area.

Figure 1



m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

1. Site Description

The Mirvac sites C and D are located in region R7 in Figure 13 of the Molino Stewart report.

The sites are generally known as follows:

- Site C – Mirvac residential development referred to as Moorebank Cove in the Molino Stewart report (under construction {DA-24/2017});
- Site D – Mirvac marina development (marina approved (DA-611/2018) with Mirvac Planning Proposal for residential development on top (RZ-5/2018) – well supported by Council).

The proposed development details included in the Molino Stewart report are summarised in the following Table 1.

Table 1. Proposed Moorebank East Developments

Site	Development Type	Commercial Space (ha)	Employees	Dwellings	
				Houses	Apartments
Site A: Tanlane P/L(Benedict)	B6 Mixed use	0.89	857	0	126
Site B: Flower Power	Mixed use and commercial strip	2.32	361	0	602
Site C: Mirvac Moorebank Cove	Low density residential	0	N/A	179	0
Site D: Mirvac Georges Cove Marina	Apartments Restaurants Marina services	1	N/A	21	374
Site E: EQ Riverside	Apartments and commercial/ retail	0.18	207	0	1,500

2. Approved Evacuation Strategy

The evacuation strategy approved by Council for the three Benedict/Mirvac sites A, C and D is as follows:

a. Car evacuation;
b. Pedestrian evacuation in case of failed car evacuation;
c. Shelter in Place above the PMF.

An overhead pedestrian bridge over Brickmakers Drive has been approved by Council as part of the Site C (Mirvac Resi) development (under DA-24/2017) which has capacity and access for all the Benedict/Mirvac developments including Sites A, C and D. This provides pedestrian access to land above the PMF level for evacuation if the vehicle evacuation fails. The developments all have many floor levels above the PMF level suitable for the tertiary evacuation option (shelter in place) if the first two strategies fail.

The Moorebank Cove (Site C) approval under DA-24/2017 also includes a Flood Emergency Response Plan (FERP) that outlines the flood evacuation strategy and hierarchy noted above, notes the

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

evacuation routes and flood signage, and notes the role of the Community Manager (under the Community Title structure) in flood evacuation training and evacuation assistance.

A similar FERP would be formulated for the developments on Sites A and D that would also be managed through Strata and Building managers.

So, all the Benedict/Mirvac sites within the Moorebank East precinct have legitimate flood evacuation strategies which conform with the SES guidelines.

3. Response to Molino Stewart Draft Evacuation Strategy

The consideration of the Mirvac Planning Proposal for site D (Marina) is well advanced and supported by Council compared to other sites (Flower Power and EQ Riverside) in the Moorebank East precinct. The Mirvac Residential development on Site C has already been approved under DA 24/2017 and is well under construction. These sites add a comparatively small increase in vehicle numbers compared to the proposed Flower Power and EQ sites in the precinct.

Most importantly, these sites (Sites A, C & D) have a multi-faceted evacuation strategy which conform to the SES guidelines.

Molino Stewart makes a reference in Section 7.2.5 to the need for a pedestrian evacuation route in case vehicular evacuation failed when referring to the Moorebank East precinct. We note that this route has already been approved for the Benedict/Mirvac sites by Council under DA-24/2017 (refer below) and is soon to be under construction.

3.1 Development in Areas C and D should be included in Scenario 2 (Infill development)

The freestanding residential development in Area C was rezoned in 2008 and the DA was approved via DA-24/2017 in 2020. The marina development on Area D is an allowable development for the existing zoning and a DA was recently approved (DA-611/2018). As such, these developments should be included in Scenario 2 which includes infill development between 2016 and 2036. These developments offer the three levels of emergency response to the PMF flood as required by SES. The primary response is evacuation by car, the secondary response is an approved pedestrian access route to flood free land and the third response is to shelter in place at levels above the PMF flood. The development in these areas has been approved by Council and should not be part of Scenario 3 which examines existing Planning Proposals.

3.2 Unrealistically conservative, cumulative assumptions adopted in evacuation modelling

a. Road capacities

The maximum lane capacity adopted in the Molino Stewart (MS) modelling traffic evacuation model should not be 600cars/hr/lane but the normal rate of 1200 to 1400cars/hr/lane (say 1400cars/hr/lane).

The SES recommend in their simple evacuation model (TEM) a maximum car capacity of 600cars/hr/lane. This model has no way of accommodating influences such as road congestion, merging or intersections. This rate was selected as a general rule to take account of all these influences. However, these influences vary considerably depending on the road layout and configuration and as such, is a broad generalization.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

During the early stages of the evacuation, and especially for those strata and community titled developments which will receive an early electronic evacuation warning, the local road capacities may be much higher than 600cars/hr/lane. Furthermore, the capacities of the major multi lane roads could be significantly higher than 600cars/hr/lane.

The model adopted by MS (LSM) uses traffic modelling which is able to model these influences and derive every changing road capacity specific to each site. As such, MS do not need to use the SES 600cars/hr/lane as the maximum road capacity in all circumstances because the model can assess the degree of changes in road capacity for every time step in the model. Therefore, the maximum lane capacity adopted in the MS LSM model should be 1400cars/hr/lane and the model will determine the actual capacity at every time step.

In Scenario 2, there are only 399 vehicles trapped on the Moorebank Peninsula. This could be readily solved by not limiting the maximum road capacity to 600cars/hr/lane when the model determines the maximum road capacity rate which could be as high as 1400cars/hr/lane.

b. Full capacity at work and home

The duration of the evacuation will be at least 12 hours and has a high probability it will overlap to some extent with the non work hours. Assuming full capacity of the numbers of people to be evacuated is unrealistic and requires a more realistic assessment.

Some of the possible reasons why full capacities would not occur for evacuation are:

- People are on holidays outside the area;
- Flood warnings are given in non work hours and people do not travel into the area for work;
- People who evacuate to local friends and family or to friends and family not located on selected evacuation routes;
- People on the edge of the PMF zone who do not evacuate;
- Increased use of public transport since the travel to work surveys used in the study for people travelling from areas outside; and
- Two car households only using one car for evacuation or multiple car households not using all cars for evacuation.

c. Warning times

The SES evacuation approach is that door knocking is required to initiate flood evacuation. The SES assumes that it will take 6 hours to mobilise people to undertake door knocking. This 6 hours is half the minimum warning time for the Moorebank Peninsula. This may be necessary for standalone residential areas however, for strata and community titled developments and work places, an electronic warning to the management with associated alarms could be sent instantaneously to initiate evacuation and provide at least 12 hours warning.

For every saving of 1.5 hours until evacuation is initiated, this would allow extra capacity of say an extra 900 cars at 600cars/hr/lane or extra 2100 cars at 1400cars/hr/lane. This means of evacuation initiation is unlikely to be affected by power outages as flood levels would not be anywhere near critical at that stage. This means that strata and community type developments (which have flood evacuation plans and training incorporated in their strata and community documents) could take advantage of the early capacity availability on local roads. Door knocking would still have to be done

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

for stand alone Torrens Title residences in areas outside of the Moorebank East developments impacted by the PMF.

The warning times will be longer than 12 hours for these types of developments with electronic warnings. The 12 hours warning is for floods to reach RL 4m AHD. A further 1.5hrs warning time would be available to many areas prior to flood levels reaching evacuation tripping points/levels. This could allow up to a further 2100 (at 1400/hr/lane) vehicles to evacuate in the early stages of the evacuation.

d. Rate of flood level rise

Again, the rate of flood water rise adopted is the absolute worst case which when added to all the other very conservative assumptions, you end up with a very unrealistic presentation of risk.

In Section 5.3 Applying the Life Safety Model to the Georges River in the MS study it is asserted, in part that:

> *While it is recognised that this is an extremely rare event, more frequent events could rise this quickly ….*

This is not correct. A comparison of the rate of rise of the 36 hour Extreme Flood Event (EFE) and 100 yr ARI flood is given in Figure 2 on the next page. This indicates that more frequent events are not as likely to rise at the rate of the EFE. There is a stark difference in the rate of rise for the 100 year ARI flood which takes 16 hours to achieve any similar rate of rise as for the PMF type flood as demonstrated in Figure 2 below. This would provide a significantly longer flood warning time and greatly increased capacity for evacuating vehicles from the area.

3.3 Area D – Marina and Mirvac Planning Proposal

The marina development approved recently by Council (DA-611/2018) should be included in Scenario 2 as discussed in point 3.1 above. The marina has parking for 637 vehicles to support the marina and recreational uses. The Mirvac Planning Proposal for this site (RZ-5/2018) incorporates 758 parking spaces which is an increase of only 121 vehicles on the already approved marina allowance. These extra vehicles could be accommodated in extra warning time of 12 minutes at 600/hr/lane or 5 minutes at 1400/hr/lane. This could be readily achieved given that evacuation for this development will not rely on door knocking and can be initiated electronically for this strata/commercial development.

The Mirvac Planning Proposal has very little impact on the flood evacuation capacity compared to already approved developments and could be readily included in Scenario 2 given the cumulative conservative nature of all the evacuation model assumptions. As mentioned in point 3.2a above, in Scenario 2, only 399 vehicles would be trapped on the Moorebank Peninsula. The Mirvac Area D Planning Proposal would only add a further 121 vehicles. This is a very small number given the leeway available in the very conservative assumptions in the evacuation model. These vehicles could be accounted for with a small increase in warning time and/or a small increase in road capacity.

The evacuation modelling shows that use of multiple evacuation routes significantly improves evacuation and tends to reduce interference between the two main areas of Moore Point and Moorebank Peninsula. There is also significant potential for resident evacuation in the future

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

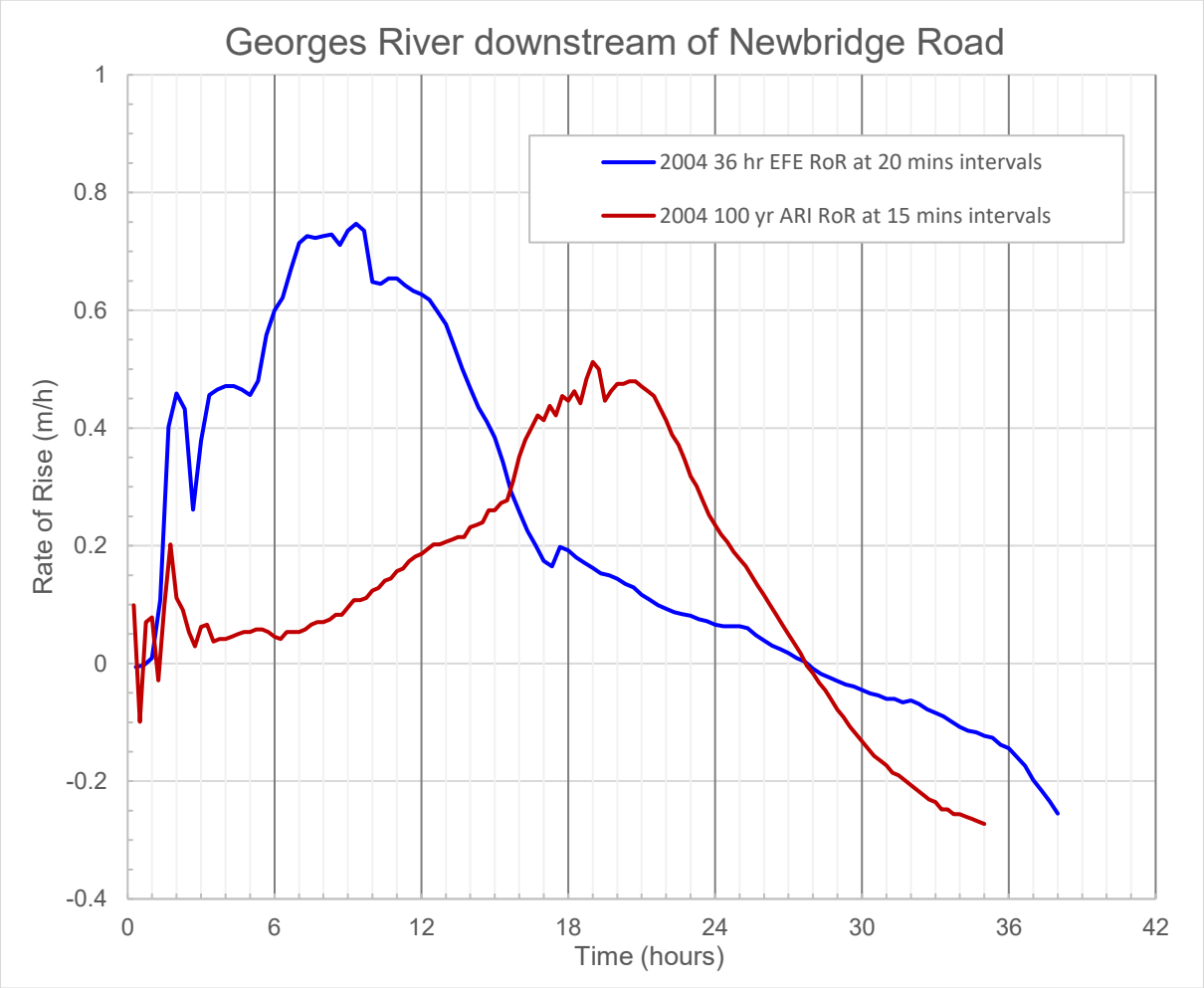


Figure 2 Rates of Rise in floodwaters downstream of Newbridge Road

Liverpool CBD as is occurring in the Parramatta CBD with increasing provision of apartments above the PMF flood levels.

3.4 Three Stages of Evacuation

The Molino Stewart report, in many locations, emphasises the SES requirement for a three stage evacuation capability. The approved developments on Areas A, C and D have these three stages of evacuation available to the residents. These three stages of evacuation would also be available for the Planning Proposal development at the Marina in Area D.

These three stages include vehicular evacuation, pedestrian evacuation and shelter in place with floor levels above the PMF level.

The sole focus of the Molino Stewart 2022 study is vehicular evacuation to undisclosed locations remote to the floodplain. This ignores the potential for a number of safe refuge areas (as noted in 4.3.1 of the MS report) at local public properties and commercial properties to provide parking for

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

vehicles and facilities to provide temporary refuge to local residents forced to evacuate. For the Moorebank East area, these possible locations around Nuwara Rd could include:

- Moorebank Library
- Moorebank Shopping Centre
- Moorebank Hotel
- Nuwurra Public School
- Moorebank High School
- Newbridge Heights Public School
- Hammonvile Public School
- St Joseph's Primary School
- St Joseph's Church

The utilization of these facilities in situations of an extreme flood (far rarer than a 100 yr ARI flood) would be expected to reduce the need for vehicular evacuation to regional refuge sites. Also, there would be those workers who live outside the local area and those residents who would still want to evacuate to friends and family living elsewhere in Sydney which would further reduce the vehicular evacuation to the regional refuge locations.

3.5 Factual Flood Information

3.5.1 Flood Gauges and warning times

In Section 4.3.5 of the MS report:

Table 7 appears to be in error. The Milperra Gauge is not in the Sutherland LGA rather it is located in Canterbury-Bankstown LGA.

Reported levels in Table 8 appear to be incorrect. The 1% AEP (100yr ARI) flood level at Milperra Gauge is around 6.0 m AHD (6.5 m gauge reading) not 9.1 m.

The MS report indicates that the flood warning time is based on flood levels reported from the Liverpool and Milperra flood gauges and if these are damaged or malfunction in a flood, then the warning time may be less than 12 hours. However, this is incorrect. The extreme flood warning is provided by BoM and they rely upon modelling of forecast rainfall and do not rely on flood gauge readings. This is why they can provide a minimum of 12 hours flood warning before there are noticeable rises in the flood level at the gauges. Damage or malfunction of flood gauges is not a potential risk to reduce the 12 hour minimum flood warning time.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

3.5.2 2020 Flood Study

The key study and information includes, in part:

- Georges River Flood Study 2020 2D TUFLOW model for flood behaviour information and flood impact probabilities

It is noted that this study is not in the public domain which precludes a review of the adopted PMF time series or any other flood related behaviour within the study area.

Given past practices, it is expected that the 2020 Georges River Flood Study has adopted the 2004 Georges River Floodplain Risk Management Study inflows which in turn were estimated in the 1991 Georges River Flood Study.

In relation to the Probable Maximum Flood, it appears that the 2022 Evacuation Modelling is relying on an Extreme Flood Estimate which is more than 30 years old and the accuracy of which has not been confirmed by assessing the PMF in accordance with current practice as outlined above.

The likely occurrence of the PMP flood recommended by ARR2019 for the Georges River based on the catchment area to East Hills is around 1 in 1,600,000 AEP. This evacuation assessment is based on a very rare event which is likely to occur once in 1.6 million years (first homo erectus occurs in Asia 1.6 million years ago) or once in 21,333 generations (75 years each).

To illustrate this in other words, the likelihood that residents and workers located within the PMF flood extent within the study area would experience a PMF, the probability of residents and workers experiencing a 1 in 100 AEP (100 yr ARI) flood in a 100 year period is 63.4%. The workers and residents and their descendants would need to reside on the floodplain for 1,600,000 years (21,333 generations based on an average generation life of 75 years) in order to have the same probability of experiencing the PMF ie. 63.2%.

The risks in terms of evacuation are further exaggerated in the Molino Stewart study due to very conservative assumptions with respect to road capacities, availability of roads, numbers of vehicles and availability of alternative refuges.

4. Conclusions

The approved developments in Areas C and D and the Mirvac Planning Proposal for Area D (marina) have been dealt with unfairly by not being included in Scenario 2. Both developments are able to comply with the SES three stage evacuation strategy and should be included in Scenario 2.

There has also been no realistic consideration of the results for the Moorebank Peninsula in that the trapping of 399 vehicles for Scenario 2 is a minor problem when you consider the worst of the worst assumptions included in the evacuation model. There could be no trapped vehicles with small variations to assumptions such as road capacities. These 399 vehicles could be accommodated in 20 minutes with a road capacity of 1400cars/lane/hr. The Mirvac Planning Proposal for Site D (marina) would only add 121 cars to the already approved number. These additional vehicles could be accommodated in just 5 minutes.

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

Models are as only as good as their assumptions and experienced flood modelling expertise needs to be applied to the results in order to assess the realistic flood risks. We need to appropriately manage risks so that the costs to society for flood evacuation is balanced with our approach to risk to life in all other areas of society. This will provide surety and the least risk during severe floods in the Georges River.

This evacuation assessment is based on a very rare event which is likely to occur once in 1.6 million years (first homo erectus occurs in Asia 1.6 million years ago) or once in 21,333 generations (75 years each) however, the risks in terms of evacuation are further exaggerated due to very conservative assumptions with respect to road capacities, availability of roads, numbers of vehicles and availability of alternative refuges.

These assumptions with respect to already approved developments and the Mirvac Planning Proposal for Site D need to be reviewed particularly in terms of road capacities and longer available flood warning times for strata/community developments so that the adoption of worst cases for all these factors does not occur because it distorts the actual risks and will place an unrealistic and unaffordable burden on development.

The MS study needs to be revised as required in this letter and further information is required to clarify the errors or mis statements in the report. Based on this study and in terms of flood risk, there is no technical reason why Council could not approve the Mirvac Planning Proposal for Site D.

It would be appreciated if Mirvac representatives could meet with Council and Molino Stewart to discuss our above concerns to find a realistic way forward for the Mirvac Planning Proposal at Site D.

Yours sincerely



Mark Tooker
Director

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

ATTACHMENT B
Risk-e Business Review

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

GEORGES COVE MARINA - MOOREBANK

MIRVAC DEVELOPMENT

Risk-e Business Consultants Pty Ltd

Table of Contents

Executive Summary *2*

Background *3*

NSW SES – Not legislated authority on flood planning development 3

NSW SES-Basing evacuation modelling on outdated or incomplete Flood Sub Plans 4

Vehicle capacity per lane during evacuation 4

Proposed Evacuation Strategy 6

Assuming full capacity of residents and/or workers requiring evacuation 8

Assuming a 100% evacuation warning compliance rate 9

Evacuation route modelling not taking into consideration local evacuation centre in Liverpool 10

Warning times 11

Conclusion *13*

Annexure – CV Dave Owens APM *14*

Executive Summary

Risk-e Business Consultants Pty Ltd was requested to review documentation that was provided to Liverpool City Council, including the Molino Stewart Flood Report and link the information to sound research and analysis to provide a more accurate picture of the proposed development that considers all aspects of the present and future development and NSW SES evacuation information.

The Reports and documents have been reviewed by Mr Dave Owens APM (CV attached) and Mr Pat Paroz APM. Mr Owens and Paroz are both subject matter experts on flooding and evacuation management. Mr Owens has been accepted by the NSW Coroners Court as a Subject Matter Expert in Emergency Management and holds two master's Degrees in this area. He has also provided numerous report and reviews on emergency management and combat agency response. Mr Owens & Paroz co-developed the current version of the Hawkesbury Nepean Valley Flood Plan on behalf of the NSW SES.

There are a number of inconsistencies within the Molino Stewart Report identified within our review that are covered in the body of the document. These have been placed together under the headings of:

- Phased approach to evacuation management
- Vehicle capacity per lane during evacuation
- Proposed Evacuation Strategy
- Assuming full capacity of residents and/or workers requiring evacuation
- Assuming a 100% evacuation warning compliance rate
- Evacuation route modelling not taking into consideration local evacuation centre in Liverpool
- Warning times

It is our recommendation, that using this information, that Mirvac Development is now in a position to write to Liverpool City Council outlining the considerable concerns with the Molino Stewart Report which is based on the assumptions provided by the NSW SES. The information provided by us should accompany the letter as a technical addendum to support Mirvac's request for development approval.

David Owens APM
Managing Director
Risk-e Business Consultants
30 June 2022

Pat Paroz APM
Senior Consultant
Risk-e Business Consultants
30 June 2022

Background

The Georges Cove Residences is a low-density Community Title development consisting of 179 Mirvac built homes, community facilities and parks. The development application for this site has been approved and homes are already under construction.

The Georges Cove Marina (Benedict) development application has been granted and allows for construction and operation of the commercial Marina which includes the approval of 637 associated car parking spaces. An alternate (Mirvac) planning approval is being pursued for the same site for a residential development of 21 homes and 374 apartments with fewer car spaces.

Liverpool City Council has approved an evacuation strategy for these sites which involves:

- Car evacuation as the primary strategy
- Pedestrian evacuation in case of failed car evacuation
- Shelter in Place above the PMF.

The staged or phased approach to evacuation conforms with the NSW SES evacuation guidelines.

An overhead pedestrian bridge over Brickmakers Drive has been approved by Liverpool City Council as part of the Georges Cove development. There is easy pedestrian access to this bridge from the Georges Cove Marina, Mirvac residential (being built) and Village developments. The bridge provides pedestrian access to land above the PMF level for evacuation if the vehicle evacuation fails, or if pedestrian evacuation is sought early in the phased approach to evacuation. We would recommend the optionality of a combination of pedestrian and vehicle evacuation in the early stages of evacuation.

Where vehicular and pedestrian options have not been taken by residents, safe refuge can be found on site as the developments **all** have many floor levels above the PMF level suitable for the tertiary evacuation option (shelter in place).

In relation to the approved car parking spaces, we make the observation that during a usually prolonged weather event that is likely to lead to a flooding emergency, it is highly unlikely that the Marina would be in operation and/or customers would be using the facility. This has not been considered in the Molino Stewart Report and should be.

NSW SES – Not legislated authority on flood planning development

Unlike the NSW Rural Fire Service in bushfires, the NSW SES is not legislated as the authority for flood planning development. Currently, the NSW SES is **providing advice** in a process where its representatives are **not subject matter experts.** The resources and expertise of the NSW SES in this area is limited as demonstrated by its inability to maintain up-to-date flood Sub Plans including the Hawkesbury-Nepean Valley Flood Plan. This demonstrated by the fact that NSW SES required an external

organisation be engaged to undertake this task (being our organisation Risk-e Business Consultants).

The NSW State Flood Plan states:

> *NSW SES will work with land use planning and consent authorities to inform and influence the consideration of the risks arising from flood, storm and tsunami, **to prevent the creation of intolerable impacts** of these hazards on the community*

NSW SES-Basing evacuation modelling on outdated or incomplete Flood Sub Plans

The evacuation modelling undertaken for the Georges Cove Marina and surrounding areas relies entirely on the 2018 Sub Plan, of which Volumes 2 and 3 were incomplete (and still remain incomplete). Volumes 2 and 3 of the Liverpool Sub Plan are important to any evacuation analysis as they contain the "triggers" for emergency response actions/evacuation. Therefore, the evacuation modelling is based on outdated data in what is a dynamic and rapidly growing area. The NSW State Flood Plan clearly articulates that it is the responsibility of the NSW SES to maintain these plans. The Molino Stewart Report acknowledges this fact, yet this has not occurred, leading to inaccurate outcomes.

Vehicle capacity per lane during evacuation

The NSW SES Timeline Evacuation Model for estimating traffic movement 'does not attempt to dynamically model traffic demand for flow rates. The purpose of the model is to produce a best estimate of how much time is expected to be needed for traffic clearance from the area being evacuated'.

The assumption used for the purposes of the Molino Stewart Report by the NSW SES is based on an average flow of 600 vehicles/lane/hour. This figure is *'derived from a **typical rural road design flow** (our emphasis) rate of 1200 vehicles/lane/hour, downrated by a factor of two to account for the adverse driving conditions such as heavy rain, darkness and driver unfamiliarity that will probably prevail in a flood.*'[1]

The roads in the vicinity of the proposed developments (Moorebank East) do not include 'typical rural' roads. Much of the roadworks used in any evacuation routes are or will be newly constructed urban roadways which link with motorways (M5 and M7) and major arterial roads such as Newbridge Road and Heathcote Road.

According to the NSW Roads and Maritime Service[2], the operational capacity for basic motorway segments on an unmanaged motorway (where all or some motorway entries are not controlled by ramp metering), is 1800 vehicles/lane/hour. This is reduced to 1640 vehicles/lane/hour to allow for the inclusion of 10% of trucks and other commercial vehicles in the traffic flow. The separated lanes of traffic on these major roads and motorways 'will also increase per-lane capacity when compared to a single

[1] *The Application of Timelines to Evacuation Planning* (2004). Steve Opper, State Planning Coordinator, NSW SES.

[2] Motorway Design Guide – *Capacity and Flow Analysis* (2017)

carriageway'[3]. The 'typical rural road design' referred to by the NSW SES and used in their modelling is highly unlikely to include divided roadways.

Austroads is the collective of the Australian and New Zealand transport agencies, representing all levels of government. The organisation provides 'high-quality, practical and impartial advice, information, tools and services to help our members to deliver efficient, reliable and safe mobility to their customers'.

Austroads[4] advises that '*peak flow capacity of a freeway with a speed limit of 100 km/h is 2300 vehicles/lane/hour and that there are a number of factors which can affect this capacity*.' These factors include:

- Road functionality
- Land width
- Terrain
- Human behaviour

The driver population can have a significant impact on traffic capacity. Local knowledge and regular use of a road network is a protective factor, whereas '*where weekend or recreation drivers are a significant portion of the traffic stream, the capacity may be reduced*'[5]. This is not the case with the development proposal.

We submit that this is particularly relevant to the NSW SES Timeline Evacuation Model, based as it is on the traffic capacity of a **rural road.** It is more likely that a rural road will have less frequent users and this may have an adverse impact on traffic capacity, thus supporting the reduction in capacity to 600 vehicles/lane/hour.

However, the same cannot be said for the road network in and around the proposed development. These roads will be used predominantly by residents and/or workers on a daily basis. They will be familiar with the roads and local traffic issues and their presence alone is highly unlikely to contribute to reduced traffic capacity.

There is a need to consider and model higher road usage during evacuations (900 vehicles per lane per hour). Currently Molino Stewart is using a blanket approach to all roads and does not consider the advanced city infrastructure that accompanies this proposed development.

It is noted that there appears to be some confusion as to the origin of the 600 vehicles/lane/hour figure. The definition used above is taken from a document prepared by Steve Opper in his role as NSW SES State Planning Coordinator[6] (February 2004). In a report dated 2011[7], the authors (all employees of the NSW SES), state that '*The figure of 600 vehicles/lane/hour was not developed by the SES. It has*

[3] VicRoads Managed Motorway Design Guide, Volume 2 Part 1, page 29.
[4] www.austroads.com.au *Austroads Traffic Analysis Concepts*. Accessed 8/6/22
[5] www.austroads.com.au *Austroads Guide to Traffic Management* – Part 3, page 36. Accessed 9/6/22
[6] *The Application of Timelines to Evacuation Planning* (2004). Steve Opper, State Planning Coordinator, NSW SES.
[7] *Timeline modelling of flood evacuation operations* (2011). Stephen Opper, Peter Cinque & Belinda Davies. NSW SES

been adopted based on similar numbers quoted in other sources such as military convoy planning.' For a factor as important as the acceptable traffic capacity for flood modelling, this matter should be clarified. There is no NSW SES Policy or peer reviewed research that support this assumption.

Proposed Evacuation Strategy

Liverpool City Council has approved an evacuation strategy for the three Benedict/Mirvac sites A, C and D. The evacuation strategy involves a multi-layered approach based on primary evacuation by vehicle (*for those residents who own a vehicle*), with a secondary option being pedestrian evacuation (via the approved pedestrian bridge which provides a safe walking route from the site to Paine Park). Additionally, the developments all have buildings with many floor levels above the PMF which will be safe for those residents who refuse to leave or decide to leave after it is too late.

This approach to an evacuation strategy is in accordance with the 2021 NSW SES Liverpool City Flood Emergency Sub Plan – Volume 1, which states, in part:

- Evacuation is the NSW SES's primary response strategy for managing the population at risk of flooding (section 5.8.1), and
- People who are reluctant or refuse to comply with any Evacuation Order will be referred to the NSW Police Force (section 5.8.4).

While **vehicular evacuation is historically** the preferred primary response to a major flood, changes over time in relation to vehicle ownership make **it essential that pedestrian evacuation is included as a phased approach to evacuation.** Phased evacuation is a strategy used in either total or partial evacuation when, due to the slow onset of a hazard or to avoid congestion on roads, affected communities are encouraged or directed to evacuate at different times[8].

We recommend that a phased approach to evacuation is adopted in these circumstances where pedestrian, vehicular and shelter in place are all considered in the modelling process.

The Molino Stewart Report (March 2022) includes the comment that '*while the NSW SES evacuation planning for the Georges River relies upon motor vehicle evacuation, there are currently thousands of people within the floodplain that do not have access to a vehicle (over 30% of dwellings in some areas).*'[9] The same report also states that '***it is emphasised that the modelling is only as good as the model's inputs and assumptions'***. This is further supported by ABS census data (2021) for the Liverpool LGA that **7.7% of the population don't own motor vehicles**, and therefore would not be able to evacuate in the manner assumed by Molino Stewart and steadfastly stipulated by the NSW SES[10]. This highlights again that due to poor assumptions provided to Molino Stewart by the NSW SES, a less than accurate report has been produced.

[8] Australian Disaster Resilience Handbook collection – Evacuation Planning (2017)
[9] Molino Stewart – Georges River Evacuation Modelling. *Flood Evacuation Analysis*. Final. March 2022.
[10] ABS census data https://www.abs.gov.au/census/find-census-data/quickstats/2021/127031523

Another *Austroads* report[11] refers to *Mobility as a Service (MaaS),* describing it as '*a shift away from personally owned modes of transportation and towards mobility solutions that are provided as an on-demand service. Examples of MaaS in recent years includes the growing popularity of Uber or Ride Sharing applications which has transformed the transport industry away from traditional taxis and reduced the need to own a car.*' This is reflected in the increasing number of households where residents do not have their own vehicles. **This highlights that the NSW SES appears to be out of touch with the realities of urban living** in a city that must/should be designed to cater for future population growth, based on the modes of transport that the growing population is adopting (alternates to vehicular transport).

The same report (page 25) also refers to 'active transport', which typically refers to walking and cycling. The report states that '*for future planning and investment decisions, it is important that active transport modes are duly considered as another element of the transport network and assessed accordingly.*' We submit that the same consideration needs to be given to active transport, particularly pedestrians, when planning for evacuations.

It is acknowledged that the NSW SES generally does not support pedestrian evacuation – but with increasing numbers of residents not owning motor vehicles, we submit that this option must necessarily be included in any suite of evacuation strategies (**phased approach to evacuation**). If the Evacuation Timeline Model is to accurately include relevant factors, then the likelihood of pedestrian evacuation must be included as a factor.

'Shelter in Place' is not supported by the NSW SES **as a primary evacuation strategy**. However, given all the variables involved in the evacuation process, **the most notable being human behaviour,** the capacity for people to seek refuge in appropriately designed and constructed buildings with provision of adequate space above the PMF, is becoming increasingly relevant.

A Victorian SES submission to an Inquiry into Flood Mitigation Infrastructure in Victoria (2011) stated, in part, 'Recent work by NSW and Victoria SES's (*Community Safety Decision Making in Flash Flood Environments* – Presented at FMA Conference Tamworth 2011) has produced a draft evidence-based guideline to assist planners and incident controllers to make appropriate planning and operational decisions for flash flood environments. This guideline recognizes evacuation as a primary strategy where possible, however also examines the safety of building occupants if they become trapped by fast rising flood waters and recommends that if such cases arise building occupants should seek shelter in the highest section of their building and if necessary, call '000' if emergency rescue is required'.

The Australasian Fire and Emergency Service Authorities Council Limited, developed a guideline for the Emergency Planning and Response to Protect Life in Flash Flood Events (2018). This guideline was developed based on research carried out by NSW

[11] Austroads – *Management of Traffic Modelling Processes and Applications*, page 24. (2021)

SES that investigated risk to life factors in flash flood environments, and operational experience.

The guideline states, in part, '*Because of the rapid onset of flash flooding and associated high-velocity floodwaters, up to* ***75% of flash flood deaths occur while people are outside buildings attempting to leave or return****, and directly exposed to floodwater. This suggests that if evacuation has not occurred prior to the arrival of floodwater, taking refuge inside a building may generally be safer than trying to escape by entering the floodwater.*'

The above advice is reflected in a message on the NSW SES website:

'*When flash flooding is likely, leaving low-lying homes and businesses (evacuation) well before flash flooding begins is the best action to take, but only if it is safe to do so. If you are trapped by rising floodwater, seek refuge in the highest part of a sturdy building.'*

While this advice refers to 'flash flooding' (defined in Australia as flooding occurring within six hours of heavy rainfall that causes it), we submit that it supports the inclusion of residents sheltering in place as a legitimate option in support of the primary strategies of vehicle and/or pedestrian evacuation.

The applicant's proposal does not suggest that sheltering in place be the primary flood emergency response. Rather, it is a final option available to persons where both vehicular and pedestrian evacuation options have failed or not been attempted. However, if done correctly it is a safe option that needs to be considered and factored into any phased evacuation model.

It is also highlighted that within the Parramatta City CBD, Shelter in Place has been accepted as an evacuation strategy by the NSW SES and Parramatta City Council.

Assuming full capacity of residents and/or workers requiring evacuation

The 2016 Census (2021 Census data not available at time of writing this report) indicates that just over 90% of the residents of the Moorebank suburb travel to work by vehicle (as driver or passenger 76.6%) or public transport (13.8%). The 2011 Census indicates that approximately 80% of Moorebank residents travelled to work.

In the event of a flood warning, it is highly likely that many of these persons would already be away from their residence and their evacuation would therefore not need to be included in terms of traffic capacity.

The 2021 Census also revealed that 4.2% of dwellings in the suburb of Moorebank were unoccupied on the night the census was conducted. The 2016 Census revealed that 5.2% of dwellings were unoccupied[12].

[12] ABS data https://www.abs.gov.au/census/find-census-data/quickstats/2021/127031523

The proportion of unoccupied dwellings (4.7% on average across the 2021 and 2016 Census data) therefore, should be factored into any evacuation modelling. Molino Stewart did not do this.

Further, given the large proportion of residents who travel to work by vehicle or public transport, it is likely that many of these people will be away from their residence when/if an evacuation warning is delivered and the vehicle cannot be used for the purposes of evacuation as stipulated by the NSW SES.

Assuming a 100% evacuation warning compliance rate

While acknowledging the NSW SES planning for the evacuation of all flood affected residents, evidence from operational responses clearly indicate that a 100% compliance rate is extremely unlikely.

The March 2022 Molino Stewart report (page 74), referring to post-flood surveys undertaken for the NSW and Victorian SES, suggest that the '*vast majority of residents do not evacuate at all when ordered to do so.* ***Most would probably await the arrival of floodwaters at their doorstep before leaving*** *and then it would be too late for vehicular evacuation and, for those who get isolated by floodwaters, too late for pedestrian evacuation'*.

Elsewhere in the same report (page 33), reference is made to research which shows:

- Less than 25% of people evacuate when told to do so
- About 10-20% of people say they will not evacuate under any circumstances.

A blanket policy of evacuation of all buildings is not feasible or realistic. Experience shows that residents are unwilling to evacuate even when instructed to do so. This is the position put in a report titled, *Update of Parramatta Floodplain Risk Management Plans* (*in draft*), where Molino Stewart state:

a) *Residents have demonstrated an unwillingness to evacuate when orders have been given to evacuate in floods throughout Australia in recent years, so it may be especially difficult to get people to leave an elevated dwelling in a high rise building on foot in torrential rain.*
b) *Residents will tend to remain in their dwellings for several hours or more even if they are without services such as electricity.*

In a paper[13] prepared for the Australian and New Zealand Disaster and Emergency Management Conference (2014), the authors wrote, in relation to the Flood Evacuation Timeline Model, that '*the guideline for the use of the FETM tool makes it clear that some, or all, of the evacuees may be unable, or unwilling to evacuate by motor vehicle even when the modelling indicates that everyone should be able to evacuate.*' One of the authors was S. Molino from Molino Stewart Pty Ltd and another was P. Cinque from the NSW SES.

[13] Are There Better Ways to Quantify Flood Risk to Life? by S Molino; M Davison; A Tagg; and P Cinque

Newgate Research[14] indicates that up to 50% of those evacuated or who reside within the evacuated area will attempt to return during the evacuation period. Therefore, it follows that even if a proportion of the at-risk population can be "evacuated", up to half of that evacuated population will seek to return to their dwellings during the flood, thereby placing them at increased risk.

The assumption imposed on Molino Stewart (we believe by the NSW SES) that shelter-in-place is an unacceptable emergency response in a flood is flawed where that shelter comprises habitable areas located above the predicted peak level of the PMF and where the residents of those premises would be isolated for less than 2 days. **There is no formal government policy** that states that shelter in place is not a viable or acceptable mode of emergency response in floods.

As previously stated, **evacuation needs to be viewed as a scalable activity** which can be **partial, phased, involve self-evacuation and shelter in place.** We contend that the Molino Stewart report ignores valid opportunities for phased evacuation by pedestrian/foot to transport hubs, as well as the feasibility of shelter in place.

While the proposed and approved Benedict/Mirvac development sites provide safe pedestrian access for evacuation if required, the evidence contained in the report by Molino Stewart clearly supports the position that a 100% compliance rate with evacuation warnings is unrealistic.

As mentioned earlier in this report, the 2021 NSW SES Liverpool City Flood Emergency Sub Plan includes the strategy that '*people who are reluctant or refuse to comply with any Evacuation Order will be referred to the NSW Police Force'*.

We submit that this is an acknowledgement by the NSW SES of the very real scenario where a proportion of residents will refuse to leave even when directed to do so. As demonstrated in the recent Covid 19 response, many residents in these areas will also not open their doors to a uniformed person, due to their past interactions or experiences in the country that they have come from. Therefore, you will never achieve 100% evacuation compliance as sought by the NSW SES. It is clearly an unrealistic assumption as it disregards known human behaviour.

Evacuation route modelling not taking into consideration local evacuation centre in Liverpool

For the purpose of the modelling, it has been assumed that all residential evacuees will head north on the M7 towards the M4 and the Homebush Evacuation Centre. The Molino Stewart March 2022 report, (page 75) provides contradictory statements in relation to this assumption. The report states '*It is noted that in reality, most people will make their own accommodation arrangements with only the residual travelling all the way to evacuation centre/s'*, but in the next paragraph states '*it is reasonable to assume that most residential traffic will travel north on the M7*' (towards Homebush).

[14] Newgate Research (June 2018) *Flood Evacuation Social Research*

This assumption fails to take into consideration the establishment, when necessary, of a Flood Evacuation Centre in Liverpool. During flooding in April 2022, an evacuation centre was established at the Whitlam Leisure Centre, 90 Memorial Avenue, Liverpool.

While evidence[15] shows that most affected residents will make their own arrangements to stay with family, friends or at alternative accommodation outside of flood affected areas, the provision of an evacuation centre in nearby Liverpool is a far more attractive proposal for those seeking refuge than a lengthy trip to the larger evacuation centre at Homebush. This would have an immediate impact on the volume of traffic travelling north along the M7 towards the M4. The Newgate Research indicated that only 17% would travel to designated evacuation centres and only 7% would use the M7 to get to safety.

The recent flood experience in 2022, where evacuation orders were given to nearly 500,000 residents in the Hawkesbury Nepean Valley/Georges River area, identified that a Mass Care Facility at Homebush was not opened. Instead, localised evacuation centres as described above were opened and managed.

Warning times

In a presentation at the First International Conference on Evacuation Modelling and Management[16], the authors (all then employees of NSW SES) state '*the modelling has guided the development of a strategic flood response plan for the Hawkesbury-Nepean Valley'* and '***the modelling showed that flood evacuation capability as it stood in 1997, was seriously deficient in terms of road traffic carrying capacity***.' We submit there are two significant issues identified in these comments – **the model was developed in 1997, and for an area of NSW that was then very much a rural location and massive Government investment in the region since, has significantly improved its road and transport infrastructure.**

The NSW SES Timeline Evacuation Model assumes that an evacuation order is not received at a property until it is doorknocked. This may have been appropriate in a rural setting in 1997, although the authors of the presentation referred to above also stated that '*in a real flood situation the SES will also use other warning methods including television, radio, and telephone. The time frame for warning delivery by these methods is likely to be shorter than for doorknocking but there is no way of assessing beforehand how long it will take for the community to receive the warning'*. The presentation also highlights what we consider are further limitations of the Timeline Evacuation Model:

- for clarity and ease of analysis, each time element has been shown as a discrete element and some of these are indicated to be entirely sequential and independent. In practice most elements will be, to some extent, concurrent
- experience of actual flood evacuation operations within the SES has shown that the elements of warning the community and the resulting traffic movement usually take place concurrently.

[15] Newgate Research (June 2018) *Flood Evacuation Social Research*
[16] Opper, S., Cinque, P. & Davies, B. (2010) *Timeline modelling of flood evacuation operations*

The presentation further states that '*the estimated warning time should not be reduced by relying on technological approaches or the uncertain outcomes of public flood education without reliable evidence justifying this reduction*'. Given that the presentation was delivered in 2010, **we submit that such evidence now exists** to justify the acceptance of more innovative means of delivering evacuation warnings and orders.

The Victorian SES, in a submission to an Inquiry into Flood Mitigation Infrastructure in Victoria (2011), advised that '*It is essential that flood warnings be disseminated through multiple mediums. Improved technologies such as Emergency Alert and social media have provided additional tools for VICSES to deliver warnings and community information during events. Warnings systems should also communicate to people from Culturally and Linguistically Diverse (CALD) backgrounds and vulnerable groups in communities.*'

The Queensland Government[17] advises that **'***A variety of warning sources increases the likelihood that warnings will be maintained throughout a flood event.*'

The NSW SES website also refers to multiple means of delivering flood and evacuation warnings and orders – of which doorknocking is one.

It should be noted that Liverpool council has previously approved 'The Marina' development parking for 637 vehicles to support the marina and recreational uses. The alternate Mirvac Planning Proposal for this site (RZ-5/2018) incorporates 624 parking spaces (which is 13 less parking spaces) on the already approved marina consented allowance. The actual number of vehicles on the site could be accommodated in extra warning time through the increase of 600 vehicles per hr/lane to a more realistic number such as 900 vehicles per hr/lane. This could be readily achieved given that evacuation for this development will not rely on door knocking and can instead be initiated electronically (SMS and Sirens) for this strata/commercial development and the Marina facility Management would be in control of the operation and hence, the customers using the facility.

The evacuation time should also be considered in terms of impact of the Mirvac Planning Proposal and would in fact be the same as for the already approved Benedict Marina Project (637 car parking spaces).

In relation to the proposed developments, additional protective factors will be implemented. These include:

- a 'community manager' who would assist NSW SES personnel in the management of the flood evacuation procedures by communicating with all residents using SMS and social media
- Residents as Flood Wardens. The wardens would assist with explaining details of the flood evacuation procedures to residents and assist in the annual flood evacuation training exercises

[17] www.chiefscientist.qld.gov.au *How do we communicate and warn about floods*

- Audible and visual alarms. It is recommended that automated SMS messaging to residents be prepared in multiple languages to cater for residents from non-English speaking backgrounds
- Vehicle and pedestrian flood evacuation route signage permanently in place

Conclusion

It is our expert opinion that as it currently stands, the Molino Stewart Report is based on either overly conservative or unrealistic assumptions, and incomplete/out of date data, that mainly have been provided by the NSW SES (our understanding). Our expert opinion is that the report **did not accurately** consider the following:

- A phased approach to evacuation considering pedestrian, vehicle and shelter in place.
- Assumptions made by the NSW SES indicate that they appear to be out of touch with the realities of urban living in a city that must be designed to cater for future population growth, based on the modes of transport that the growing population is adopting (alternates to vehicular transport).
- Traffic lane capacity based on a unreasonably conservative figure of 600 per lane/hour when they are well aware that the roads around the proposed development are not rural and will be familiar to the majority of road users.
- Referring to expected traffic delays caused by vehicles making their way north on the M7 to Homebush when their own comments, supported by independent research, clearly indicate that only a small proportion of residents would follow this path. Also, they have not factored into the modelling, the Liverpool evacuation centre or travelling to or sheltering with nearby family and friends.
- 100% evacuation compliance is a known fallacy that cannot be achieved, yet Molino Stewart used this as a base assumption.

It is our expert opinion that had the correct assumptions, along with current evacuation triggers, been provided to Molino Stewart by the NSW SES (and adopted) and consideration was given to the phased approach to evacuation modelling, different, more realistic conclusions would have been reached.

Annexure – CV Dave Owens APM



David Owens APM MLshipMgmt MEmergMgmt DipCrim
Managing Director
Risk-e Business Consultants

David established Risk-e Business Consultants, an Executive Level Management Consultancy, when he retired as Deputy Commissioner of the NSW Police Force after over 30 years of service. The NSW Police Force is Australia's oldest and largest policing organisation and one of the biggest in the English-speaking world. As the Deputy Commissioner, David was responsible for the leadership and management of nearly 13,000 police and 1200 public servants, with responsibility and accountability of a budget of $3 billion.

David has demonstrated that he clearly understands that large organisations must establish robust accountability mechanisms for crisis & emergency management, fiscal responsibility, project and performance management. Whilst strategically focused on the areas of human resources, operations and finance, he also ensured that innovation and project management was incorporated into all aspects of his work. This leadership was recognised in the awarding of the 2012 Australian Business Awards for Innovation and Project Management (project Eyewatch).

David worked with all levels of Government (Federal and State) along with private organisations and volunteer groups. David has effectively worked with Senior Executives at The Federal Bureau of Investigations, The Vatican, The Olympics, Ministers of Parliament (Federal & State) and Boards of Companies/ Emergency Services. In 2009, David was selected as the only Australasian representative to attend the National Executive Institute conducted by the FBI with participants selected from around the world for their leadership abilities.

David has performed in various roles which include Venue Commander for the Sydney 2000 Olympics, Operation Commander, Operation CONTEGO (APEC 2007 Leaders Week) having responsibility for policing & security arrangements. He was also the overall Operation Commander, Operation ANGELUS (World Youth Day 2008) during which His Holiness Pope Benedict XVI conducted services for over 500 000 pilgrims in Sydney.

David was appointed to the legislative role of State Emergency Operations Controller (SEOCON) on 01 December 2007 and performed this position for some four years, making him the longest serving officer in this role. As SEOCON, he was responsible for overall emergency management responses within the New South Wales. A sample of some of the Operations that he conducted are: Sydney 2000 Olympics, Venue Commander, Sailing; Equine Influenza (2007) with Department of Primary Industries; Pasha Bulka and North Coast Floods (2007); Black Saturday Bushfires Victoria (2009) 150 staff deployed; Emergency Management for World Youth Day and APEC Leaders Week; Christchurch New Zealand Earthquake 2011; Japanese Tsunami (2011) Urban Search & Rescue Deployment and United Nations Urban Search & Rescue accreditation Turkey (2011).

In addition, he **represented the NSW Police Force on the State Emergency Management Committee and State Rescue Board respectively, significantly contributing to planning and policy development.** David was the corporate sponsor and driving force behind the implementation of the NSW Police Force Mental Health Intervention Team (MHIT) which is now recognised as International best practice. He also implemented the Incident Commanders

course and the standardisation of Operational Risk Management for the NSWPF. David was responsible for the introduction of the *EyeWatch* project in 2011 which is a platform for the delivery of information to the community utilising *Facebook* as the network tool. This effectively created 21st Century Neighbourhood Watch Communities. This project won the 2012 Australian Business Awards for Project Management and Innovation.

Transitioning from Government to the Private sector, David has been a consultant to the NSW and ACT Governments on Investigations, Policy Development and Emergency Management. David has also worked with the Office of Liquor, Gaming and Racing (investigations and policy advice); Ambulance NSW (Strategic reviews and leadership development); Customer Service (Investigations), Sydney Metro Trains (Emergency and Crisis Management Exercises and coaching) and in **2015 was the independent Chair for the NSW Government on Loose Fill Asbestos Insulation (a $280m project), all recommendations accepted by NSW Government.** David has also consulted to private industry on a range of issues in the security and emergency management arenas and in 2014 David completed accreditation as an OGC Gateway Review Team Member. In 2015 David was appointed by the State Emergency Management Committee as the facilitator for the Greater Sydney Mass Care Exercise. In June 2016, appointed as the NSW State Recovery Coordinator for the East Coast Low and in September 2016 as the Regional Recovery Coordinator for the Central Western floods. In 2017, David was appointed by the NSW Government to the NSW Energy Security Taskforce. State Emergency Management Committee (Exercise Lumen Tenebris) 2018 – largest public/private partnership exercise conducted NSW. 2018 facilitation of NSW Health Influenza Pandemic Exercise and ANSTO Health Supply Workshop. 2018 – NSW Govt Summer Readiness Review. 2019 ANSTO (Executive mentoring), **2019 State Emergency Management Committee Catastrophic Flood Exercise Hawkesbury Nepean (4 months planning & facilitation). 2020 Co-Lead NSW Independent Bushfire Inquiry (76 Recommendations accepted by NSW Govt) and rewrite of the Hawkesbury Nepean Valley Flood Emergency Sub Plan (highest insurance risk in Australia).** Fresh Hope – Master EM, BCP and 8 Individual BCP Plans. Georges River LEMC – EM Plan, Lecturer, National Centre for Emergency Management Studies. Exercise Development & Facilitation Big Fat Smile Childcare, WestConnex M4/M5 tunnel extension and New Haven Farm Home Disability Services. 2021 Review Response Wingecarribee Shire Council 2019/20 Bushfires. Consultant Subject Matter Expert LEAMAC Property Group on flood plain management. **Commonwealth National Resilience & Recovery Agency (10 Emergency Management Exercises – 2021/22)**

QUALIFICATIONS:

David holds two (2) Masters in Emergency Management (2013) and Leadership and Management (2011); Diploma in Criminology (1998); Graduate Certificate in Management (1999) and attended the National Executive Institute Session XXXIV, Federal Bureau of Investigation (FBI), 2009. Certificate IV in Training & Assessment (2015); Diploma of Security & Risk Management (2017); Master Licence (Security Industry Act) and Master Licence (Commercial Agents and Private Inquiry Agents Act). Mental Health First Aid Australia (2017).

Lecturer, National Centre for Emergency Management Studies (2021 – current) Professor/Lecturer Rabdan Academy UAE Integrated Emergency Management (2021 – current)

AWARDS:

David has received the following awards: National Medal (1997 & 1st Clasp)), NSW Police Medal (1st, 2nd & 3rdClasp); Three Commissioner's Unit Citations; Commissioner's Olympic Commendation; Two Commissioners Commendations; Australian Police Medal (2007) and the NSW State Government Service Medal. 2012 Australian Business Awards for Project Management and Innovation. Resilient Australia Award Government Category – Activate Wollondilly project (2018)

AFFILIATIONS:
Member International Association of Emergency Managers; Risk Management Institute of Australia; ASIAL (Australian Security Industry Association Ltd) and NSW Police Legacy – Backup for Life Program. Westpac Helicopter Rescue Service (Chair/Board Member 2012-2018) NSW Ambulance Board (2019 – current). Career Transition Program Worksafe Solutions (2019 – 2021)

PUBLISHED:

- Public Private Partnerships Exploring the opportunities (2014 – ASIAL Security Insider);
- Independent Review of the NSW SES Operational Response Northern River Floods 2017;
- Harnessing the power of Social Media in Emergency Management and Community Engagement (2013 Disaster Management conference paper);
- Exercise Lumen Tenebris (Australian Police Journal Sept 2019);
- NSW Bushfire Inquiry (August 2020)
- Wingecarribee Shire Council Response to 2019/2020 Bushfires (August 2021)

ATTACHMENT C
FLOOD SAFE PLAN

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

Flood Safe Plan

Appendix A

Georges Cove Village 146 Newbridge Rd Moorebank

Potential impacts of flooding on workers and visitors	Severity level
People's health and safety are compromised	Low
Frail and elderly customer evacuation	Low
Property is damaged or destroyed	Low
Cars and other property in car park damaged	Low
Profits are lost or service provision stopped	Low
Retail goods are damaged or ruined	Low

Triggers for actions now and always

Actions that can be done immediately and maintained to reduce the potential impact of flooding are detailed as follows.

Actions

Action	How to do it	Who will do it	What you will need	Estimated time needed	Completed
Inform workers and visitors that flooding is a real risk	Use signage in car park and entry, and train flood wardens	Site Manager, Flood Wardens	Training procedures and policies, this plan	1 hour for training	[ ]
Display the FloodSafe Plan and poster	Display Flood Safe Plan in car park and entry and with each tenant	Site Manager	Copy of the flood safe plan	30 minutes	[ ]
Encourage staff to participate in development & implementation of this plan	Site tenant Meeting	Site Manager, Flood Wardens	Flood safe plan and computer	2 hours	[ ]
Ensure OH&S procedures cover specific risks associated with floods	Management meeting to review existing plans and modify where necessary	Site Manager	Copies of all the plans and site audit to identify risks	2 hours	[ ]
Maintain an up to date list of emergency contact numbers for tenants	Management meeting	Site Manager	Various updated contact details and maintain data base	30 minutes	[ ]
Train tenants and workers in flood procedures	Management meeting and training sessions	Site Manager	Copies of the flood safe plan	1 hour	[ ]
Incorporate flood awareness in tenant management and worker induction training	Staff induction manual	Site Manager	Staff induction manual	1 hour	[ ]
Prepare an Emergency Kit	Gather items and store in suitable	Site Manager	Emergency kit to contain torch with	2 hours	[ ]

	location on site and accessible.		spare batteries, portable radio with spare batteries, first aid kit, candles, waterproof matches, waterproof bag for valuables and mobile phone, and a copy of the emergency contacts list and a copy of the flood safe plan		
Ensure flood wardens know flood evacuation actions	Staff training and emergency drills	Site Manager	Building plans	2 hours	[ ]
Store backups of important computer files and critical paper records in suitable location	Create computer backups and paper copies of critical documents and store in suitable location or off-site.	Business owners, Site manager, staff	On-site storage and off-site storage location	1 hour	[ ]

Triggers for actions when flooding is likely

- Heavy rainfall
- The Bureau of Meteorology issuing a Flood Watch
- The Bureau of Meteorology issuing a Severe Weather Warning or Severe Thunderstorm Warning indicating a likelihood of flash flooding
- The Bureau of Meteorology issues flood warning for flood levels above RL 4m AHD
- The State Emergency Service issues flood evacuation order

Actions

Action	How to do it	Who will do it	What you will need	Estimated time needed	Completed
Notify tenants and workers of any warnings	In person and using wardens	Site Manager, Flood Wardens	Broadcast system for verbal warnings to tenants	30 minutes	[ ]
Keep radio tuned to local radio station, keep in contact with BoM, SES and monitor relevant websites	http://www.bom.gov.au/nsw/warnings/ http://www.bom.gov.au/products/IDR713.loop.shtml http://new.mhl.nsw.gov.au/Site-213435	Site Manager	Radio, 4G/5G enabled device and spare batteries	While flooding is likely	[ ]
Ensure flood wardens and staff are aware of Flood Watch or a Severe Weather Warning	In person and using wardens	Site Manager / Flood Wardens			[ ]
Prevent tenants, workers and visitors leaving the site to Newbridge Rd	When ponding occurs on Level 1 and alarm activated and exit gate closes automatically	Site Manager and flood wardens	One flood warden manning the exit	Duration of unsafe conditions	[ ]
Evacuate workers / visitors	Announce flood evacuation order over PA system and direct people to their cars for vehicular evacuation.	Site Manager and flood wardens			[ ]

Back up important computer files and critical paper records and take to the mezzanine level		Site manager or designated staff member			[ ]

Triggers for actions during a flood

Heavy rainfall is experienced

During heavy rainfall a designated flood warden to commence visual monitoring of the entry on Newbridge Road.

The alarm sounds or flashes to confirm BoM or SES flood warnings

The flood wardens commence movement of people to their cars and directing them to the exits. The flood wardens monitoring car evacuation to ensure it occurs smoothly. If Newbridge Rd exit is closed by flood waters, then direct cars to the Mirvac Georges Cove exit route. Chief flood warden to decide after three hours if the pedestrian evacuation should be initiated. If so, then flood wardens manage pedestrian evacuation to the elevated pedestrian bridge over Brickmakers Drive. Wardens ensure all people leave the site.

Action	How to do it	Who will do it	What you will need	Estimated time needed	Completed
Keep in contact with tenants and keep them updated on the situation	Implement staff contacting strategies using tenant meetings, telephone calls or briefings	Site Manager	Radio to obtain up to date information and liaison with the SES if needed; computer or 4G/5G	On going during event	[ ]

			device to check websites		
Do not enter flood water or attempt to leave the building	Ensure wardens are trained and providing relevant information to customers	Site Manager and flood wardens	Latest information and Flood Safe Plan	On going during event	[ ]
Keep radio tuned to local radio station, keep in contact with SES and monitor relevant websites	Tune radio to ABC Local Radio 702 AM; http://www.bom.gov.au/nsw/warnings/ http://www.bom.gov.au/products/IDR713.loop.shtml	Site manager and flood wardens	Radio, spare batteries, phone, computer and 4G/5G mobile device	During event	[ ]
Monitor tenant and worker to ensure safety	Ensure all people onsite are well informed and adhering to flood response actions	Site manager and flood wardens	Undertake regular inspections of floor/tenants	During flood event	[ ]

Triggers for actions after a flood

- Site Manager or flood wardens issue all clear
- The NSW State Emergency Service issue an all clear

Actions

Action	How to do it	Who will do it	What you will need	Estimated time needed	Completed
Before re-occupying the premises undertake an OH&S risk assessment	Conduct a visual risk assessment of external areas, the car park and ground level if appropriate, looking for structural damage, damage to services, dangerous debris, etc.	Site Manager and flood wardens	Any safety equipment that is deemed necessary		[ ]
Remove debris and clean, repair and disinfect any levels which were inundated	With appropriately skilled personnel	Site Manager to organise			[ ]
Replace any essential plant, equipment that is damaged as soon as possible	With appropriately skilled personnel	Site manager to organise			[ ]
Restore critical records, computer equipment and files	With appropriately skilled personnel	Site manager to organise			[ ]

Staff Contact List

Name	Number	Mobile	Flood role / issues
Site Manager			
Flood Warden 1			
Flood Warden 2			
Flood Warden 3			

Emergency Contact List

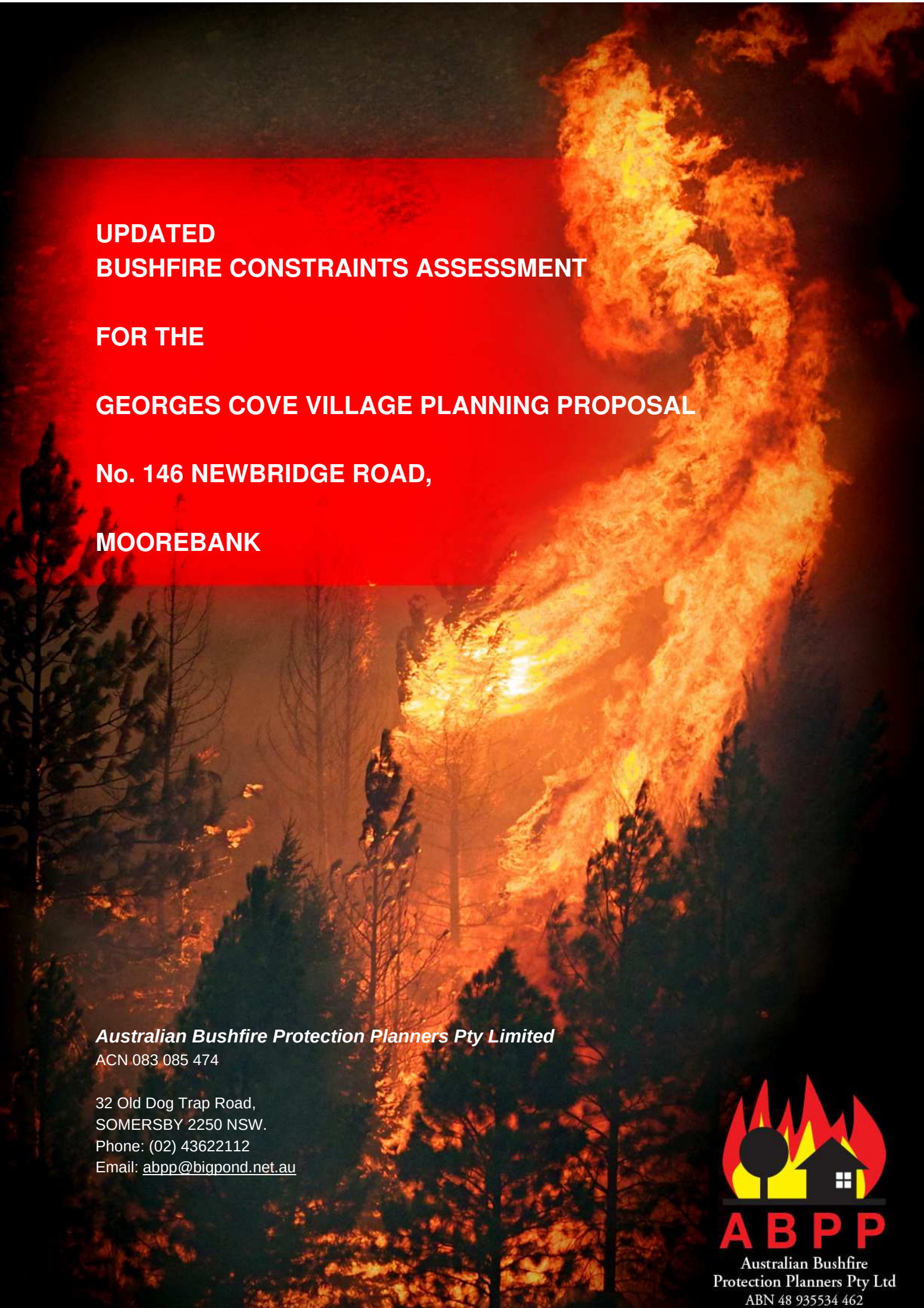
Name	Number	Mobile
Ambulance	000	
Gas		
NSW SES	132 500	
Sydney Water - Faults	13 090	
Fire - Emergency	000	
Police - Emergency	000	
Electricity		
Bureau of Meteorology (for flood warnings)	1300 659 219	
Liverpool Council Wet Weather Line		
Liverpool Police Station or Cronulla Police Station		
Electrician		

For emergency help in floods and storms phone the SES on 132 500

m 0409 912 631 e mark.tooker@tookerandassociates.com.au a 30 Walworth Avenue, Newport abn 39 619 046 070

Appendix F

Bushfire constraints assessment



UPDATED
BUSHFIRE CONSTRAINTS ASSESSMENT

FOR THE

GEORGES COVE VILLAGE PLANNING PROPOSAL

No. 146 NEWBRIDGE ROAD,

MOOREBANK

Australian Bushfire Protection Planners Pty Limited
ACN 083 085 474

32 Old Dog Trap Road,
SOMERSBY 2250 NSW.
Phone: (02) 43622112
Email: abpp@bigpond.net.au

ABPP
Australian Bushfire
Protection Planners Pty Ltd
ABN 48 935534 462

UPDATED

BUSHFIRE CONSTRAINTS ASSESSMENT

FOR THE

GEORGES COVE VILLAGE PLANNING PROPOSAL

No. 146 NEWBRIDGE ROAD,

MOOREBANK

Assessment Number	Document	Preparation Date	Issue Date	Directors Approval
B234034 - 3	Final	27.06.2023	26.07.2023	***G.L.Swain***

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

EXECUTIVE SUMMARY

Australian Bushfire Protection Planners Pty Limited has been commissioned to prepare a Bushfire Constraints Assessment Report for the proposed rezoning of the land within the Georges Cove Village, No. 146 Newbridge Road at Moorebank.

This report updates the previous report prepared for the construction of mixed-use development on the site.

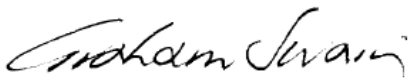
The new Planning Proposal seeks to amend the permitted uses to include the provision for a mixed-use retail development including a Supermarket and light industrial options to accompany the low density Mirvac Residential Estate.

The site is identified on the Liverpool Council Bushfire Prone Land Map as containing the buffer zone to Category 1 Bushfire Prone Vegetation on the reserve land to the west.

Therefore, pursuant to Ministerial Direction No. 4.3 – ***'Planning for Bushfire Protection'*** [under Section 9.1(2) of the ***Environmental Planning & Assessment Act – 1979],*** Liverpool Council, in the preparation of a planning proposal that effects, or is in proximity to land mapped as bushfire prone land, must consult with the Commissioner of the NSW Rural Fire Service following receipt of a gateway determination under Section 3.34 of the Act, and prior to undertaking community consultation in satisfaction of Clause 4, Schedule 1 to the EP&A Act and take into account any comments so made.

This Bushfire Constraints Report therefore undertakes an assessment of the bushfire protection measures required to address the potential bushfire risk to the future retail/commercial development from the vegetation in the reserve, consistent with the Ministerial Direction No. 4.3 – ***'Planning for Bushfire Protection'*** [under Section 9.1(2) of the ***Environmental Planning & Assessment Act – 1979].***

The characteristics of the site, as discussed in this report, together with the fire protection measures recommended, provide that the Planning Proposal is suitable in terms of its intended retail / commercial.



Graham Swain
Managing Director
Australian Bushfire Protection Planners Pty Limited.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

TABLE OF CONTENTS

EXECUTIVE SUMMARY 3
TABLE OF CONTENTS 4

SECTION 1 5
INTRODUCTION 5
1.1 Statutory Requirements. 5
1.1.1 Legislation. 5
1.1.2 Planning Policies. 6
1.2 Planning Proposal. 6
1.3 Documentation reviewed in this Assessment. 17
1.4 Site Inspection. 17

SECTION 2 18
DESCRIPTION OF THE LAND WITHIN THE REZONING PRECINCT 18
2.1 Location. 18
2.2 Existing Land Use. 19
2.3 Landuse adjoining the George Cove Village. 19
2.4 Topography. 20
2.5 Vegetation. 20

SECTION 3 21
BUSHFIRE PRONE LAND MAP 21

SECTION 4 22
BUSHFIRE CONSTRAINTS ASSESSMENT 22
4.1 Introduction. 22
4.2 Asset Protection Zones. 22
4.3 Access for Firefighting Operations. 25
4.4 Water Supplies for Firefighting Operations. 25
4.5 Construction Standards to the future buildings. 25

REFERENCES: 26

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

SECTION 1

INTRODUCTION

1.1 Statutory Requirements.

This assessment has been prepared having regard to the following legislative and planning requirements:

1.1.1 Legislation.

(a) Environmental Planning and Assessment Act (EPA Act)

Planning and development within NSW are regulated by the ***Environmental Planning & Assessment Act, 1979*** (EPA Act).

In relation to a Planning Proposal that is in close proximity to bushfire prone land Ministerial Direction No. 4.3 – ***Planning for Bushfire Protection*** [under Section 9.1(2) of the ***Environmental Planning & Assessment Act – 1979***] applies to all Councils that are required to prepare a bushfire prone land map under Section 10.3 of the ***Environmental Planning & Assessment Act***.

Pursuant to Ministerial Direction No. 4.3 – Planning for Bushfire Protection, the relevant planning authority must consult with the Commissioner of the NSW Rural Fire Service following receipt of a gateway determination under Section 3.34 of the Act, and prior to undertaking community consultation in satisfaction of Clause 4, Schedule 1 to the EP&A Act and take into account any comments so made:

A planning proposal must:

- Have regard to Planning for Bushfire Protection 2019;
- Introduce controls that avoid placing inappropriate developments in hazardous areas, and;
- Ensure that bushfire hazard reduction is not prohibited within the APZ.

A planning proposal must, where development is proposed, comply with the following provisions, as appropriate:

(a) Provide an Asset Protection Zone [APZ] incorporating at a minimum:

- An Inner Protection Area bounded by a perimeter road or reserve which circumscribes the hazard side of the land intended for development and has a building line consistent with the incorporation of an APZ, within the property, and
- An Outer Protection Area managed for hazard reduction and located on the bushland side of the perimeter road.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

(b) For infill development [that is development within an already subdivided area], where an appropriate APZ cannot be achieved, provide for an appropriate performance standard in consultation with the NSW Rural Fire Service. If the provisions of the draft LEP permit Special Fire Protection Purposes [as defined under Section 100B of the ***Rural Fires Act 199],*** the APZ provisions shall be complied with;

(c) Contain provisions for two-way access roads which link to perimeter roads and/or to fire trail networks;

(d) Contain provisions for adequate water supply for fire fighting purposes;

(e) Minimise the perimeter of the area of land interfacing the hazard which may be developed;

(f) Introduce controls on the placement of combustible materials in the Inner Protection Area, and;

A planning proposal may be inconsistent with the terms of this direction only if the relevant planning authority can satisfy the Planning Secretary [or an officer of the Department nominated by the Secretary] that the Council has obtained written advice from the Commissioner of the NSW Rural Fire Service, to the effect that, notwithstanding the non-compliance, the NSW Rural Fire Service does not object to the progression of the planning proposal.

1.1.2 Planning Policies.

Planning for Bushfire Protection – 2019. (NSW Rural Fire Service)

This document provides guidance on the planning and development control processes in relation to bushfire protection measures for development in bushfire prone areas. The Commissioner may determine, under Section 100B of the ***Rural Fires Act,*** additional measures that are considered necessary to protect the development against the impact of bushfire.

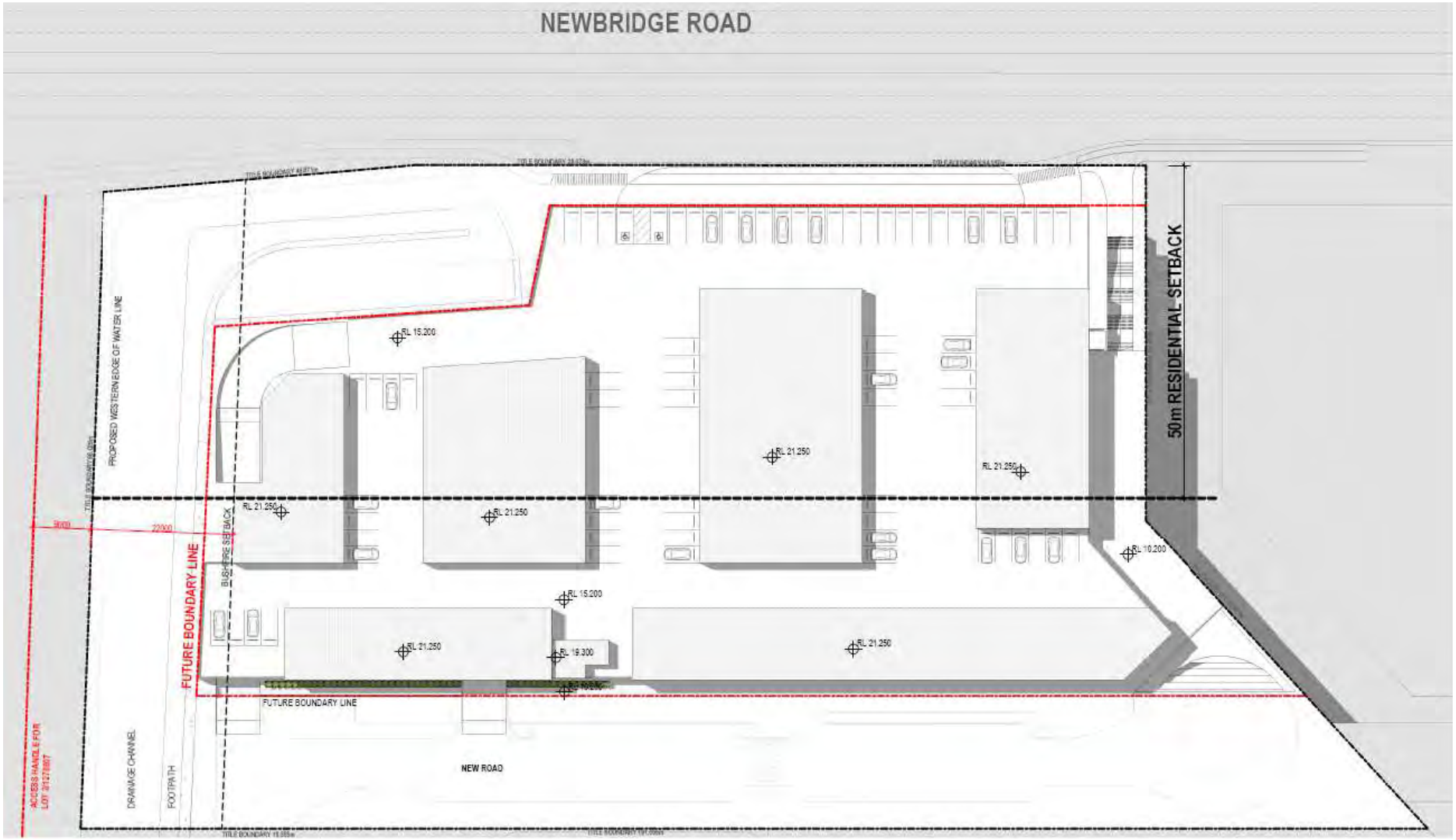
1.2 Planning Proposal.

This updated Bushfire Constraints Assessment Report has been prepared for a Planning Proposal seeks to amend the permitted uses to include the provision for a mixed-use retail development including a Supermarket and light industrial options to accompany the low-density Mirvac Residential Estate, located to the south of the site.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

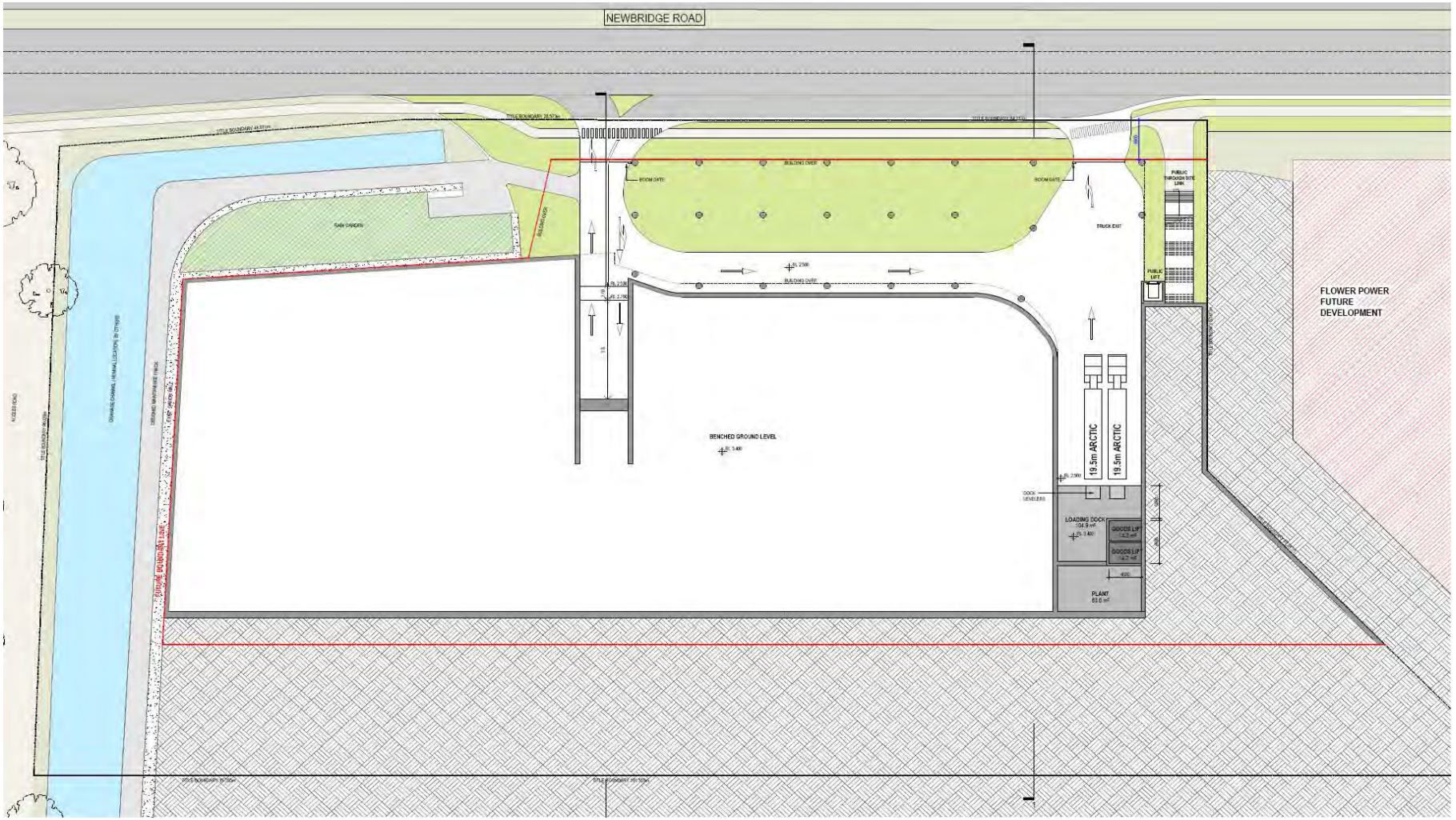
Figure 1 – Site Plan.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au



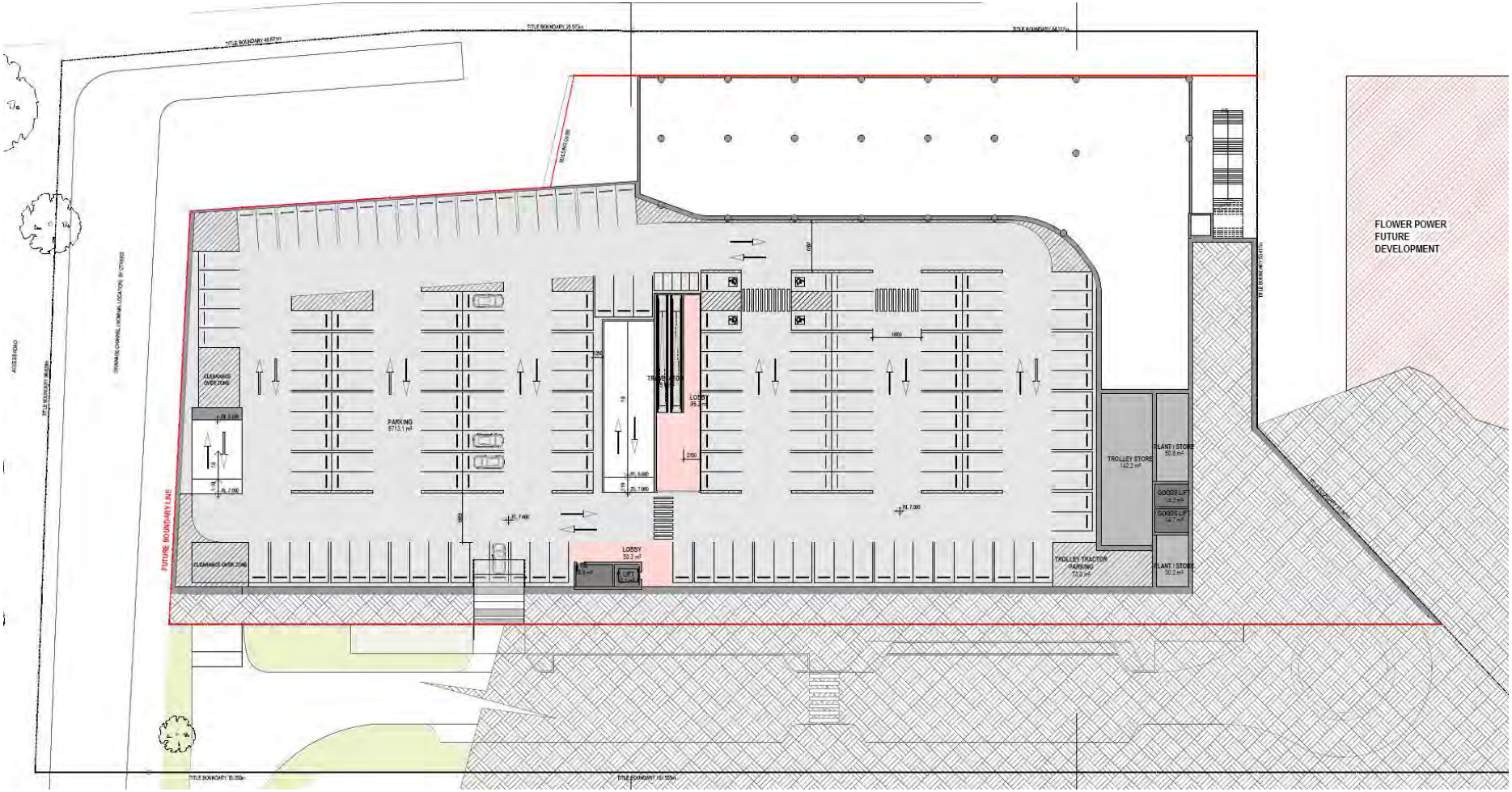
© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 2 – Dock Plan.



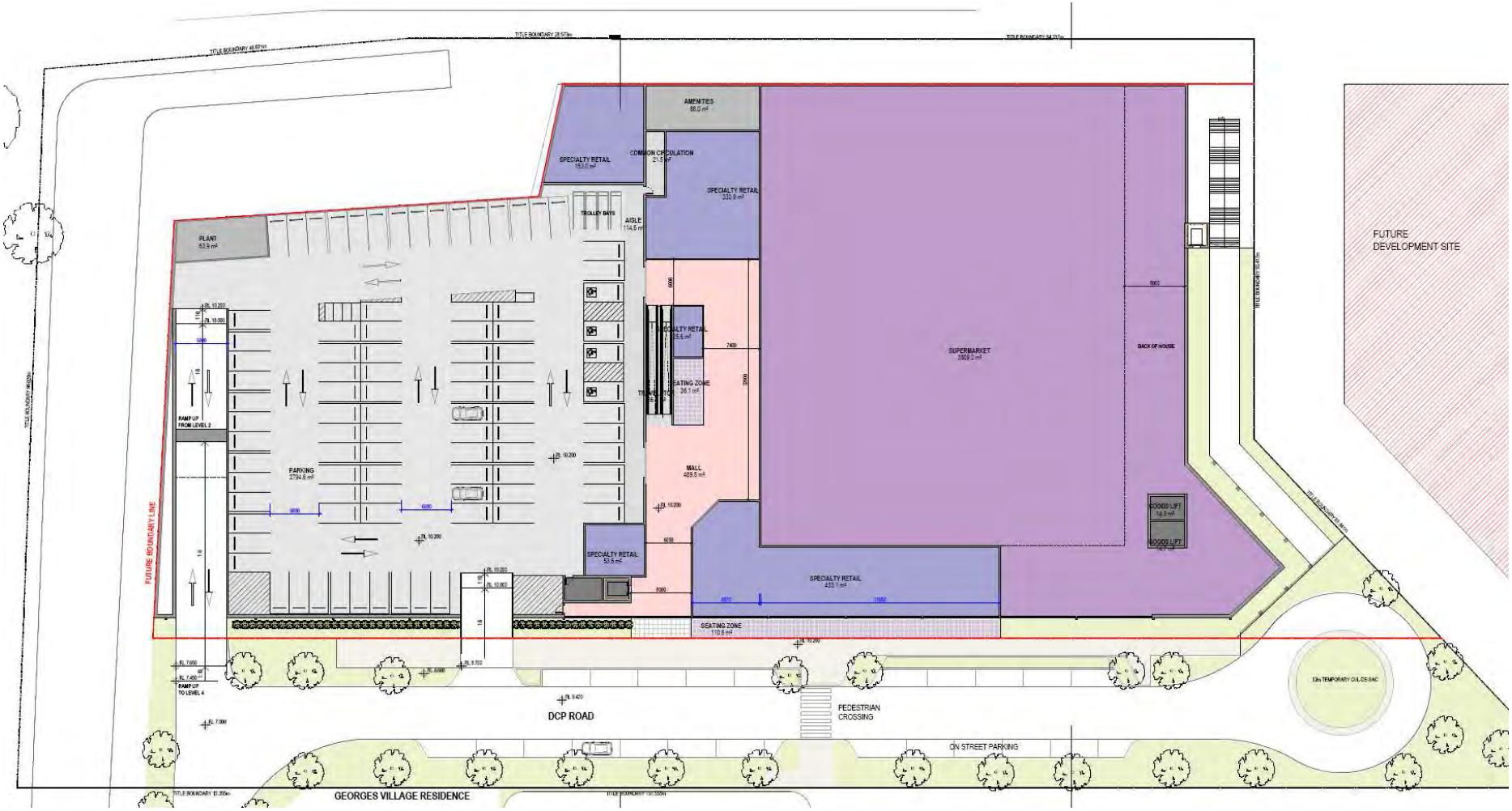
© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 3 – Level 2 Carpark Plan.



© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 4 – Level 3 Retail Floor Plan.



© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 5 – Level 4 Light Industrial Floor Plan.



© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 6 – Level 5 Mezzanine Floor Plan.



© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 7 – Sections.



© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 8 – Newbridge Road Perspective.



© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 9 – Street Perspective.



© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

1.3 Documentation reviewed in this Assessment.

- ***Planning for Bushfire Protection 2019*** prepared by the NSW Rural Fire Service/Planning N.S.W;

- Australian Standard AS3959 - 2018 ***Construction of Buildings in Bushfire Prone Areas***;

- ***Rural Fires Regulation 2021;***

- Liverpool Bushfire Prone Land Map;

- Concept Plans prepared by Rothelowman;

- SEPP 65 Statement prepared by Rothelowman;

- Planning Proposal Documents prepared by Rothelowman;

1.4 Site Inspection.

Graham Swain of Australian Bushfire Protection Planners Pty Limited inspected the site on 11th September 2017 to assess the topography, slopes and vegetation classification within and adjoining the site.

Adjoining properties were also inspected to determine the surrounding land use / land management.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

SECTION 2
DESCRIPTION OF THE LAND WITHIN THE REZONING PRECINCT

2.1 Location.

The Georges Cove Village occupies the northern portion of Lot 101, No 146 Newbridge Road, Moorebank – refer to Figure 10 below.

Figure 10 – Location of the Georges Cove Village site.



© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 11 – Aerial Photograph of the Georges Cove Village site.



2.2 Existing Land Use.

The site currently accommodates a materials recycling operation.

2.3 Landuse adjoining the George Cove Village.

The land to the north of the site contains the Newbridge Road corridor.

Beyond the road corridor the land contains industrial development.

The land to the east of the site contains a retail plant nursery. The land to the south contains the Mirvac residential estate which is currently under construction.

The land to the west of the site consists of a private access handle and Public Reserve.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

2.4 Topography.

Appendix A1.4 of ***Planning for Bushfire Protection 2019*** states that the effective slope is the slope of the land under the classified vegetation which will most significantly influence bushfire behaviour.

The only aspect to the site which contains bushfire prone vegetation is on the Public Reserve to the west. The land within the Public Reserve is level.

2.5 Vegetation.

Cumberland Ecology undertook an Ecological Constraints Assessment in 2009 and found that the vegetation within the Public Reserve to the west of the Georges Cove Village site contains Cooks River Castlereagh Iron Bark Forest [EEC] – refer to Figure 12.

Figure 12 – Plan of Vegetation Communities prepared by Cumberland Ecology.



© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

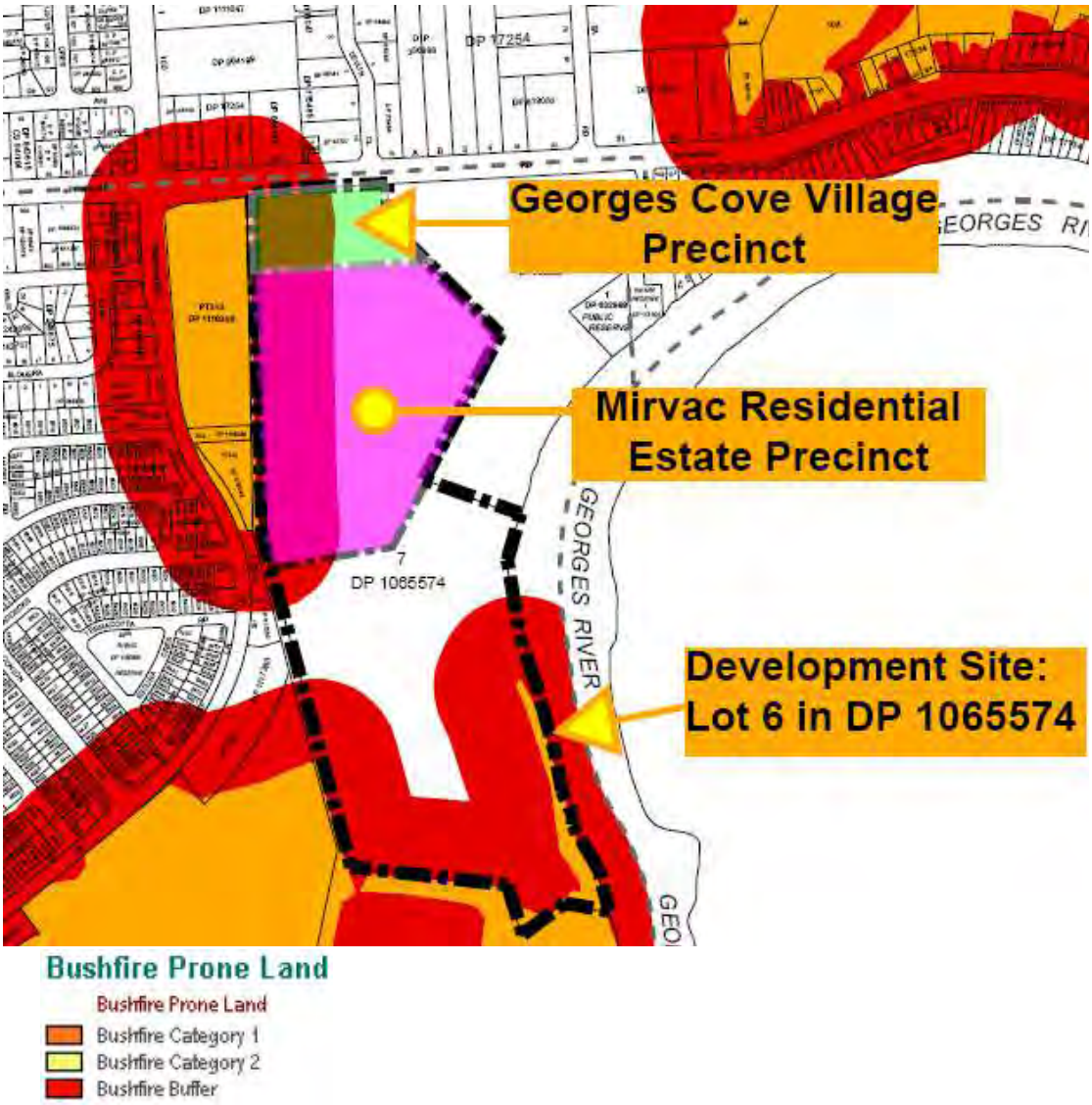
SECTION 3

BUSHFIRE PRONE LAND MAP

The Liverpool Council has prepared a Bushfire Prone Land Map pursuant to the requirements of Section 10.3 of the ***Environmental Planning & Assessment Act 1979.***

Figure 13 below provides an extract of the Certified Bushfire Prone Land Map for the site and shows that the land is mapped as containing the buffer zone to the Category 1 Bushfire Prone Vegetation found within the Public Reserve, to the west of the site.

Figure 13 – Extract from the Liverpool Bushfire Prone Land Map.



© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

SECTION 4
BUSHFIRE CONSTRAINTS ASSESSMENT

4.1 Introduction.

Under Ministerial Direction 4.3 a planning proposal must, where development is proposed, comply with the following provisions, as appropriate:

(a) Provide an Asset Protection Zone [APZ] incorporating at a minimum:

- An Inner Protection Area bounded by a perimeter road or reserve which circumscribes the hazard side of the land intended for development and has a building line consistent with the incorporation of an APZ, within the property, and

- An Outer Protection Area managed for hazard reduction and located on the bushland side of the perimeter road.

(b) For infill development [that is development within an already subdivided area], where an appropriate APZ cannot be achieved, provide for an appropriate performance standard in consultation with the NSW Rural Fire Service. If the provisions of the draft LEP permit Special Fire Protection Purposes [as defined under Section 100B of the ***Rural Fires Act 1997],*** the APZ provisions shall be complied with;

(c) Contain provisions for two-way access roads which link to perimeter roads and/or to fire trail networks;

(d) Contain provisions for adequate water supply for fire fighting purposes;

(e) Minimise the perimeter of the area of land interfacing the hazard which may be developed; and

(f) Introduce controls on the placement of combustible materials in the Inner Protection Area.

These requirements are examined in the following sections of this report.

4.2 Asset Protection Zones.

Appendix 1 of ***Planning for Bushfire Protection 2019*** provides the following procedure for determining setback distances (Asset Protection Zones):

(a) ***Determine vegetation formations as follows:***

- Identify all vegetation in all directions from the site for a distance of 140 metres;
- Consult Figure A2.1 to determine the predominant vegetation type;

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

(b) Determine the effective slope of the land under the predominant vegetation Class;

(c) Determine the appropriate fire [weather] area;

(d) Consult Table A1.12.5 and determine the appropriate setback [Asset Protection Zone] for the assessed land use, vegetation formation and slope range.

The Liverpool Bushfire Prone Land Map identifies that the site is impacted by the buffer zone to the Category 1 Bushfire Prone Vegetation within the Public Reserve, located to the west of the site.

This vegetation has a width of approximately ninety [90] metres and therefore presents a high level of hazard to the proposed Georges Cove Village.

The Planning Proposal is for mixed landuse including:

- Retail;
- Commercial/Office.

For retail and commercial development, the aim of ***Planning for Bushfire Protection 2019*** is to position buildings so that they are not subject to flame contact.

In order to satisfy this requirement, the minimum separation distance to the Category 1 Bushfire Prone Vegetation on the land to the to the west of the site is 22 metres.

The Planning Proposal provides a Defendable Space width less than 22 metres to the Carpark floors, resulting in this part of the complex being in the Flame Zone. The construction of the Carpark will include non-combustible walls with an FRL of 240/240/240 therefore addressing the Flame Zone construction requirements.

The floors containing the Light Industrial and retail development are set back to achieve the Defendable Space width of 22 metres. This setback includes the width of the Drainage Channel, Maintenance Track, Retaining Wall and setback to the building.

Refer to Figure 14 Plan of Asset Protection Zone on Page 23.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Figure 14 – Plan of Asset Protection Zone/Defendable Space to the west of the proposed development.



© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

4.3 Access for Firefighting Operations.

Access for fire-fighting operations is directly off Newbridge Road and the new road network within the Mirvac Estate, to the south.

4.4 Water Supplies for Firefighting Operations.

Existing fire-fighting hydrants are in Newbridge Road and the new road network in the Mirvac Estate, to the south.

4.5 Construction Standards to the future buildings.

The nominated minimum width of the Defendable Space for the Light Industrial/Office components of the complex has been determined in order to mitigate flame contact on these components of the development.

The required bushfire construction standard for western elevation the Industrial/Office buildings is BAL 40, pursuant to A.S. 3959 – 2018.

The Planning Proposal provides a Defendable Space width less than 22 metres to the Carpark floors, resulting in this part of the complex being in the Flame Zone. The construction of the Carpark will include non-combustible walls with an FRL of 240/240/240, therefore addressing the Flame Zone construction requirements.

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

REFERENCES:

- N.S.W Rural Fire Service – ***Planning for Bushfire Protection 2019***;
- ***Environmental Planning & Assessment Act – 1979;***
- ***Rural Fires Act – 1997;***
- ***Rural Fires Regulation 2022;***
- NSW Rural Fire Service – ***Guideline for Bushfire Prone Land Mapping 2015;***
- ***Bushfire Environmental Assessment Code 2022;***
- Building Code of Australia;
- Australian Standard A.S. 3959-2018 "***Construction of Buildings in Bushfire Prone Areas";***
- ***Liverpool Bushfire Prone Land Map.***

© Australian Bushfire Protection Planners Pty Limited
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

Appendix G

Traffic impact assessment

Georges Cove Village - Modified Planning Proposal

Addendum Traffic Impact Assessment

Prepared for Benedict Industries Pty Ltd

October 2023

Georges Cove Village - Modified Planning Proposal

Addendum Traffic Impact Assessment

Benedict Industries Pty Ltd

J17103 RP#1

October 2023

Version	Date	Prepared by	Approved by	Comments
V1	03/08/2023	John Mai	Abdullah Uddin	Draft
V2	24/10/2023	John Mai	Abdullah Uddin	Final

Approved by



Abdullah Uddin
Associate Traffic Engineer
24/10/24

Ground floor 20 Chandos Street
St Leonards NSW 2065
PO Box 21
St Leonards NSW 1590

This report has been prepared in accordance with the brief provided by Benedict Industries Pty Ltd and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of Benedict Industries Pty Ltd and no responsibility will be taken for its use by other parties. Benedict Industries Pty Ltd may, at its discretion, use the report to inform regulators and the public.

© Reproduction of this report for educational or other non-commercial purposes is authorised without prior written permission from EMM provided the source is fully acknowledged. Reproduction of this report for resale or other commercial purposes is prohibited without EMM's prior written permission.

TABLE OF CONTENTS

1 Introduction 1

1.1 Overview 1

1.2 Background 1

1.3 Site context 2

2 Comparison between previous proposal and current proposal 3

2.1 Site access and egress 3

2.2 Internal car park design 4

3 Existing traffic and transport conditions 6

3.1 Current condition of the site and surrounds 6

3.2 Road network within the village 6

3.3 Public transport 7

3.4 Bicycle network 8

3.5 Pedestrian connectivity 9

3.6 Journey to work data analysis 10

3.7 Existing traffic volumes 11

4 Development traffic assessment 14

4.1 Georges Cove Village development traffic assessment 14

4.2 Cumulative developments 20

4.3 Baseline, Georges Cove Village development and cumulative traffic 24

4.4 Intersection impact assessment 27

5 Conclusion and summary 33

References 35

Appendices

Appendix A Architectural plans A.1

Appendix B Traffic survey data B.1

Appendix C SIDRA results C.1

Tables

Table 2.1 Comparison of 2017 and 2023 proposal 3

Table 3.1 Trip distribution 10

Table 4.1 Inclusions in Scenario A and Scenario B 14

Table 4.2	Evening peak hour traffic generation factor	16
Table 4.3	Georges Cove Village development traffic volumes	17
Table 4.4	Cumulative developments	20
Table 4.5	Cumulative traffic volumes from different developments	22
Table 4.6	Intersection LOS standards	27
Table 4.7	SIDRA modelling result for Brickmakers Drive/Promontory Way	29
Table 4.8	SIDRA modelling result for Newbridge Road/Governor Macquarie Drive/Brickmakers Drive	30
Table 4.9	SIDRA modelling result for Newbridge Road/Site Access	31
Table 4.10	SIDRA modelling result for Newbridge Road/Davy Robinson Drive	32

Figures

Figure 1.1	Planning proposal site context	2
Figure 2.1	Site access from Newbridge Road and loading dock	4
Figure 2.2	Inbound and outbound vehicular routes from DCP Road to the car parking areas	5
Figure 3.1	Aerial view of the Georges Cove Precinct (July 2023)	6
Figure 3.2	Bus stops and bus route in the vicinity of the site	8
Figure 3.3	Bicycle network in the vicinity of the site	9
Figure 3.4	Surveyed intersections	11
Figure 3.5	2023 surveyed traffic volumes during the AM and PM peak hour	12
Figure 4.1	Georges Cove Village traffic distribution for Scenario A	15
Figure 4.2	Georges Cove Village traffic distribution for Scenario B	16
Figure 4.3	Georges Cove Village traffic volumes for Scenario A	18
Figure 4.4	Georges Cove Village traffic volumes for Scenario B	19
Figure 4.5	Scenario A cumulative traffic distribution	21
Figure 4.6	Scenario B cumulative traffic distribution	22
Figure 4.7	Scenario A cumulative traffic volumes	23
Figure 4.8	Scenario B cumulative traffic volumes	24
Figure 4.9	Baseline, Georges Cove Village development and cumulative traffic volumes for Scenario A	25
Figure 4.10	Baseline, Georges Cove Village development and cumulative traffic volumes for Scenario B	26

Photographs

Photograph 3.1	Mast Place (looking north)	7
Photograph 3.2	Ketch Lane (looking north)	7
Photograph 3.3	Footpath in Angler Avenue (looking north)	9
Photograph 3.4	Pedestrian overbridge to be opened late 2023	10

1 Introduction

1.1 Overview

This report has been prepared on behalf of Benedict Industries Pty Limited to consider the traffic impacts of a proposed amendment to the *Liverpool Local Environmental Plan 2008* (LLEP).

The amendment relates to the land situated at 146 Newbridge Road, Moorebank (the site) and would result in the following:

- a site-specific provision for a retail premises with a maximum gross floor area of 4,000 m^2

The proposed amendment would be pursuant to Schedule 1 of the Liverpool Local Environmental Plan 2008 (LLEP 2008) and would provide for an additional permitted use on the subject site.

This report is a supporting technical document and should be read in conjunction with the planning proposal.

1.2 Background

An earlier planning proposal, prepared by the applicant, was referred to the Liverpool Local Planning Panel and was considered at a Council meeting in September 2020. Council subsequently forwarded the proposal to the Department of Planning and Environment (DPE) for Gateway determination. DPE returned the Gateway Request in December 2020 noting a need to further address issues regarding flooding and evacuation.

The applicant has since revised the design and function of the proposed development, and hence the earlier planning proposal is being modified.

Note that the earlier planning proposal sought:

- provision of a child care centre, being prohibited development pursuant to the (then) land zoning of B6 Enterprise Corridor
- exceedance of the permissible 15 m building height control
- exceedance of the permissible floor space ratio of 0.75:1
- a gross floor area of 15,500 m^2 as per an existing Voluntary Planning Agreement (VPA).

These matters are no longer proposed.

In April 2023, Council was provided revised concept architectural plans and in June 2023 Council issued advice regarding the information required in order to progress the revised planning proposal, based on the revised drawings.

Concept designs of the site plans prepared by Rothelowman Architects are provided at Appendix A.

In regard to traffic, the following comments were provided by Council:

a) Updated Traffic Impact Assessment

The most recent Traffic Impact Assessment report is prepared by Ason Group, dated 9 October 2017.

Due to the timeframe which has lapsed since the Traffic Impact Assessment Report was prepared being over 5 years and as the planning proposal concept architectural plans submitted in April 2023 have significantly changed since the preparation of the Traffic Impact Assessment Report, a revised Traffic Impact Assessment Report is to be submitted to Council.

This may be in the form of an addendum as the development intensity of the subject site has been reduced as per the planning proposal concept architectural plans submitted in April 2023. It is required to include updated access and internal design comments (section 5), updated existing traffic and transport conditions/traffic studies (section 6), section 7 (Traffic Assessment), section 8 (summary) and appendix A (SIDRA Modelling outputs).

The traffic report, prepared by Ason Group (Ason), has been reviewed and this report responds to the revised design and the above matters required by Council.

1.3 Site context

The planning proposal relates only to Georges Cove Village; however this traffic assessment considers the other development sites within the broader Georges Cove precinct, which includes residential and commercial component of Georges Cove Marina, the residential development at Georges Cove residences and the Moorebank Recyclers land.

The planning proposal site (Georges Cove Village) is shown in the precinct context in Figure 1.1.



Figure 1.1 Planning proposal site context

2 Comparison between previous proposal and current proposal

A comparison of the 2017 planning proposal and 2023 planning proposal is provided in Table 2.1. For the 2023 proposal, the gross lettable floor area (GLFA) has been estimated to be 75% of the gross floor area (GFA), as noted in *Guide to Traffic Generating Developments* (RTA Guide) (RTA 2002).

Table 2.1 Comparison of 2017 and 2023 proposal

Land use	Component	2017 number of components or GLFA (m^2)	2023 number of components or GLFA (m^2) GFA shown in brackets (m^2)
Residential units (including Seniors Living)	1 bed	46	0
	2 bed	60	0
	3 bed	56	0
Total (Residential)		*162*	*0*
Service Apartments/Terraces	1 bed	2	0
	2 bed	7	0
Total (Service apartments/Terraces)		*9*	*0*
Retail	Supermarket	1,599 m^2	2,848.2 m^2 (3,797.6 m^2)
	Fast Trade	904 m^2	*0*
	Speciality Shops	1,607 m^2	1,188.8 m^2 (1,585 m^2)
Total (Retail)		*4,110 m^2*	*4,037 m^2 (5,382.6 m^2)*
Commercial (office)		1,156 m^2	0
Medical		695 m^2	0
Childcare centre		798 m^2 (86 children)	0
Gym		551 m^2	0
Light industrial (office)		0	3,519.2 m^2 (4,692.3 m^2)
Car parking		*	351 spaces
Accessible parking		*	10 spaces
Motorbike parking		*	10 spaces

Note: *Number of parking spaces not specified

There is no residential component in the revised proposal. A light industrial (office) component has been added. The net retail component has been reduced slightly.

2.1 Site access and egress

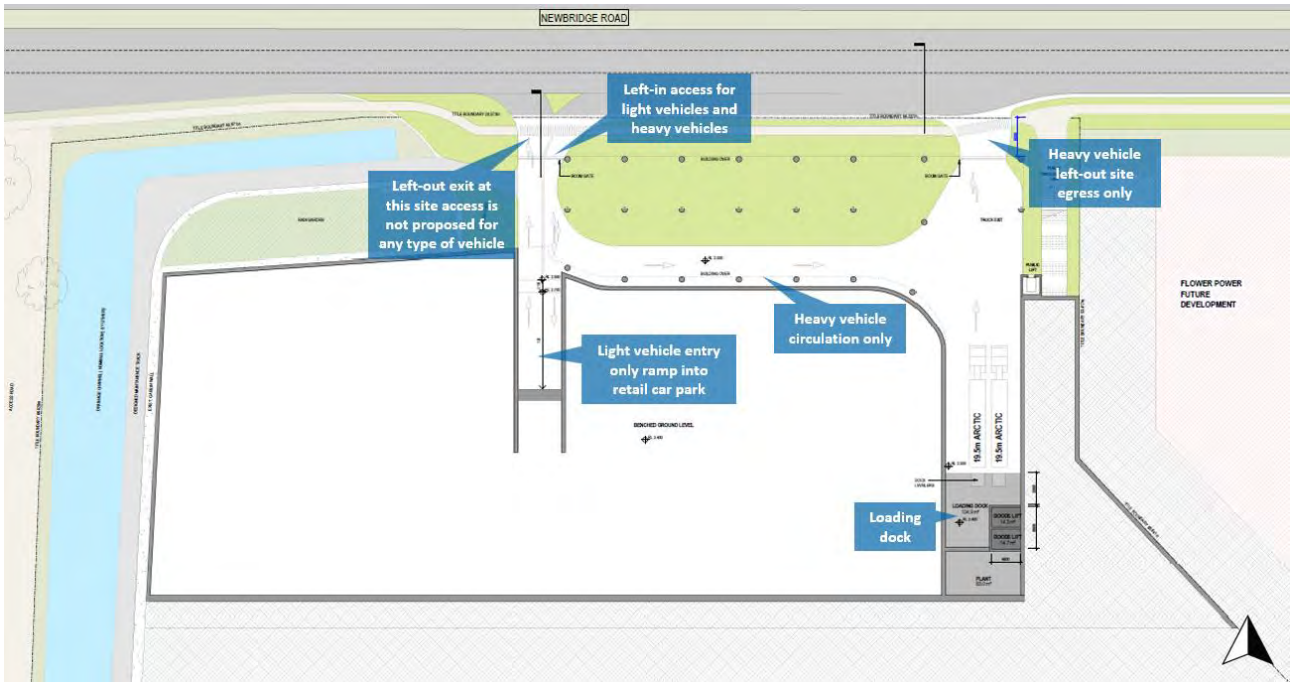
Access to the site is proposed via:

- left in only access from Newbridge Road (east) for use by light and heavy vehicles, including a 50-metre deceleration lane that is currently in place
- left out only egress to Newbridge Road (west) for use by heavy vehicles using the loading dock (not light vehicles)
- two entry and exit driveways to a new road on the southern boundary of the site, which will hereinafter be referred to as DCP Road.

2.2 Internal car park design

Heavy vehicles accessing the site from Newbridge Road (east) will access the loading dock via a one-way internal circulation that is separate from the car park provided for light vehicles, as shown in Figure 2.1.

The retail car park will be located on the bottom levels, which will be separated from the light industrial car park on the top level.



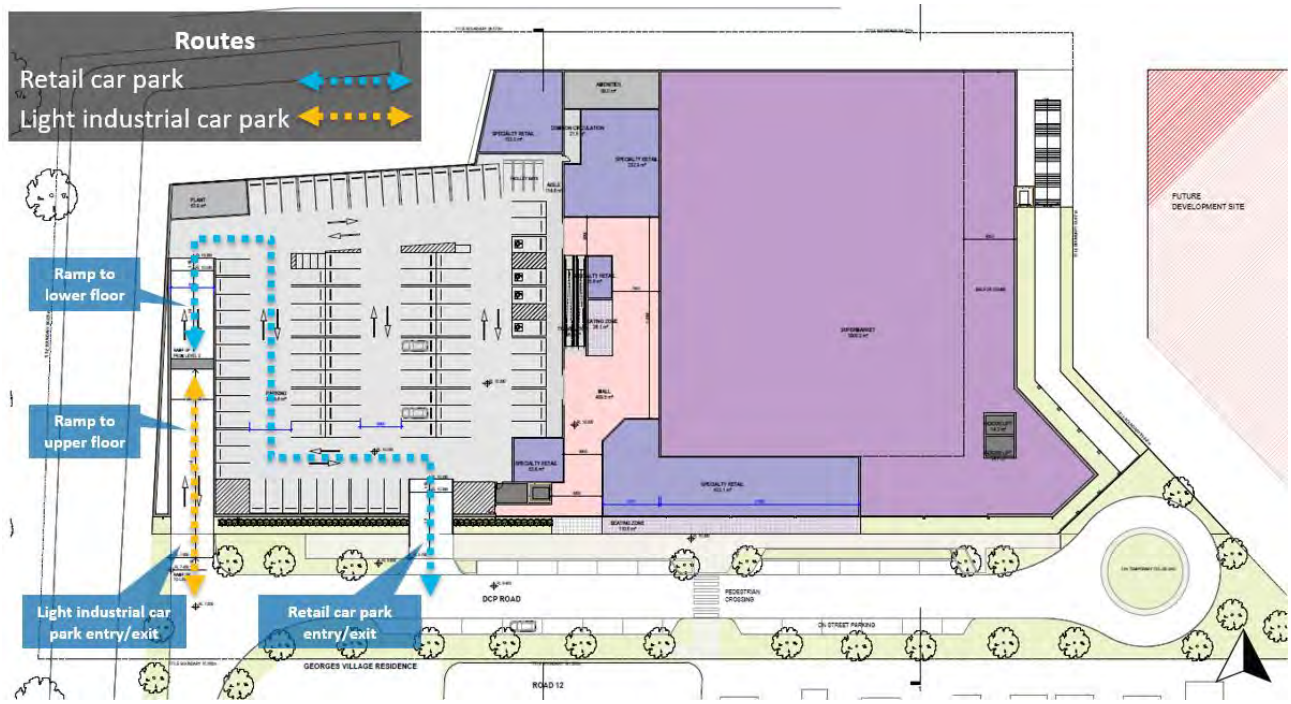
Source: Rothelowman

Figure 2.1 Site access from Newbridge Road and loading dock

Light vehicles accessing the site from Newbridge Road (east) will access the retail car park via a ramp, as shown in Figure 2.1. The retail portion of the car park will also be accessible from DCP Road. Two floors of retail car parking will be provided and circulation within the two floors of the retail car park can be completely accessed internally without going onto a public road.

The car park for light industrial/office spaces will be accessed via a ramp from DCP Road, on the south-west corner of the site.

The routes to access the retail and light industrial car parks from DCP Road are shown in Figure 2.2.



Source: Rothelowman

Figure 2.2 Inbound and outbound vehicular routes from DCP Road to the car parking areas

3 Existing traffic and transport conditions

3.1 Current condition of the site and surrounds

The vehicular bridge on Promontory Way connecting Brickmakers Drive and Spinnaker Drive is now complete and operational (Figure 3.1). Dedicated left and right turn lanes are provided at the Brickmakers Drive/Promontory Way intersection. The residential dwellings along the western fringe of the Georges Cove residential estate are already occupied and the others being constructed.



Source: MetroMap

Figure 3.1 Aerial view of the Georges Cove Precinct (July 2023)

3.2 Road network within the village

The internal road and pedestrian infrastructure serving the occupied residential dwellings are now completed (Photograph 3.1 and Photograph 3.2). The infrastructure along the eastern side of the precinct is currently being constructed. Therefore, traffic surveys undertaken as part of the study have captured both residential and construction traffic.



Photograph 3.1 Mast Place (looking north)



Photograph 3.2 Ketch Lane (looking north)

3.3 Public transport

Buses run along Newbridge Road. The closest bus stops to the site are served by bus route M90 (Figure 3.2), which operates from Liverpool Station to Burwood Station via Bankstown.

The operating hours of the M90 are:

- Monday to Friday: 5 am–11 pm
- Saturdays: 6 am–11 pm
- Sundays and Public Holidays: 7 am–9 pm.

The M90 service operates at 10-minute intervals during the AM and PM peaks, 15-minute intervals during the day on weekdays and 20-minute intervals during the day on weekends and public holidays. The Georges Cove Site is therefore well serviced by public transport.



Source: MetroMap

Figure 3.2 Bus stops and bus route in the vicinity of the site

3.4 Bicycle network

An off-road bicycle path is provided on the north side of Newbridge Road (Figure 3.3), which directly passes the site. The paths connect to the wider bicycle network towards Liverpool and Bankstown. These provide opportunities for staff and visitors to cycle to the site.



Source: MetroMap

Figure 3.3 Bicycle network in the vicinity of the site

3.5 Pedestrian connectivity

Pedestrian connectivity within the precinct is suitable. Footpaths are provided in most of the street frontages (Photograph 3.3) within the Georges Cove residences, which will connect to Georges Cove Village. At Promontory Way, a pedestrian foot overbridge will link the Georges Cove residences and the residential precinct located west of Brickmakers Drive (Photograph 3.4).



Photograph 3.3 Footpath in Angler Avenue (looking north)



Photograph 3.4 Pedestrian overbridge to be opened late 2023

3.6 Journey to work data analysis

Australian Bureau of Statistics (ABS) data from the Census of Population and Housing 2021 is published on https://profile.id.com.au/ (ID). In this report, ID data has been used to determine the trip distribution, based on the locations of residents of people working in the Liverpool Local Government Area (LGA). The route selection for each journey is taken as the fastest route between the site and the destination.

Furthermore, the likely residences of retail customers have been factored into the traffic distribution, taking into account that traffic entering the retail premises are more likely to be local.

Based on the combination of the 2021 ID data and factoring in the local traffic for retail premises, a trip distribution has been found for a typical person visiting the site, which has been compared with the distribution assumed by Ason. These results are shown in Table 3.1.

Table 3.1 Trip distribution

Direction	2017 Ason	2023 EMM (this report)
North – Governor Macquarie Drive north of Newbridge Road	15%	10%
East – Newbridge Road east of Davy Robinson Drive	30%	39%
South – Brickmakers Drive south of Promontory Way	15%	16%
West – Newbridge Road west of Governor Macquarie Drive	40%	35%

As seen in Table 3.1, the difference in each direction is less than 10% for each direction, which is unlikely to vary the results significantly. For simplicity, the Ason distribution have been used for each direction.

3.7 Existing traffic volumes

As part of this traffic report, traffic surveys were conducted on Thursday 22 June 2023 between 7 am–9 am and 4 pm–6 pm, during a non-school holiday period. The following intersections were surveyed, as shown in Figure 3.4:

- Brickmakers Drive/Promontory Way
- Newbridge Road/Governor Macquarie Drive/Brickmakers Drive
- Newbridge Road/Site Access
- Newbridge Road/Davy Robinson Drive.



Source: MetroMap

Figure 3.4 Surveyed intersections

The network peak hours have been found to be:

- AM: 7:15 am to 8:15 am
- PM: 4:45 pm to 5:45 pm.

The traffic volumes on the road network in the vicinity of the site are shown in Figure 3.5.

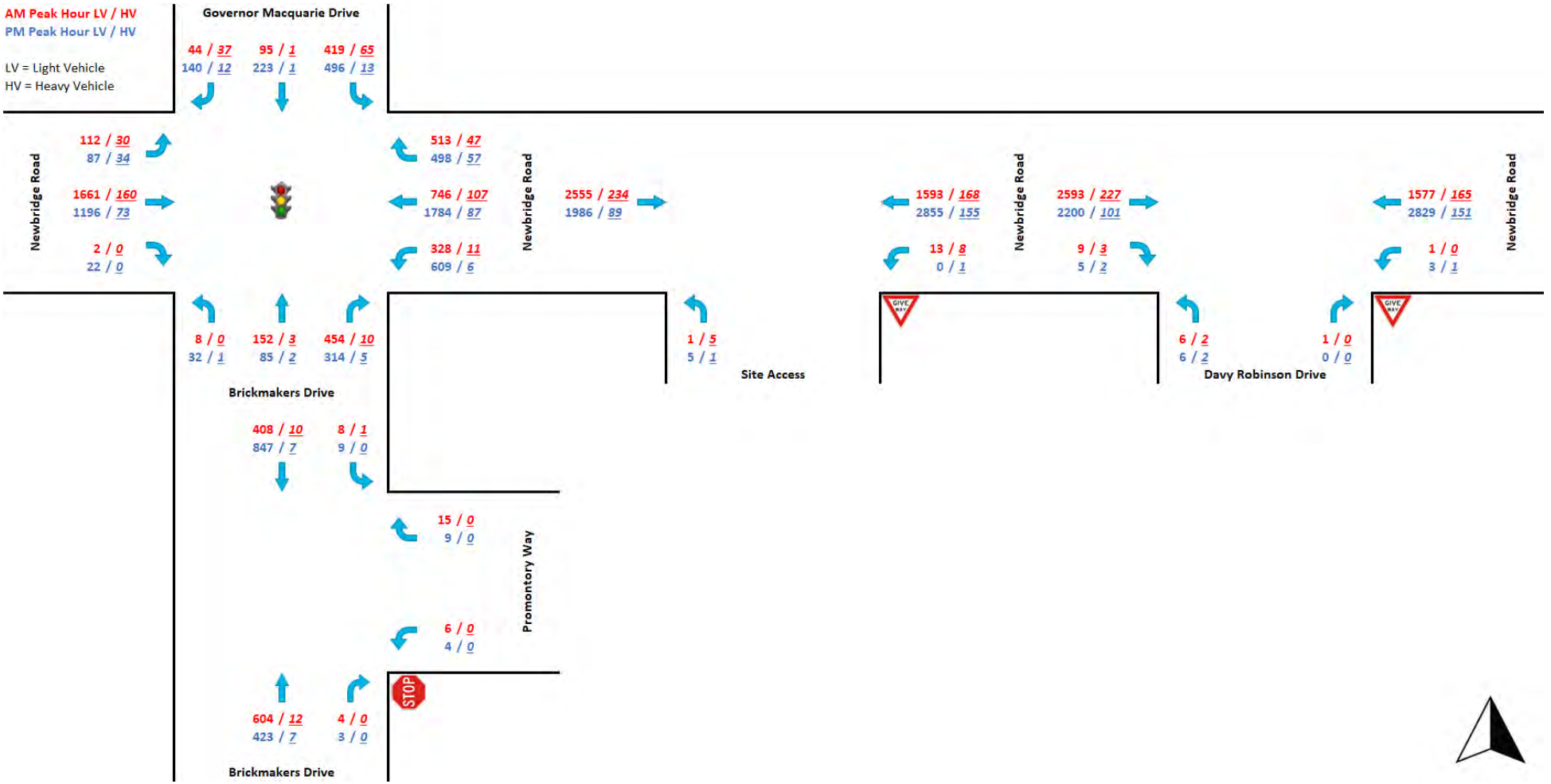


Figure 3.5 **2023 surveyed traffic volumes during the AM and PM peak hour**

The traffic data in the above figure shows that Newbridge Road carried 4,577 vehicles in the AM peak and 5,092 vehicles in the PM peak. For Promontory Way, the respective AM and PM volumes were 34 and 25.

The traffic volumes from Figure 3.5 will be referred to as the baseline traffic volumes in the subsequent sections of the report.

Along Newbridge Road, the heavy vehicle percentages were found to be:

- AM peak: 9%
- PM peak: 5%

4 Development traffic assessment

Two scenarios have been assessed to determine the traffic impacts of the development of Georges Cove Village.

Scenario A assumes that DCP Road will not be connected to Davy Robinson Drive. Newbridge Road/Davy Robinson Drive intersection will not be signalised. Scenario A has been modelled based on the existing connection of the site to Brickmakers Drive via Promontory Way.

Scenario B assumes that DCP Road will be connected to Davy Robinson Drive via the Flower Power site (Figure 1.1). Newbridge Road/Davy Robinson Drive intersection will be signalised. Scenario B has been modelled to determine whether there will be potential improvement to the performance of Newbridge Road/Governor Macquarie Drive/Brickmakers Drive and Brickmakers Drive/Promontory Way intersections as a result of providing another signalised intersection at Newbridge Road/Davy Robinson Drive for the development traffic to enter and exit the area.

A summary of Scenario A and Scenario B is shown in Table 4.1.

Table 4.1 Inclusions in Scenario A and Scenario B

Scenario	Signalised Newbridge Rd/ Governor Macquarie Dr/ Brickmakers Dr	Signalised Brickmakers Dr/ Promontory Way	Signalised Newbridge Rd/ Davy Robinson Dr	Left in from Newbridge Road to Georges Cove Village for light and heavy vehicles	Left out from Georges Cove Village to Newbridge Road for heavy vehicles	Left out from Georges Cove Village to Newbridge Road for light vehicles
A	Yes	Yes	No	Yes	Yes	No
B	Yes	Yes	Yes	Yes	Yes	No

Details of the traffic distribution for Scenario A and Scenario B are discussed later in this chapter.

4.1 Georges Cove Village development traffic assessment

The traffic assessment for the Georges Cove Village development assumes that all other developments within the precinct are operational. This is a conservative approach for the traffic assessment.

4.1.1 Georges Cove Village development traffic distribution

The details for the development traffic distribution for each scenarios are:

- **Scenario A**:
  - DCP Road will not be connected to Davy Robinson Drive.
  - All Georges Cove Village traffic that leaves to the south via DCP Road will connect to the broader road network via Brickmakers Drive/Promontory Way signalised intersection.
  - Light and heavy vehicles will be allowed to turn left from Newbridge Road (east) to enter the Georges Cove Village site, but light vehicles will not be allowed to leave the Georges Cove Village site directly onto Newbridge Road (west).
  - Heavy vehicles will still be allowed to leave the Georges Cove Village site directly via a left turn onto Newbridge Road (west).

- **Scenario B**:

  - DCP Road will be connected to Davy Robinson Drive, allowing all Georges Cove Village traffic to use the Newbridge Road/Davy Robinson Drive signalised intersection, as well as the Brickmakers Drive/Promontory Way signalised intersection.

  - Light and heavy vehicles will be allowed to turn left from Newbridge Road (east) to enter the Georges Cove Village site, but light vehicles will not be allowed to leave the Georges Cove Village site directly onto Newbridge Road (west).

  - Heavy vehicles will still be allowed to leave the Georges Cove Village site directly via a left turn onto Newbridge Road (west).

The Georges Cove Village traffic distribution for Scenario A is shown in Figure 4.1, and Scenario B is shown in Figure 4.2.



Source: MetroMap

Figure 4.1 Georges Cove Village traffic distribution for Scenario A



Source: MetroMap

Figure 4.2 Georges Cove Village traffic distribution for Scenario B

4.1.2 Georges Cove Village development traffic generation and volumes

Georges Cove Village development traffic has been calculated based on Section 3.6.1 of the RTA Guide. During weekdays, the site is likely to generate the most traffic on Thursday. Hence, the relevant formula from Section 3.6.1 that calculates traffic on a Thursday is likely to provide a conservative estimate of the peak hour traffic generation.

The peak hour traffic generation can be calculated using the 2023 GLFA in Table 2.1. The traffic generation rate for the evening peak period for different land uses are shown in Table 4.2. Movements are defined to be a vehicle going from one point to another, excluding the return journey. A return trip to/from a land use is counted as two movements.

Table 4.2 Evening peak hour traffic generation factor

Land use category	GLFA (m^2)	Peak hour traffic generation rate (vehicle movements per m^2 of GLFA)
Supermarket (retail)	2,848.2	0.155
Speciality shops (retail)	1,188.8	0.046
Light industrial and office	3,519.2	0.022

Furthermore, the following factors have been considered to calculate the peak hour traffic movements:

- For the evening peak, the presence of the site next to an arterial road (Newbridge Road) and the multiple stores within the site mean that the site will benefit from a reduction in vehicular movements due to linked trips (passing trade) and multi-purpose trips (where more than one shop is visited). In accordance with Section 3.6.1 of the RTA guide, retail traffic generation rates during the evening peak, shown in Table 4.2, have been reduced by 25%.

- For the morning peak, it is assumed that retail traffic generation rates are 33% of the evening peak traffic generation rates shown in Table 4.2.

The traffic split for the morning and evening peak period are:

- AM peak hour: 70% in/30% out
- PM peak hour: 50% in/50% out.

It is assumed that the proportion of heavy vehicles entering/exiting the site follows the same distribution as Newbridge Road, which is 9% during the AM peak hour and 5% during the PM peak hour.

Considering all of the above, the development is expected to generate the following morning and evening peak hourly traffic volumes shown in Table 4.3. The traffic volumes in the table shows that the PM peak volumes are significantly higher, compared to AM peak, due to the influence of the retail component of the development. The traffic generation due to the retail is minimal during the AM peak.

Table 4.3 Georges Cove Village development traffic volumes

Peak hour	Movements in		Movements out		Total movements
	Light vehicles	Heavy vehicles	Light vehicles	Heavy vehicles	
AM	158	11	61	11	241
PM	214	11	214	11	450

The Georges Cove Village traffic volumes calculated from Table 4.3 are distributed to the wider road network in accordance with Figure 4.1 and Figure 4.2 (Scenario A and Scenario B respectively). The resultant Georges Cove Village traffic volumes for Scenario A and Scenario B are shown in Figure 4.3 and Figure 4.4 respectively. Note that the sum of the movements may be off by one due to rounding.

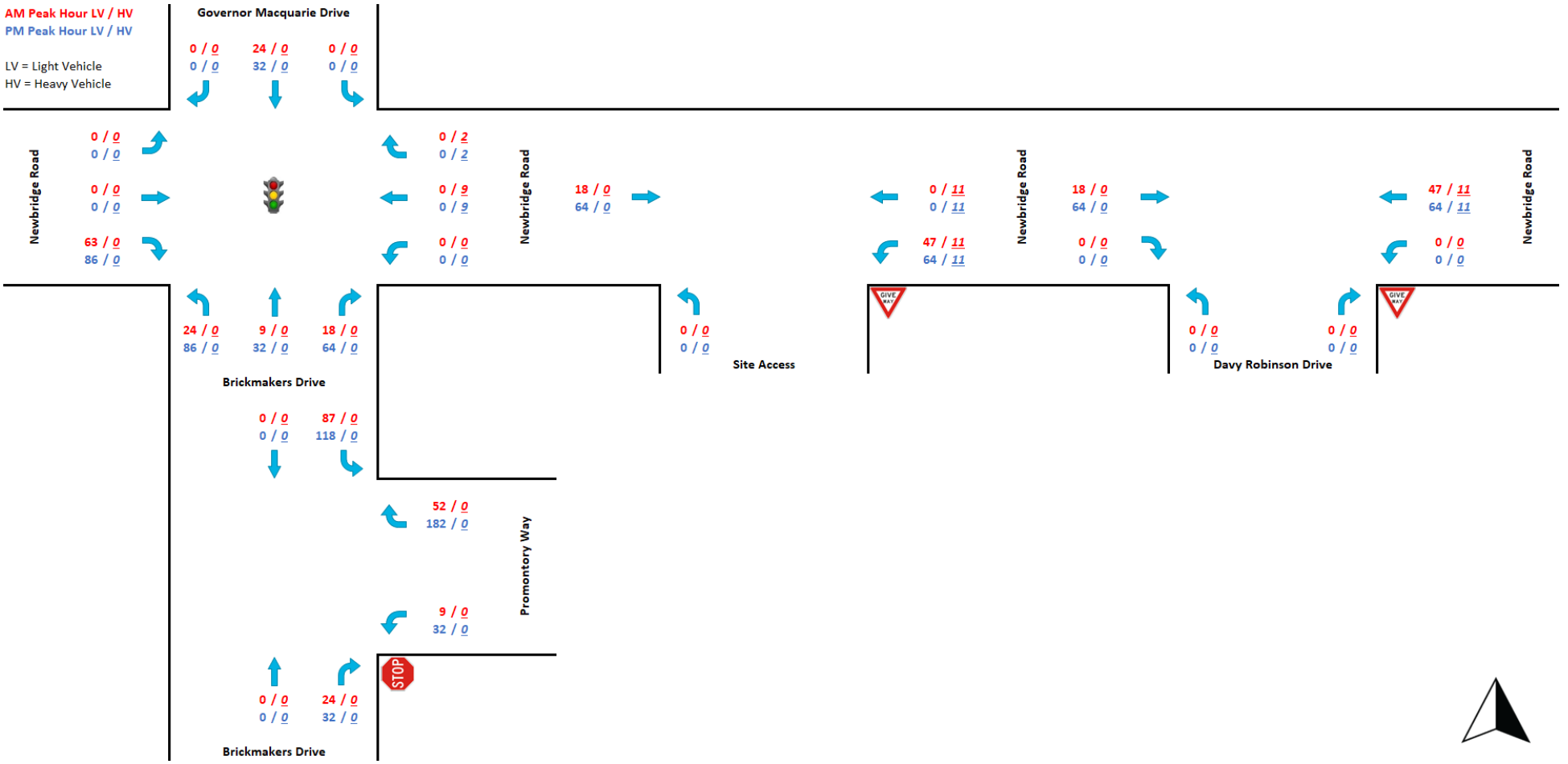


Figure 4.3 Georges Cove Village traffic volumes for Scenario A

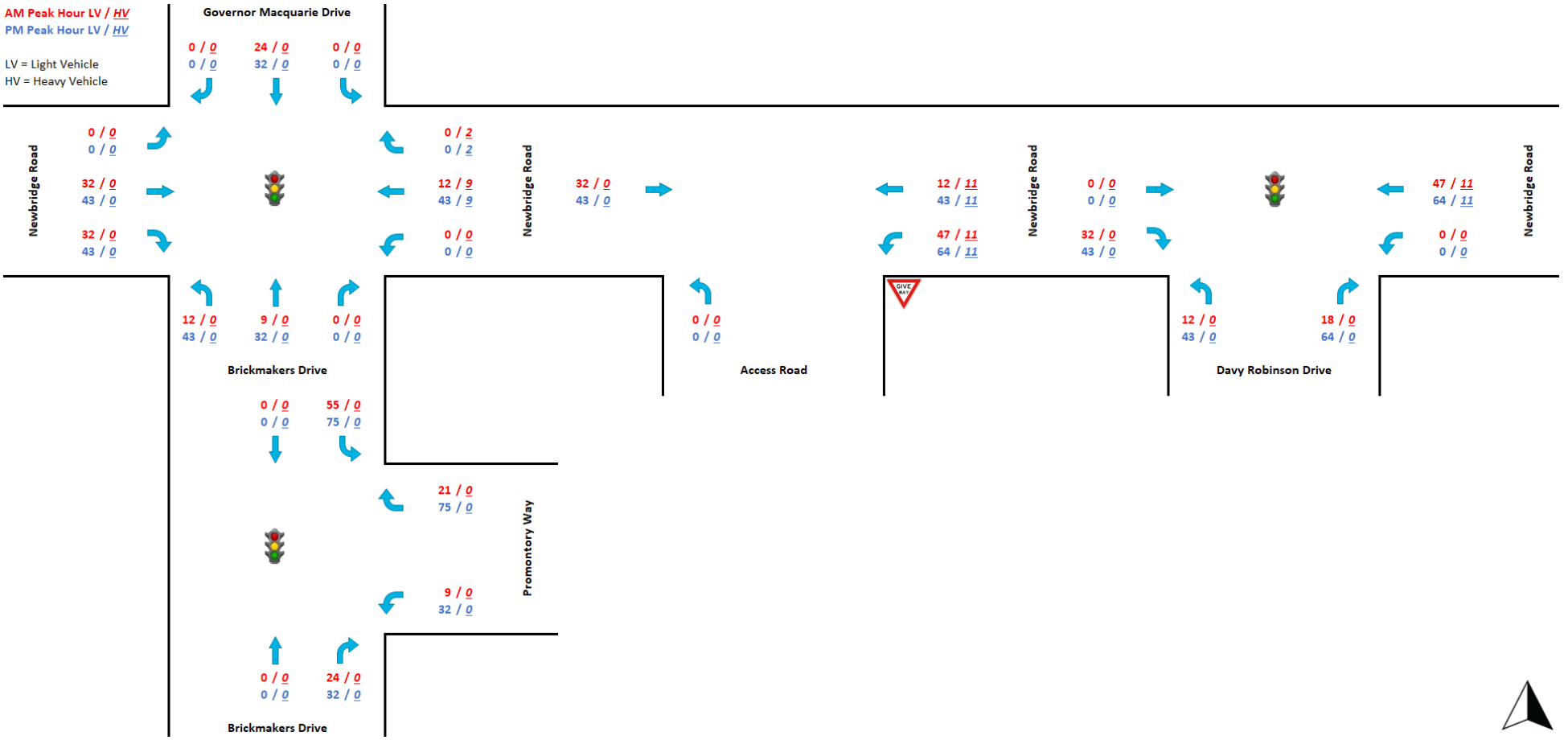


Figure 4.4 Georges Cove Village traffic volumes for Scenario B

4.2 Cumulative developments

To assess the cumulative traffic for the planning proposal, the following components of the broader precinct have been included:

- Georges Cove residences
- Georges Cove Marina (residential)
- Georges Cove Marina (commercial)
- Moorebank Recyclers land.

For the cumulative developments, a comparison of the traffic generating factors in the previous planning proposal[1] (EMM 2018) and the 2023 proposal is provided in Table 4.4.

Table 4.4 Cumulative developments

Land use	Component	2018 proposal	2023 proposal
Georges Cove residences	Residential	179 dwellings	No change
Moorebank Recyclers land	Industrial	Trucks delivering/dispatching waste and dispatching products	No change
Georges Cove Marina	Commercial	1,243 m^2 commercial gross floor area (GFA), 250 dry storage berths, 186 marina berths	No change
Georges Cove Marina	Residential	374 dwellings	340 dwellings (319 apartments and 21 terrace dwellings) and 1,500 m^2 restaurant & cafe

4.2.1 Cumulative traffic distribution

The details for the cumulative traffic distribution (i.e. other than for Georges Cove Village) for each scenario assume:

- **Scenario A**:
  - DCP Road will not be connected to Davy Robinson Drive.
  - All traffic will be entering and exiting Georges Cove precinct via Promontory Way.
  - Brickmakers Drive/Promontory Way is a signalised intersection with the existing approach and departure lane layout and a pedestrian crossing facility at the north approach.

[1] Georges Cove Marina Residential Planning Proposal Traffic Impact Assessment prepared by EMM dated 10 April 2018

- **Scenario B**:
  - DCP Road will be connected to Davy Robinson Drive following the development of Flower Power site and Georges Cove Village site.
  - Traffic will be distributed so that it enters and exits the Georges Cove precinct via both Promontory Way and Davy Robinson Drive.
  - Brickmakers Drive/Promontory Way is a signalised intersection with the existing approach and departure lane layout and a pedestrian crossing facility at the north approach.
  - Newbridge Road/Davy Robinson Drive is a signalised intersection with the existing approach and departure lane layout and pedestrian crossing facilities on all three approaches (east, south and west approaches).

The cumulative traffic distribution for Scenario A and Scenario B are shown in Figure 4.5 and Figure 4.6.



Source: MetroMap

Figure 4.5 Scenario A cumulative traffic distribution



Source: MetroMap

Figure 4.6 Scenario B cumulative traffic distribution

4.2.2 Cumulative traffic volumes

The assumed cumulative traffic generation for the different developments in the precinct are shown in Table 4.5.

Table 4.5 Cumulative traffic volumes from different developments

Development component	Peak hour	Movements in		Movements out		Total movements
		Light vehicles	Heavy vehicles	Light vehicles	Heavy vehicles	
Georges Cove Marina (residential)	AM	33	0	132	0	165
	PM	99	0	66	0	165
Georges Cove Marina (commercial)	AM	46	3	9	3	61
	PM	41	2	41	2	86
Georges Cove residences	AM	30	0	122	0	152
	PM	91	0	61	0	152
Moorebank Recyclers land	AM	0	23	0	20	43
	PM	0	13	0	16	29
Total	**AM**	**109**	**26**	**263**	**23**	**421**
	PM	**231**	**15**	**168**	**18**	**432**

The cumulative traffic volumes calculated from Table 4.5 are distributed to the wider road network in accordance with Figure 4.5 for Scenario A and Figure 4.6 for Scenario B. The resultant cumulative traffic volumes are shown in

Figure 4.7 and Figure 4.8 for Scenario A and Scenario B respectively. Note that the sum of the movements may be off by one due to rounding.

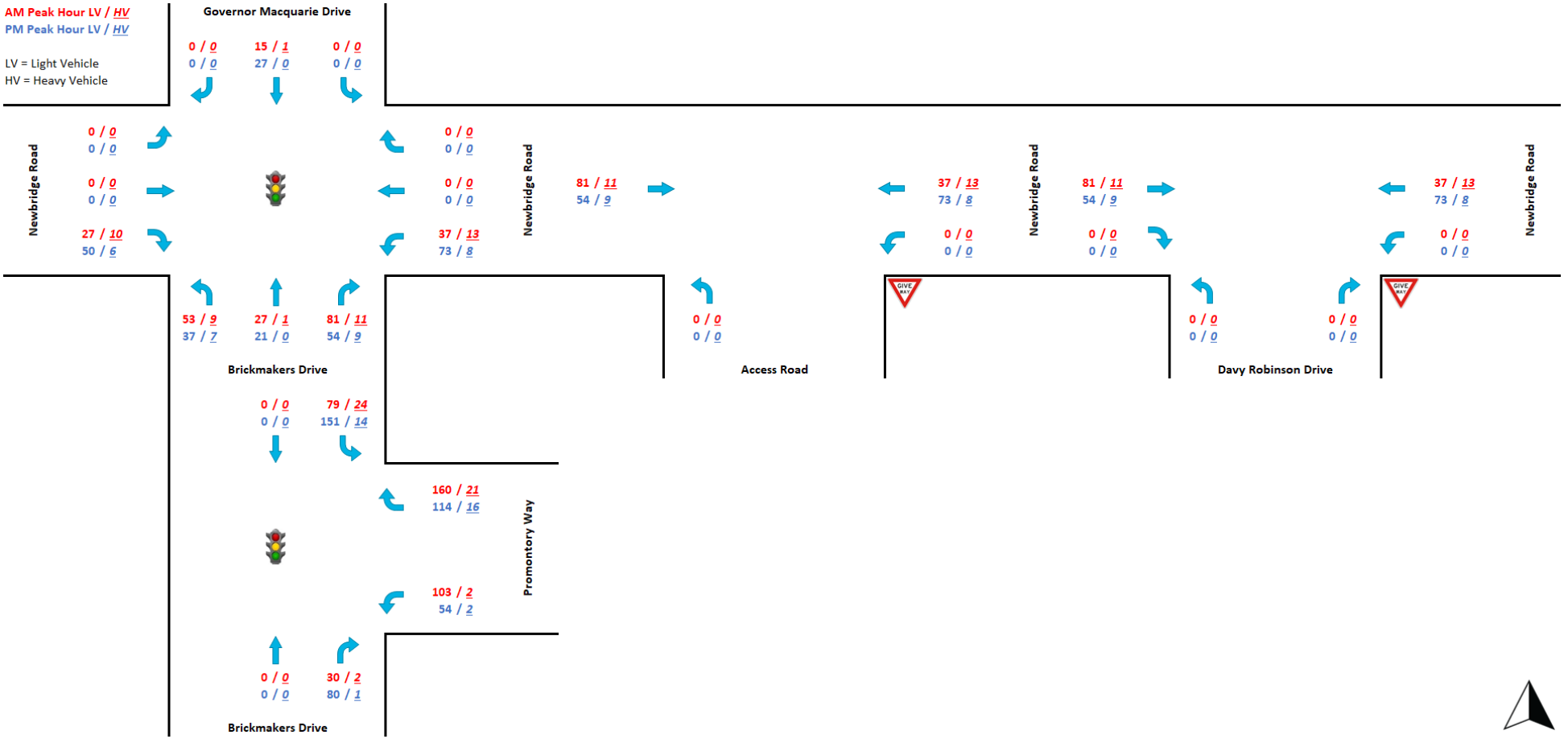


Figure 4.7 **Scenario A cumulative traffic volumes**

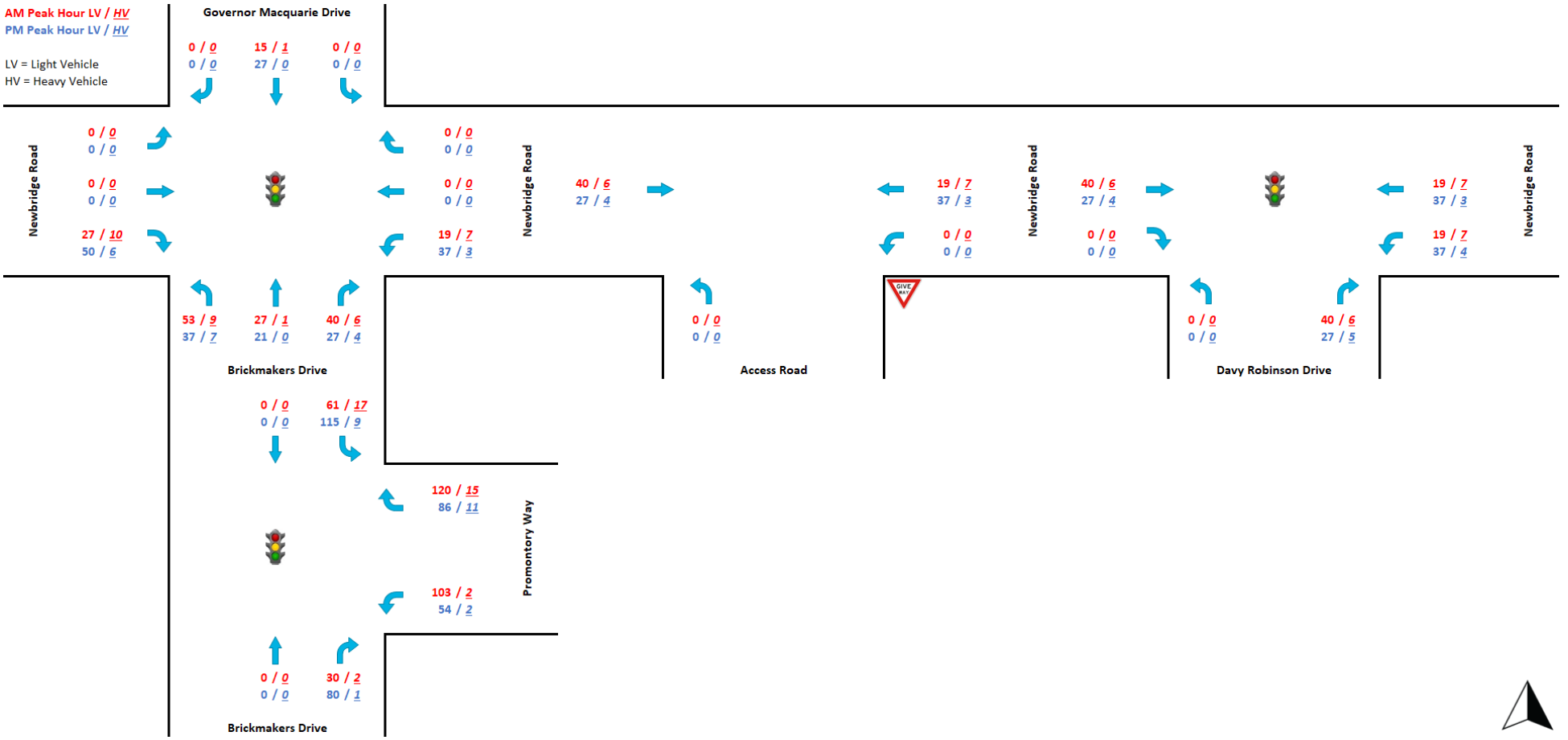


Figure 4.8 Scenario B cumulative traffic volumes

4.3 Baseline, Georges Cove Village development and cumulative traffic

Currently, left-in movements are permitted from Newbridge Road (east) to the site, while left-out movements are permitted from the site to Newbridge Road (west) for both light and heavy vehicles. The existing left turn light vehicle movements from the site to Newbridge Road will be restricted in the future once the Georges Cove Village site is developed. All movements exiting the site at the existing intersection will be restricted as the access road will only be for left turning vehicles entering the site.

To calculate the baseline traffic volumes, the existing left turning movements from the site that will be restricted in the future have been redistributed to the other parts of the road network.

The redistributed baseline, Georges Cove Village development and cumulative traffic have been combined in Scenario A and Scenario B, which are shown in Figure 4.9 and Figure 4.10 respectively.

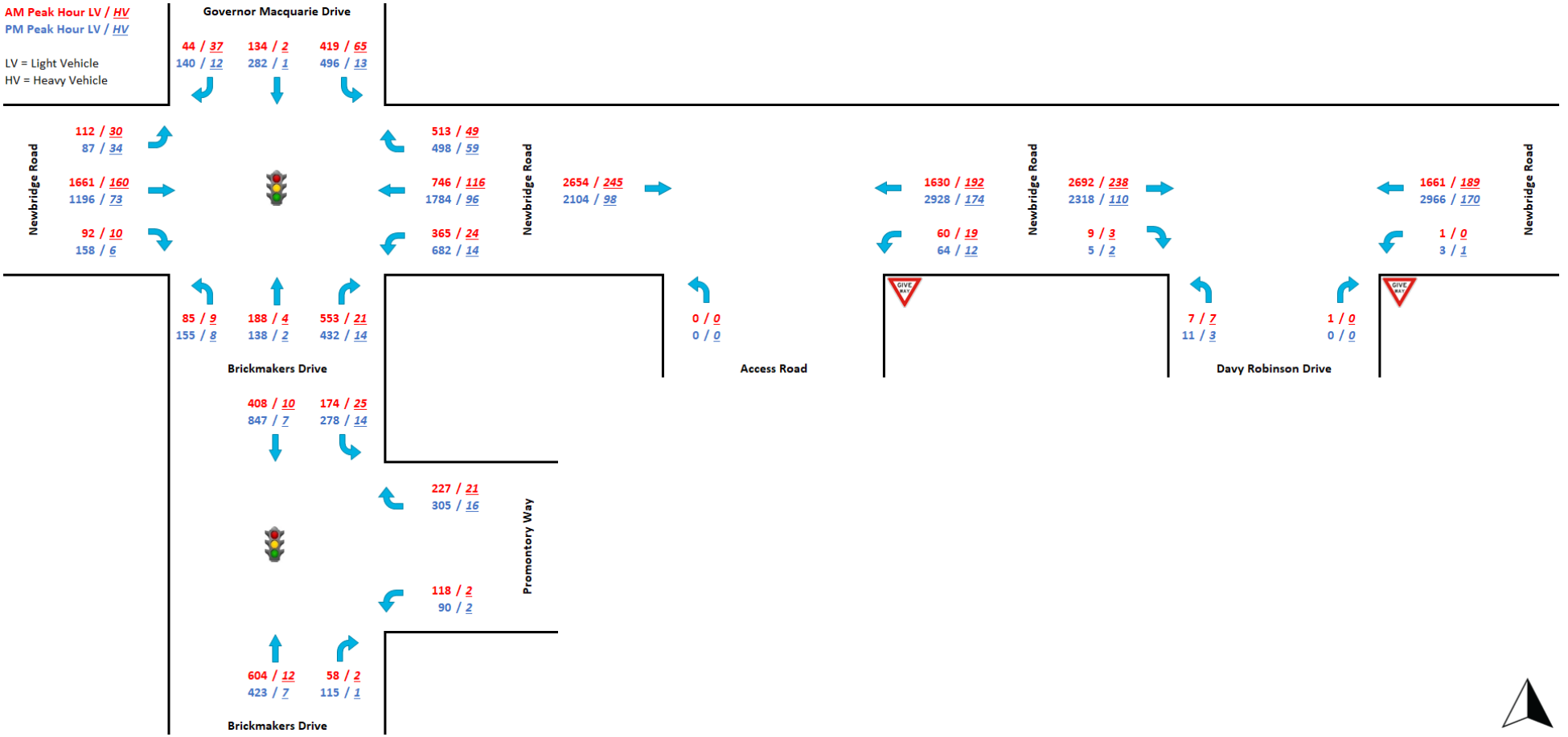


Figure 4.9 **Baseline, Georges Cove Village development and cumulative traffic volumes for Scenario A**

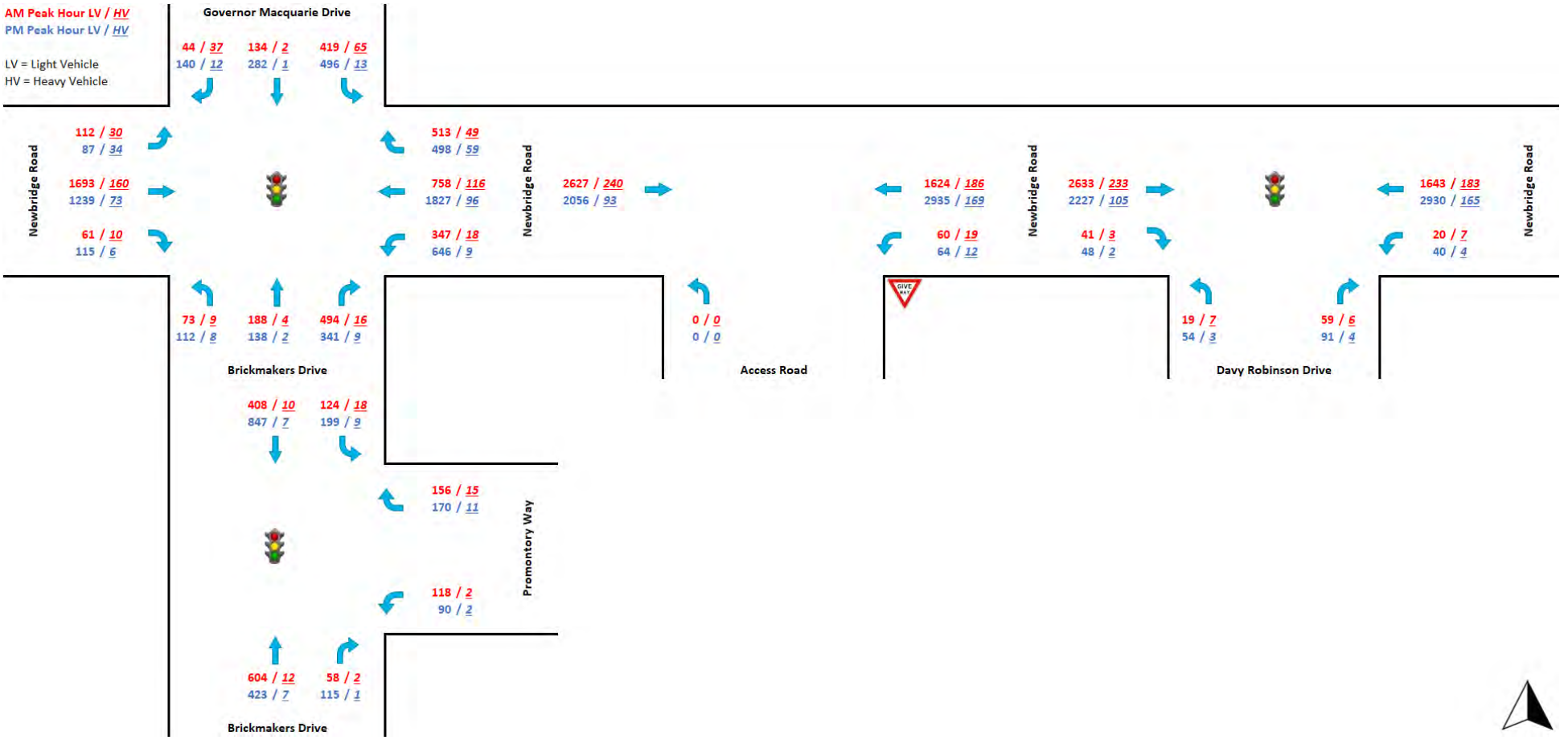


Figure 4.10 **Baseline, Georges Cove Village development and cumulative traffic volumes for Scenario B**

4.4 Intersection impact assessment

The intersections shown in Figure 3.4 have been modelled with the SIDRA Intersection 9.1 software, a micro-analytical tool for individual intersections and linked intersection-network modelling. The modelling is based on the surveyed traffic volumes detailed in Section 3.7 and site traffic volumes in Section 4.3. SIDRA provides the following performance indicators:

- Degree of saturation (DOS) – the total usage of the intersection expressed as a factor of 1 with 1 representing 100% use/saturation (e.g. 0.8 = 80% saturation).

  In practice, the target degrees of saturation of 0.90 for signals, 0.85 for roundabouts and 0.80 for unsignalised intersections are generally agreed to. These are usually called 'practical degrees of saturation'.

- Average delay (DEL) – for a signalised or roundabout intersection, this is the average delay in seconds encountered by all vehicles passing through the intersection. For a priority-controlled intersection, this is the average delay experienced by the worst approach and turning movement. It is often important to review the average delay of each approach as a side road could have a long delay time, while the large free flowing major traffic will provide an overall low average delay.

- Level of service (LOS) – this is a categorisation of average delay, intended for simple reference. For a priority-controlled intersection, this is the categorisation of the average delay experienced by the worst approach and turning movement.

- 95% queue lengths (Q95) – is defined to be the queue length in metres that has only a 5% probability of being exceeded during the analysed time period. It transforms the average delay into measurable distance units.

The LOS is a good indicator of overall performance for individual intersections, with each level summarised in Table 4.6.

Table 4.6 Intersection LOS standards

Level of service	Average delay (seconds per vehicle)	Traffic signals, roundabout	Priority intersection ('Stop' and 'Give Way')
A	<14	Good operation	Good operations
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity. At traffic signals, incidents will cause extensive delays. Roundabouts require other control mode.	At capacity, required other control mode
F	>71	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing; required other control mode

Source: *RTA Guide to Traffic Generating Developments* (RTA 2002)

SIDRA intersection modelling has been conducted for the following scenarios:

- Existing scenario: This scenario includes surveyed traffic volumes only and without any proposed development or cumulative traffic volumes.
- Scenario A: This scenario includes the baseline, development and cumulative traffic volumes all entering and exiting via Promontory Way, as discussed in Section 4.1.1 and Section 4.2.1.
- Scenario B: This scenario includes the baseline, development and cumulative traffic volumes distributed via Promontory Way and Davy Robinson Drive, as discussed in Section 4.1.1 and Section 4.2.1.

The following abbreviations are used for the turn movements:

- TH: through
- LT: left turn
- RT: right turn.

The SIDRA results for the key intersections are presented in the following tables. Detailed SIDRA results can be found in Appendix C.

4.4.1 Brickmakers Drive/Promontory Way

Table 4.7 SIDRA modelling result for Brickmakers Drive/Promontory Way

Control: 1. Priority controlled (stop) 2. Signalised 3. Signalised	AM Peak						PM Peak					
Scenarios	**Intersection volume**	**DEL (s)**	**LOS**	**DOS**	**Q95 (m)**	**Q95 approach and direction**	**Intersection volume**	**DEL (s)**	**LOS**	**DOS**	**Q95 (m)**	**Q95 approach and direction**
1. Existing (without development)	1,124	11.6	A	0.337	0.8	RT from Promontory Way (east)	1,378	22.7	B	0.463	1.0	RT from Promontory Way (east)
2. Scenario A: Baseline + Georges Cove Village development + cumulative developments via Promontory Way	1,748	25.5	B	0.573	186.9	TH from Brickmakers Drive (south)	2,216	15.3	B	0.858	142.4	TH from Brickmakers Drive (north)
3. Scenario B: Baseline + Georges Cove Village development + cumulative developments via Promontory Way and Davy Robinson Drive	1,607	9.7	A	0.641	66.3	TH from Brickmakers Drive (south)	1,980	13.2	A	0.883	133.8	TH from Brickmakers Drive (north)

Key findings for Brickmakers Drive/Promontory Way intersection:

- In AM and PM, the intersection performs satisfactorily within capacity with LOS A or B and DoS <0.9 for all scenarios.
- Signalisation of the Brickmakers Drive/Promontory Way intersection prior to the completion of this development will produce an acceptable level of performance and provide capacity to accommodate additional traffic.
- In the AM peak in Scenario A, the queue may stretch back to the roundabout. This queuing will be alleviated by the connection of the DCP Road to Davy Robinson Drive, as modelled in Scenario B. In addition, it should be noted that the existing traffic counts at this intersection also included construction related heavy vehicles. Hence, the SIDRA model is conservative. Overall, the SIDRA results for Scenario B are better than Scenario A due to less traffic at this intersection.
- Regardless of the timing of the Flower Power development and the eventual signalisation of Brickmakers Drive/Davy Robinson Drive, all the remaining developments can proceed under Scenario A at acceptable levels.

4.4.2 Newbridge Road/Governor Macquarie Drive/Brickmakers Drive

Table 4.8 SIDRA modelling result for Newbridge Road/Governor Macquarie Drive/Brickmakers Drive

Control: Signalised	AM Peak						PM Peak					
Scenarios	**Intersection volume**	**DEL (s)**	**LOS**	**DOS**	**Q95 (m)**	**Q95 approach and direction**	**Intersection volume**	**DEL (s)**	**LOS**	**DOS**	**Q95 (m)**	**Q95 approach and direction**
1. Existing (without development)	5,268	70.7	F	1.177	368.8	LT from Newbridge Road (west)	6,081	110.3	F	1.128	300.4	LT from Newbridge Road (west)
2. Scenario A: Baseline + Georges Cove Village development + cumulative developments via Promontory Way	5,725	120.1	F	1.113	651.7	LT from Newbridge Road (west)	6,716	72.0	F	0.982	293.8	TH from Newbridge Road (east)
3. Scenario B: Baseline + Georges Cove Village development + cumulative developments via Promontory Way and Davy Robinson Drive	5,634	105.2	F	1.081	617.7	LT from Newbridge Road (west)	6,572	60.0	E	0.930	293.8	TH from Newbridge Road (east)

Key findings for Newbridge Road/Governor Macquarie Drive/Brickmakers Drive intersection:

- In AM and PM, the intersection performs over the capacity with LOS F for existing scenarios.
- Despite additional traffic volumes for Scenario A and B, some intersection parameters will be improved due to the prioritisation of certain movements in the existing scenario. In the existing scenario, the prioritisation of certain movements is contributing to DOS >1.1 in the AM peak and an average delay greater than 100 seconds in the PM peak.
- As the intersection is already over capacity in the existing scenarios, the additional traffic volumes from the Georges Cove Village development and cumulative developments make a negligible difference, as they only contribute up to 10.4% of the intersection traffic volumes.
- When comparing Scenario A and Scenario B, there is a reduction in the average intersection delay from 120.1 seconds to 105.3 seconds in the AM peak once Davy Robinson Drive is connected to the site.
- When comparing Scenario A and Scenario B, the LOS improves from F to E in the PM peak once Davy Robinson Drive is connected to the site.

4.4.3 Newbridge Road/Site Access

Table 4.9 SIDRA modelling result for Newbridge Road/Site Access

Control: Priority controlled (give way)	AM Peak						PM Peak					
Scenarios	**Intersection volume**	**DEL (s)**	**LOS**	**DOS**	**Q95 (m)**	**Q95 approach and direction**	**Intersection volume**	**DEL (s)**	**LOS**	**DOS**	**Q95 (m)**	**Q95 approach and direction**
1. Existing (without development)	4,818	13.4	A	0.529	1.0	LT from Access Road (south)	5,360	17.2	B	0.560	413.5	TH from Newbridge Road (east)
2. Scenario A: Baseline + Georges Cove Village development + cumulative developments via Promontory Way	5,053	9.9	A	0.506	0	N/A	5,663	9.8	A	0.578	247.6	TH from Newbridge Road (east)
3. Scenario B: Baseline + Georges Cove Village development + cumulative developments via Promontory Way and Davy Robinson Drive	5,006	9.9	A	0.514	0	N/A	5,609	9.8	A	0.667	173.4	TH from Newbridge Road (east)

Key findings for Newbridge Road/Site Access intersection:

- In AM, the intersection performs satisfactorily within capacity with LOS A and DoS <0.6 for all scenarios.
- In PM, the intersection performs satisfactorily within capacity with LOS B and DoS <0.7 for all scenarios.
- In Scenario A, due to the maximum queue of 247.6 m on the east approach of Newbridge Road/Governor Macquarie Drive/Brickmakers Drive, light and heavy vehicles from Newbridge Road (east) will be part of the queue while attempting to enter the site. There are no vehicles exiting at this intersection.

4.4.4 Newbridge Road/Davy Robinson Drive

Table 4.10 SIDRA modelling result for Newbridge Road/Davy Robinson Drive

Control: 1. Priority controlled (give way) 2. Priority controlled (give way) 3. Signalised	AM Peak						PM Peak					
Scenarios	**Intersection volume**	**DEL (s)**	**LOS**	**DOS**	**Q95 (m)**	**Q95 approach and direction**	**Intersection volume**	**DEL (s)**	**LOS**	**DOS**	**Q95 (m)**	**Q95 approach and direction**
1. Existing (without development)	4,825	159.7	F	1.013	15.4	LT from Davy Robinson Drive (south)	5,580	448.7	F	1.219	24.6	RT from Newbridge Road (west)
2. Scenario A: Baseline + Georges Cove Village development + cumulative developments via Promontory Way	5,061	184.8	F	1.029	20.7	LT and RT from Davy Robinson Drive (south)	5,884	436.0	F	1.228	24.6	RT from Newbridge Road (west)
3. Scenario B: Baseline + Georges Cove Village development + cumulative developments via Promontory Way and Davy Robinson Drive	5,109	22.7	B	0.894	338.3	TH from Newbridge Road (west)	5,972	18.9	B	0.882	382.0	TH from Newbridge Road (east)

Key findings for Newbridge Road/Davy Robinson Drive intersection:

- In AM and PM, the intersection performs over capacity in the existing scenario and Scenario A, with LOS F and DoS >1.0 for these scenarios with priority controlled (give way) intersections.
- Overall, the intersection will have capacity to accommodate the development when it is upgraded to a signalised intersection once the DCP Road is connected to Davy Robinson Drive. Depending on the spatial traffic distribution and broader network connectivity, upgrades may be required to Davy Robinson Drive (south approach), such as dedicated left and right turn lanes to minimise queue lengths and overall delays. This is also dependent on the development of the Flower Power site.
- Given that signalisation of Newbridge Road/Davy Robinson Drive intersection improves the overall performance of the road network, Transport for New South Wales (TfNSW) should consider signalisation of Newbridge Road/Davy Robinson Drive in the future.

5 Conclusion and summary

This traffic report considers the revised design for the Georges Cove Village site and responds to Liverpool City Council's requirements for a revised report.

In summary:

- The revised Georges Cove Village proposal will have retail and light industrial land uses, with no residential components.
- The retail car park will be located on the bottom levels, which will be separated from the light industrial car park on the top level.
- Vehicles will be able to access the site via Promontory Way for all scenarios, while vehicles may access the site via Davy Robinson Drive in Scenario B. Scenario B is dependent on the development of the Flower Power site to connect DCP Road to Davy Robinson Drive, as well as the signalisation of Newbridge Road/Davy Robinson Drive.
- Light vehicles will be able to enter the site from DCP Road on the south side of the site, as well as make a left turn from Newbridge Road (east) to the site access. For Scenario A, all light vehicle traffic will exit via Promontory Way, but will not exit via Davy Robinson Drive or from the site to Newbridge Road (west). For Scenario B, DCP Road will be connected to Davy Robinson Drive to the east of the site, so light vehicles will be able to exit via Davy Robinson Drive by a signalised intersection at Newbridge Road/Davy Robinson Drive.
- Heavy vehicles will be able to enter via a left turn from Newbridge Road east to the site, then proceed through an anti-clockwise circulation on the lower floor, exiting via a left turn to Newbridge Road (west) at the north-east of the site.
- The SIDRA traffic analysis shows that:
    - Newbridge Road/Governor Macquarie Drive/Brickmakers Drive intersection is already operating over capacity, with LOS F and DOS >1, so additional traffic volumes from the development will have a minor impact on the intersection.
    - Efficiencies in the operation of the Newbridge Road/Governor Macquarie Drive/Brickmakers Drive intersection can reduce the delays in the PM peak compared to the existing scenario, even after the addition of the Georges Cove Village development and cumulative traffic volumes.
    - The connection of DCP Road to Davy Robinson Drive and the signalisation of Newbridge Road/Davy Robinson Drive will improve the performance of Newbridge Road/Governor Macquarie Drive/Brickmakers Drive intersection in the AM and PM peak. Hence, due to the overall network benefits, TfNSW should consider signalisation of Newbridge Road/Davy Robinson Drive.
    - The signalised Brickmakers Drive/Promontory Way intersection will operate satisfactorily at LOS A or B, with minimal delays. However, in the AM peak the queue may stretch back to the roundabout. This queuing will be alleviated by the connection of the DCP Road to Davy Robinson Drive. In addition, it should be noted that the existing traffic counts at this intersection also included construction related heavy vehicles. Hence, the SIDRA model is conservative.
    - Newbridge Road/Site Access Road intersection will be impacted by traffic queues on Newbridge Road extending from Newbridge Road/Governors Macquarie Drive/Brickmakers Drive. While light

and heavy vehicles will be queued while attempting to enter the site, no light vehicles will exit the site. Only heavy vehicles will exit the site onto Newbridge Road, which generally occurs outside of peak hours. Therefore, the additional impacts to this intersection will be negligible.

- In the existing scenario, Davy Robinson Drive (south approach) on the Newbridge Road/Davy Robinson Drive intersection experiences LOS F during the AM and PM peak hour. When the development traffic can exit via Davy Robinson Drive, signalisation of Newbridge Road/Davy Robinson Drive intersection will allow it to perform at LOS B.

- Until the DCP Road is constructed, as part of the Flower Power site development (Lot 2 DP 602988), and connection is established with Davy Robinson Drive, all traffic will be required to enter and exit the precinct via Promontory Way. In accordance with the Georges Cove Marina Consent (DA-611/2018), this intersection must be signalised prior to marina operations. It is expected that the precinct's traffic network will operate satisfactorily with the single connection via Promontory Way.

- The DCP Road connection to Davy Robinson Drive would further improve the operation of all roads in the precinct once constructed, and Newbridge Road/Davy Robinson Drive intersection is signalised by TfNSW. However, the DCP Road connection to Davy Robinson Drive and the signalisation of Newbridge Road/Davy Robinson Drive is not necessary for satisfactory traffic network performance in the precinct.

- Overall, this development either improves or maintains the existing levels of service surrounding the development. There will only be minor impacts on the existing community and users of the surrounding road network.

References

Ason 2017. *Traffic Impact Assessment.* Ason Group.

EMM 2018. *Georges Cove Marina Residential Planning Proposal.*

RTA 2002. *Guide to Traffic Generating Developments.* Transport for New South Wales.

Appendix A
Architectural plans

EMM
creating opportunities

DEVELOPMENT SUMMARY

LEVEL	PARKING	NLA COMMERCIAL	NLA RETAIL	CIRCULATION/ SERVICES
Not Placed	0.0 m²	0.0 m²	0.0 m²	0.0 m²
LEVEL 1 - DOCK	0.0 m²	0.0 m²	0.0 m²	216.9 m²
LEVEL 2 - PARKING	5786.1 m²	0.0 m²	0.0 m²	479.3 m²
LEVEL 3 - SUPERMARKET	2794.6 m²	3809.2 m²	1045.0 m²	862.7 m²
LEVEL 4 - INDUSTRIAL	0.0 m²	3859.3 m²	0.0 m²	96.3 m²
LEVEL 5 - INDUSTRIAL MEZZANINE	0.0 m²	1274.4 m²	0.0 m²	0.0 m²
	8580.7 m²	8942.9 m²	1045.0 m²	1655.2 m²

GFA SCHEDULE

NAME	AREA
Core	83.0 m²
GFA_Office	4692.3 m²
GFA_Retail/Commercial	1585.0 m²
GFA_Supermarket	3797.6 m²
Services	230.2 m²
	10388.1 m²

GFA SUMMARY

LEVEL	GFA
LEVEL 1 - DOCK	83.0 m²
LEVEL 2 - PARKING	376.7 m²
LEVEL 3 - SUPERMARKET	5388.0 m²
LEVEL 4 - INDUSTRIAL	3243.4 m²
LEVEL 5 - INDUSTRIAL MEZZANINE	1297.0 m²
	10388.1 m²

AREA	PERMISSIBLE FSR	PERMISSIBLE GFA
17218.4 m²	0.75	12913.8 m²

Area Schedule (NLA - RETAIL)

Level	Area
LEVEL 3 - SUPERMARKET	5326.7 m²
	5326.7 m²

Area Schedule (NLA - INDUSTRIAL)

Level	Area
LEVEL 4 - INDUSTRIAL	3627.5 m²
LEVEL 5 - INDUSTRIAL MEZZANINE	1275.6 m²
	4903.0 m²



SHEET LIST

No.	TITLE	REV.
SK00.00	DEVELOPMENT SUMMARY	P2
SK00.01	SITE PLAN	P6
SK01.01	LEVEL 1 - DOCK	P6
SK01.02	LEVEL 2 - CARPARK	P6
SK01.03	LEVEL 3 - RETAIL	P6
SK01.04	LEVEL 4 - LIGHT INDUSTRIAL	P2
SK01.05	LEVEL 5 - MEZZANINE OFFICE	P2
SK01.06	LEVEL 6 - ROOF	P2
SK02.01	SECTIONS	P2
SK03.01	WINTER SOLSTICE	P2
SK03.02	EQUINOX	P2
SK05.01	GFA PLANS	P4
SK05.02	NLA PLANS	P4

PARKING SCHEDULE

LEVEL	CARPARKS				CAR PARKING	MOTORBIKE PARKING
	INDUSTRIAL	INDUSTRIAL (ACCESSIBLE)	RETAIL	RETAIL (ACCESSIBLE)		
LEVEL 2 - PARKING	0	0	182	4	182	5
LEVEL 3 - SUPERMARKET	0	0	97	4	97	5
LEVEL 4 - INDUSTRIAL	72	2	0	0	72	0
	72	2	279	8	351	10

Area Schedule (NLA - RETAIL PARKING RATE)	
Area	Parking Rate (RETAIL)
5326.7 m²	266

Area Schedule (NLA - INDUSTRIAL PARKING RATE)	
Area	Parking Rate
4903.0 m²	140

Area Schedule (NLA - FACTORY PARKING RATE)	
Area	Parking Rate
4903.0 m²	65

Liverpool DCP:

1 disabled parking per 100 retail/commercial

Current Industrial LFA: 4923.5m^2

1 carpark per **35m^2** of **Office LFA**

1 carpark per **75m^2** of **Factory/Warehouse LFA**

Current Retail LFA: 5331.7m^2

1 carpark per **20m^2** of **Retail LFA**

LINK:
https://eplanning.liverpool.nsw.gov.au/Pages/Plan/Book.aspx?exhibit=OnlineControls&hid=4992&s=b6+enterprise+corridor

Liverpool Development Control Plan 2008 > Part 1 (General Controls for all Development) > 20 (Car Parking and Access) > 20.3 (On site parking)

PLANNING PROPOSAL

Revisions

P1	20.12.22	FOR CLIENT REVIEW	DM
P2	31.03.23	FOR CLIENT REVIEW	DM

5/07/2023 3:51:03 PM

Project: **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing: **DEVELOPMENT SUMMARY**

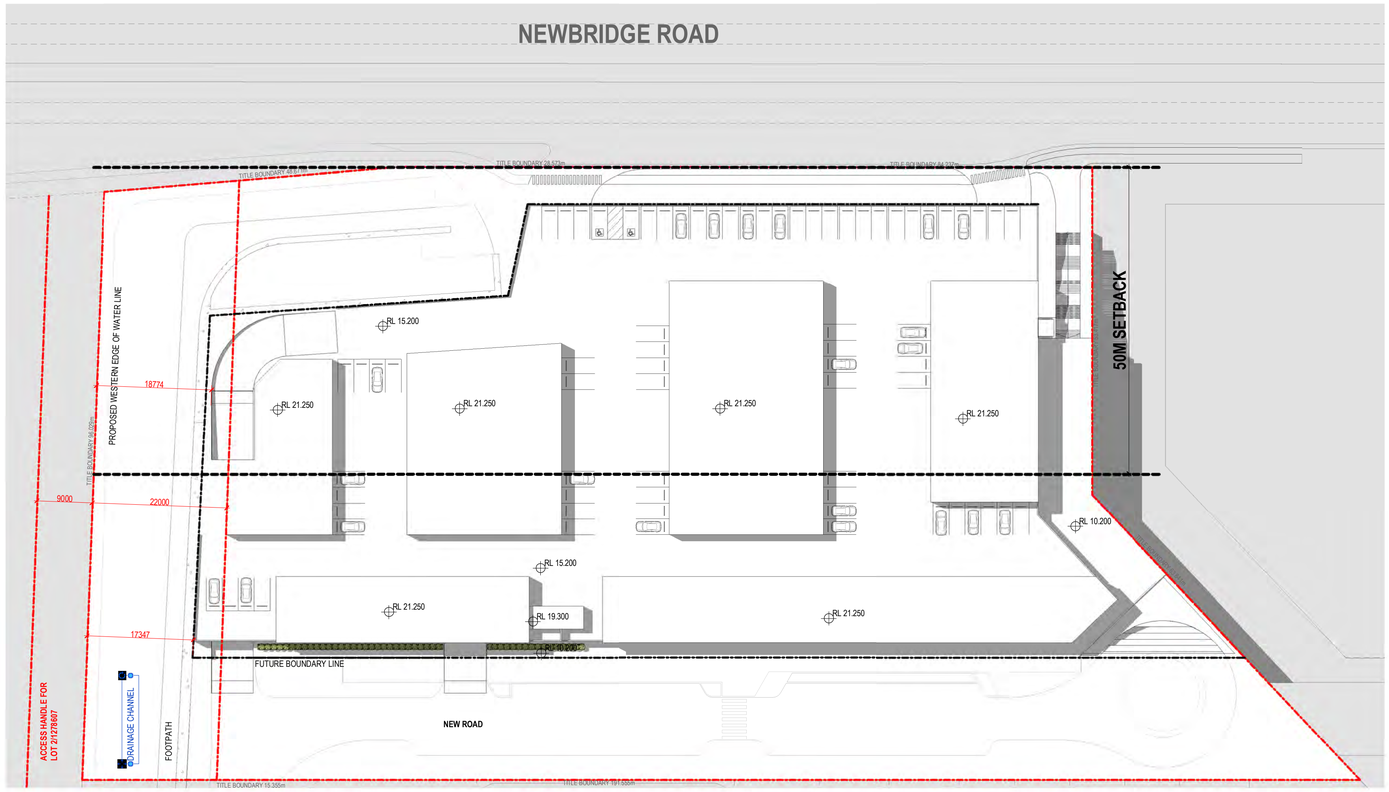
Project No: **214205** Date: **20.12.22** Author: **DM** Scale: @ A1

Drawing No.: **SK00.00 P2**

Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman

Brisbane, Melbourne, Sydney
www.rothelowman.com.au



SITE PLAN - 50m Setback

PLANNING PROPOSAL

Revisions

P2	20.06.19	FOR CLIENT REVIEW	JLi
P3	19.08.19	FOR CLIENT REVIEW	JLi
P4	28.08.19	FOR CLIENT REVIEW	JLi
P5	20.12.22	FOR CLIENT REVIEW	DM
P6	31.03.23	FOR CLIENT REVIEW	DM

5/07/2023 4:09:25 PM

Project: **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing: **SITE PLAN**

Project No: **214205**

Date: **20.12.22**

Author: **DM**

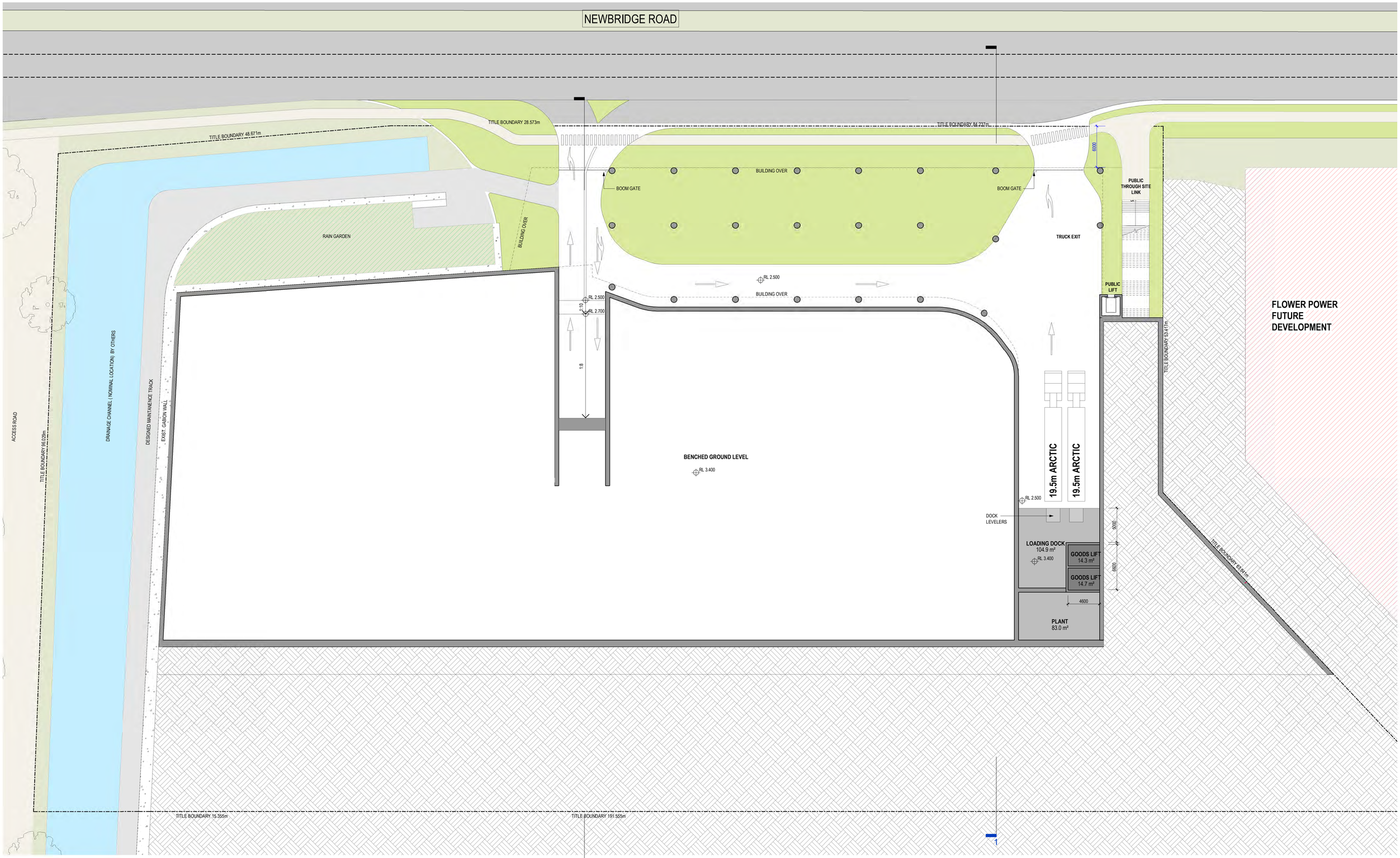
Scale: @ A1: **1 : 500**

Drawing No.: **SK00.01 P6**

Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman

Brisbane, Melbourne, Sydney
www.rothelowman.com.au



PLANNING PROPOSAL

Revisions			
P2	20.06.19	FOR CLIENT REVIEW	JLi
P3	19.08.19	FOR CLIENT REVIEW	JLi
P4	28.08.19	FOR CLIENT REVIEW	JLi
P5	20.12.22	FOR CLIENT REVIEW	DM
P6	31.03.23	FOR CLIENT REVIEW	DM

5/07/2023 3:51:23 PM

Project: **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing: **LEVEL 1 - DOCK**

Project No: **214205**

Date: **20.12.22**

Author: **DM**

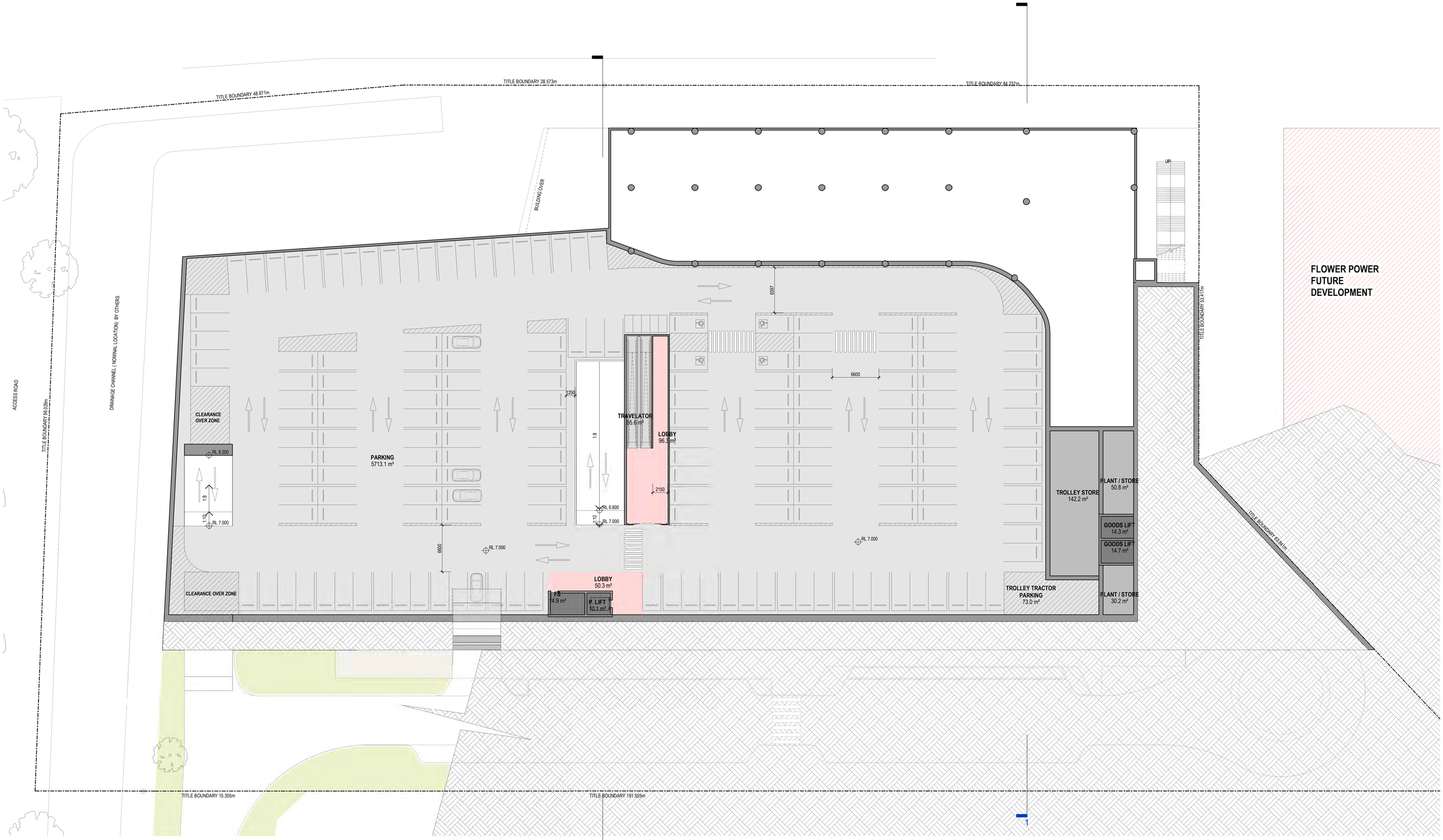
Scale: @ A1 **1 : 250**

Drawing No.: **SK01.01 P6**

Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman

Brisbane, Melbourne, Sydney
www.rothelowman.com.au



PLANNING PROPOSAL

Revisions			
P2	20.06.19	FOR CLIENT REVIEW	JLi
P3	19.08.19	FOR CLIENT REVIEW	JLi
P4	28.08.19	FOR CLIENT REVIEW	JLi
P5	20.12.22	FOR CLIENT REVIEW	DM
P6	31.03.23	FOR CLIENT REVIEW	DM

5/07/2023 3:51:33 PM

Project: **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing: **LEVEL 2 - CARPARK**

Project No: **214205**

Date: **20.12.22**

Author: **DM**

Scale: @ A1 **1 : 250**

Drawing No.: **SK01.02 P6**

Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman

Brisbane, Melbourne, Sydney
www.rothelowman.com.au

TITLE BOUNDARY 48.671m
TITLE BOUNDARY 28.573m
TITLE BOUNDARY 84.237m
TITLE BOUNDARY 98.029m
TITLE BOUNDARY 53.417m
TITLE BOUNDARY 63.841m
TITLE BOUNDARY 15.355m
TITLE BOUNDARY 191.555m

FUTURE
DEVELOPMENT SITE

AMENITIES
88.0 m²

SPECIALTY RETAIL
153.0 m²

COMMON CIRCULATION
21.5 m²

SPECIALTY RETAIL
232.9 m²

TROLLEY BAYS

AISLE
114.6 m²

PLANT
63.9 m²

UP

8000

6000

SPECIALTY RETAIL
25.6 m²

7400

BACK OF HOUSE

SEATING ZONE
36.1 m²

TRAVELATOR
56.3 m²

32000

SUPERMARKET
3809.2 m²

RL 10.200
1:10
RL 10.000
6880
1:8
RAMP UP
FROM LEVEL 2

PARKING
2794.6 m²

MALL
489.5 m²

RL 10.200

6600
6600

RL 10.200

RL 10.200

GOODS LIFT
14.3 m²

GOODS LIFT
14.7 m²

SPECIALTY RETAIL
53.6 m²

6000

RL 10.200
1:10
RL 10.000

SPECIALTY RETAIL
433.1 m²

8000
8870
31680

1:8

SEATING ZONE
110.6 m²

RL 10.200

RL 7.650
1:10
RL 7.450
RAMP UP
TO LEVEL 4

RL 8.600

RL 8.700

12m TEMPORARY CUL-DE-SAC

RL 9.400

DCP ROAD

PEDESTRIAN
CROSSING

RL 7.000

ON STREET PARKING

GEORGES VILLAGE RESIDENCE

ROAD 12

1

2

PLANNING PROPOSAL

Revisions

P2	20.06.19	FOR CLIENT REVIEW	JLi
P3	19.08.19	FOR CLIENT REVIEW	JLi
P4	28.08.19	FOR CLIENT REVIEW	JLi
P5	20.12.22	FOR CLIENT REVIEW	DM
P6	31.03.23	FOR CLIENT REVIEW	DM

5/07/2023 3:51:41 PM

Project / **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing / **LEVEL 3 - RETAIL**

Project No / **214205**

Date / **20.12.22**

Author / **DM**

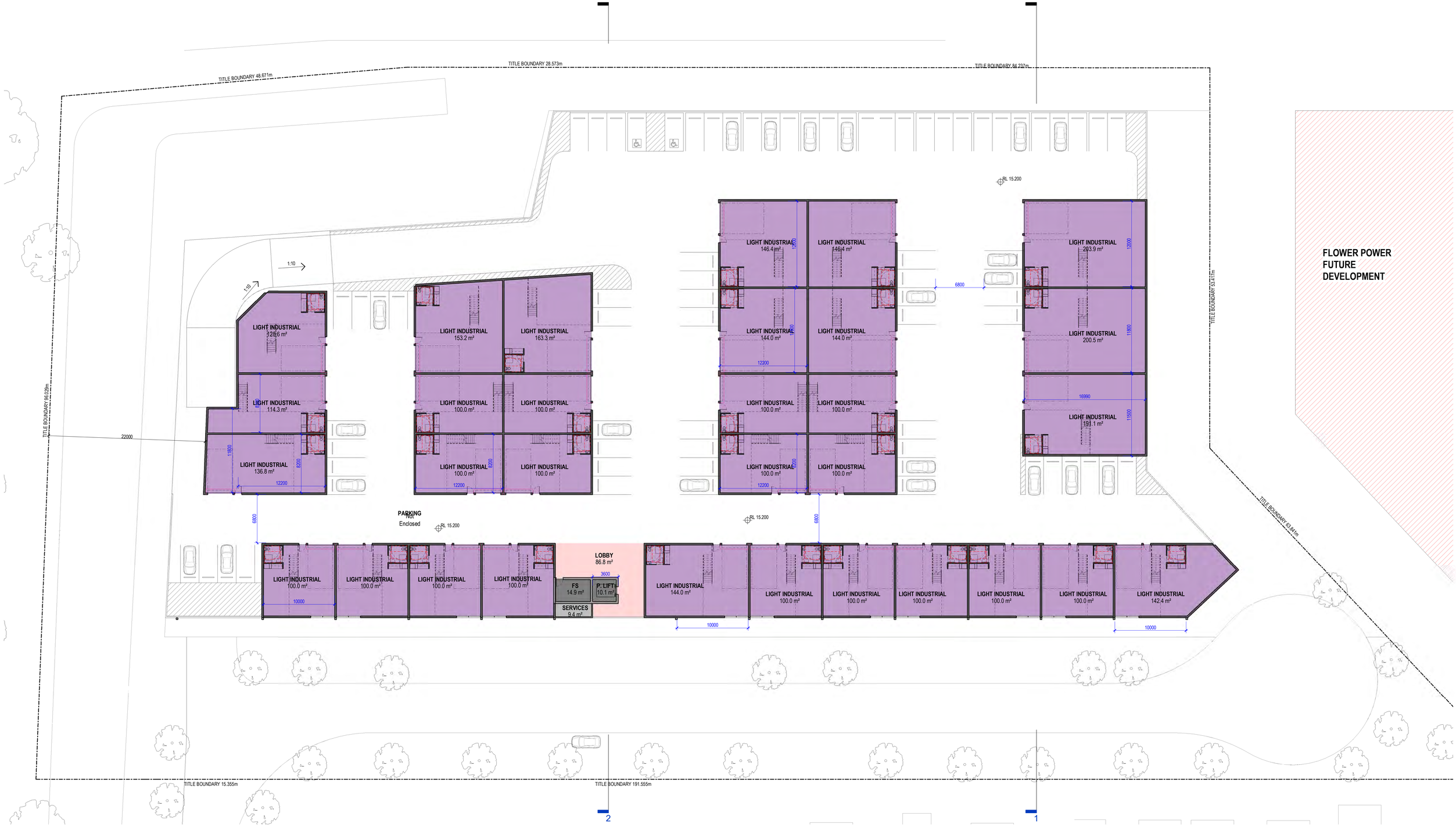
Scale: @ A1 / **1 : 250**

Drawing No. / **SK01.03 P6**

Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman

Brisbane, Melbourne, Sydney
www.rothelowman.com.au



PLANNING PROPOSAL

Revisions

P1	20.12.22	FOR CLIENT REVIEW	DM
P2	31.03.23	FOR CLIENT REVIEW	DM

5/07/2023 3:51:52 PM

Project: **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing: **LEVEL 4 - LIGHT INDUSTRIAL**

Project No: **214205**

Date: **20.12.22**

Author: **DM**

Scale: @ A1 **1 : 250**

Drawing No.: **SK01.04 P2**

Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman

Brisbane, Melbourne, Sydney
www.rothelowman.com.au

TITLE BOUNDARY 28.573m

TITLE BOUNDARY 48.671m

TITLE BOUNDARY 84.237m

TITLE BOUNDARY 53.417m

TITLE BOUNDARY 98.029m

TITLE BOUNDARY 83.843m

22000

10000

MEZZANINE OFFICE 35.4 m²

MEZZANINE OFFICE 49.4 m²

MEZZANINE OFFICE 35.4 m²

MEZZANINE OFFICE 50.7 m²

MEZZANINE OFFICE 50.7 m²

MEZZANINE OFFICE 35.1 m²

MEZZANINE OFFICE 35.1 m²

MEZZANINE OFFICE 35.4 m²

MEZZANINE OFFICE 35.4 m²

MEZZANINE OFFICE 50.7 m²

MEZZANINE OFFICE 50.7 m²

MEZZANINE OFFICE 50.7 m²

MEZZANINE OFFICE 50.7 m²

MEZZANINE OFFICE 35.1 m²

MEZZANINE OFFICE 35.1 m²

MEZZANINE OFFICE 35.4 m²

MEZZANINE OFFICE 35.4 m²

MEZZANINE OFFICE 50.7 m²

MEZZANINE OFFICE 50.7 m²

MEZZANINE OFFICE 50.5 m²

MEZZANINE OFFICE 31.9 m²

MEZZANINE OFFICE 31.9 m²

MEZZANINE OFFICE 31.9 m²

MEZZANINE OFFICE 31.9 m²

RL 18.200

RL 19.300

MEZZANINE OFFICE 75.5 m²

MEZZANINE OFFICE 31.9 m²

MEZZANINE OFFICE 31.9 m²

MEZZANINE OFFICE 31.9 m²

MEZZANINE OFFICE 31.9 m²

MEZZANINE OFFICE 53.9 m²

FLOWER POWER
FUTURE
DEVELOPMENT

TITLE BOUNDARY 15.355m

TITLE BOUNDARY 191.555m

2

1

PLANNING PROPOSAL

Revisions				
	P1	20.12.22	FOR CLIENT REVIEW	DM
	P2	31.03.23	FOR CLIENT REVIEW	DM

5/07/2023 3:52:01 PM

Project: **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing: **LEVEL 5 - MEZZANINE OFFICE**

Project No: **214205**

Date: **20.12.22**

Author: **DM**

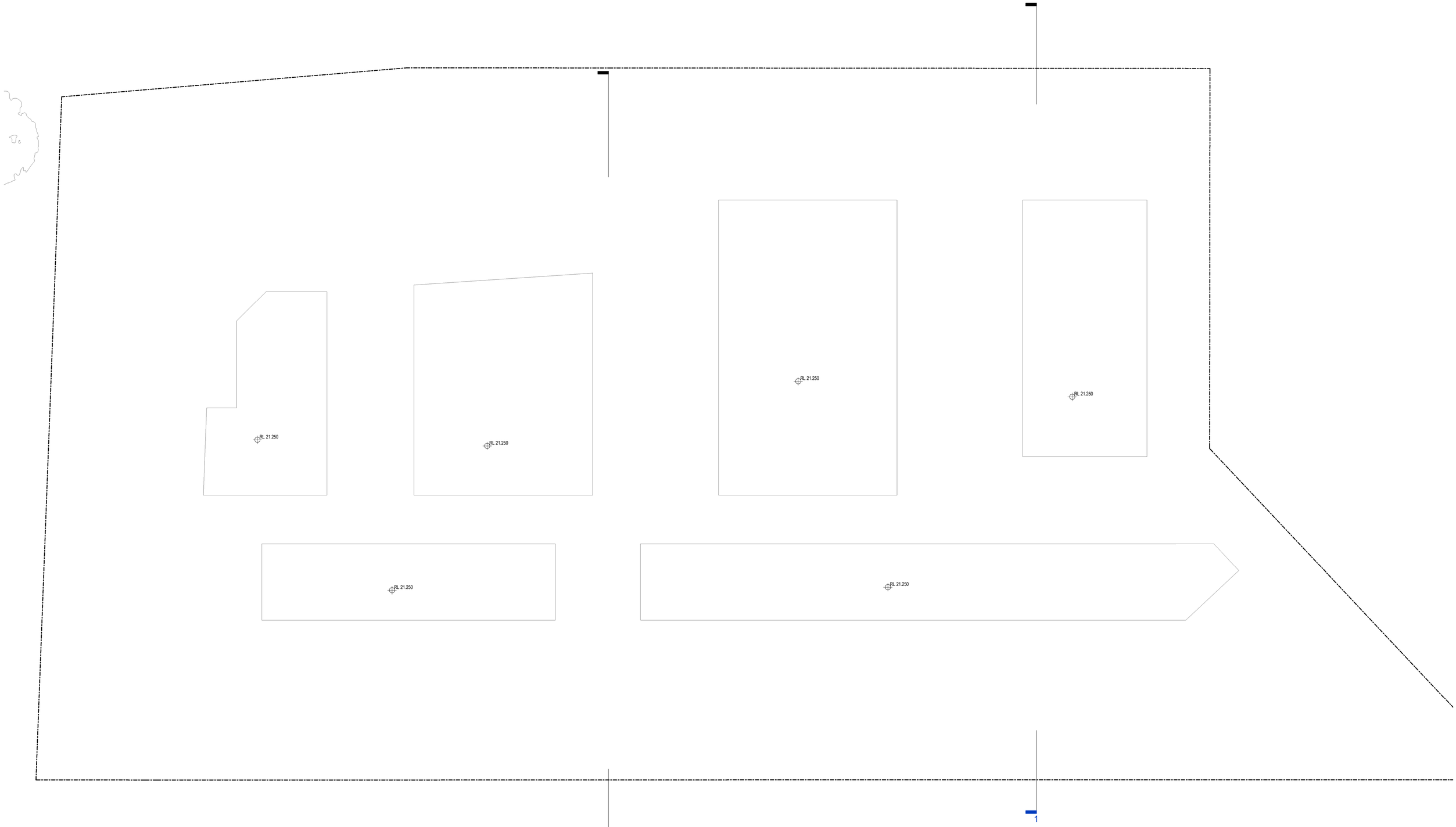
Scale: @ A1 **1 : 250**

Drawing No.: **SK01.05 P2**

Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman

Brisbane, Melbourne, Sydney
www.rothelowman.com.au



PLANNING PROPOSAL

Revisions				
	P1	20.12.22	FOR CLIENT REVIEW	DM
	P2	31.03.23	FOR CLIENT REVIEW	DM

5/07/2023 3:52:09 PM

Project: **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing: **LEVEL 6 - ROOF**

Project No: **214205**

Date: **20.12.22**

Author: **DM**

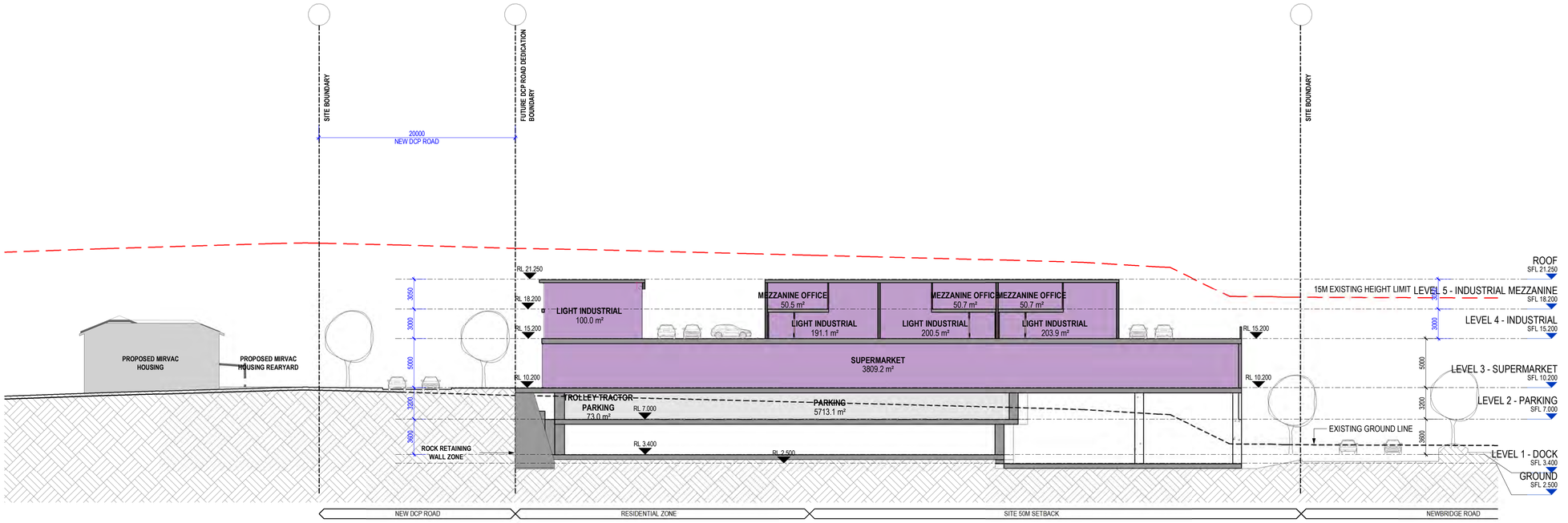
Scale: @ A1: **1 : 250**

Drawing No.: **SK01.06 P2**

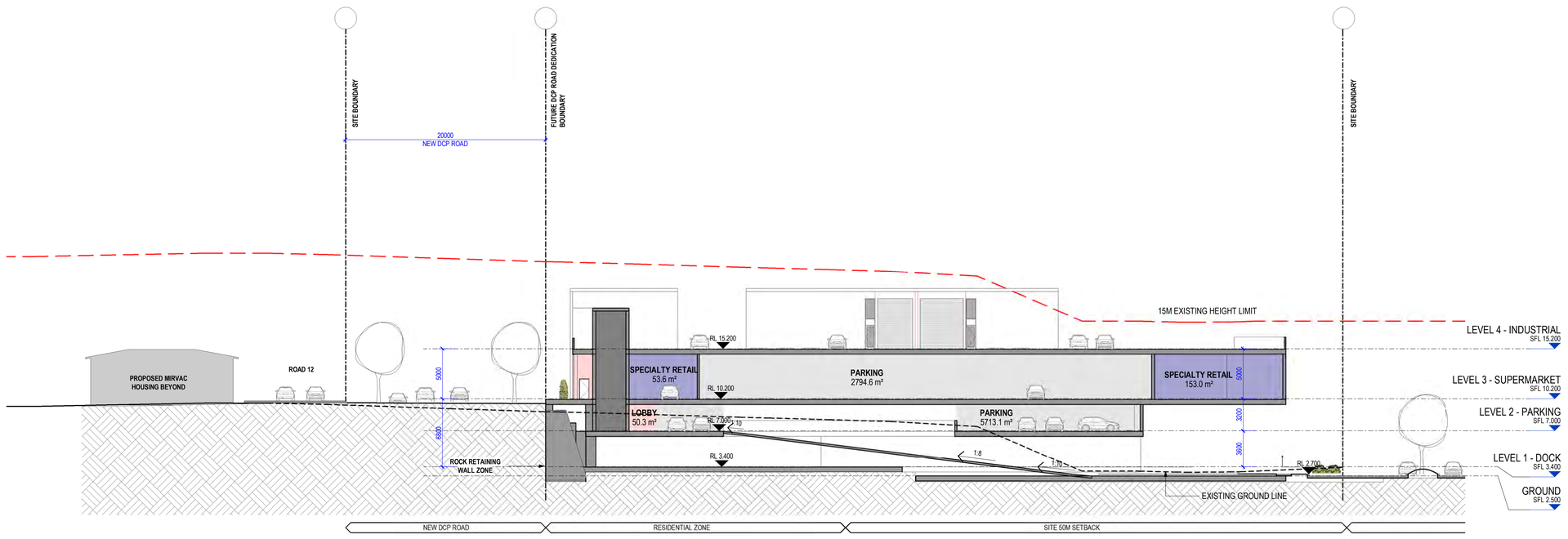
Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman

Brisbane, Melbourne, Sydney
www.rothelowman.com.au



SECTION_1



SECTION_2

PLANNING PROPOSAL

Revisions

P1	20.12.22	FOR CLIENT REVIEW	DM
P2	31.03.23	FOR CLIENT REVIEW	DM

5/07/2023 3:52:16 PM

Project: **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing: **SECTIONS**

Project No: **214205**

Date: **20.12.22**

Author: **DM**

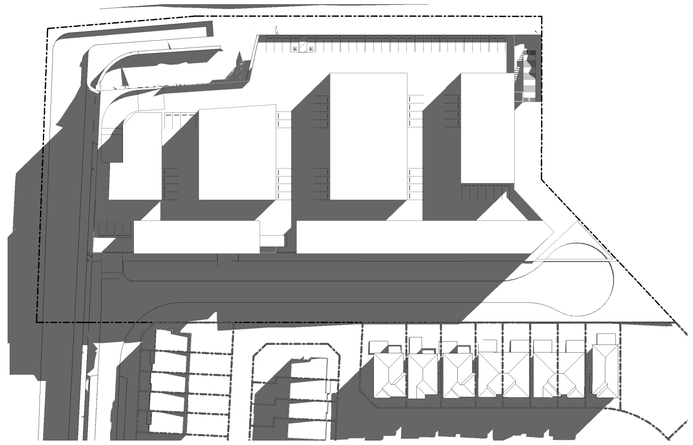
Scale: @ A1: **1 : 250**

Drawing No.: **SK02.01 P2**

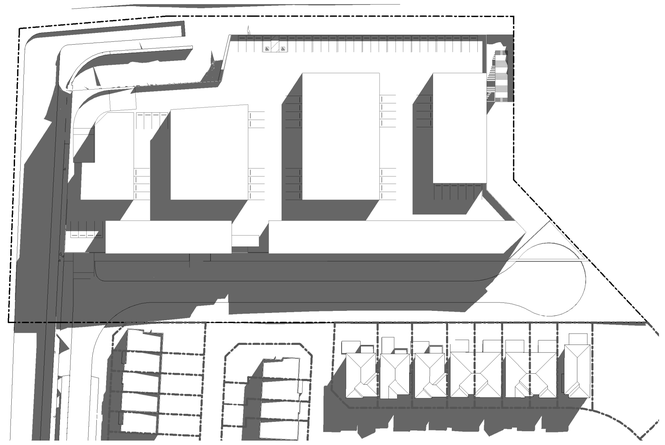
Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman

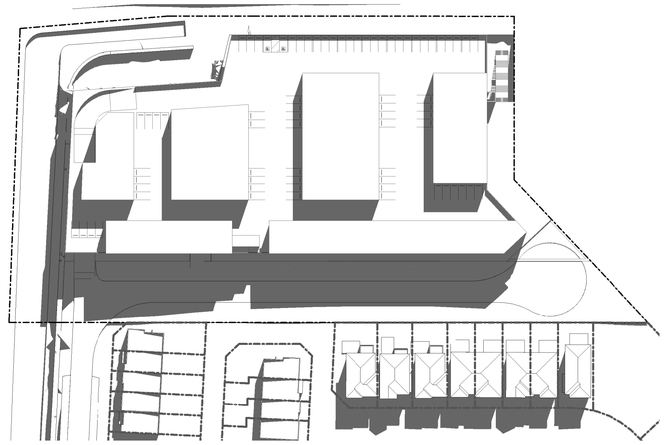
Brisbane, Melbourne, Sydney
www.rothelowman.com.au



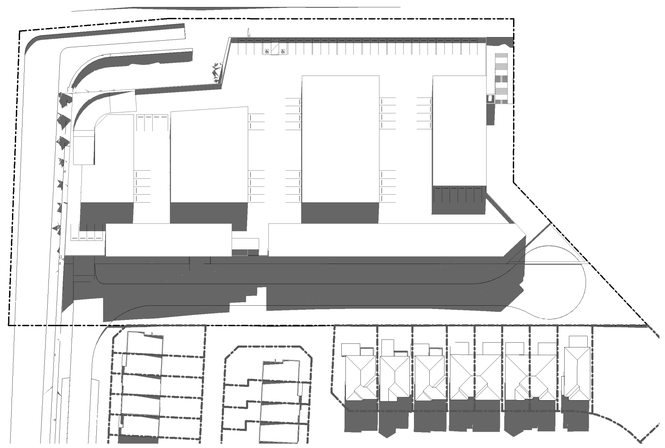
0900 JUN22



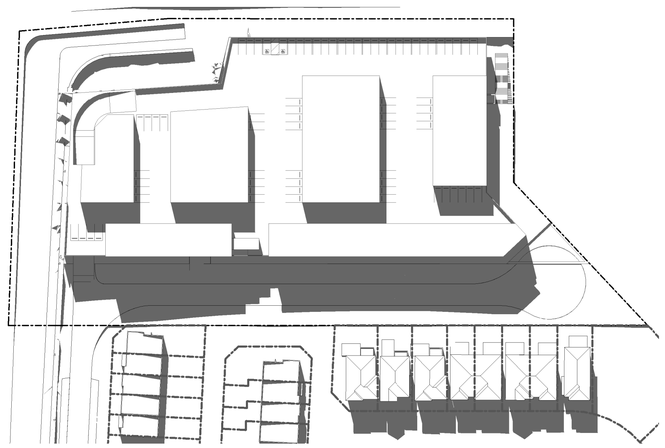
1000 JUN22



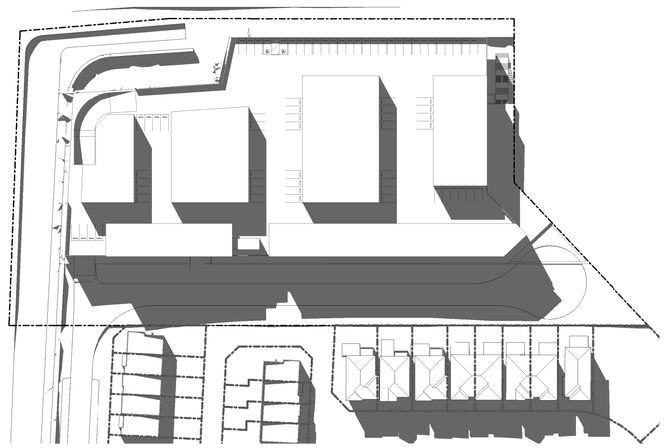
1100 JUN22



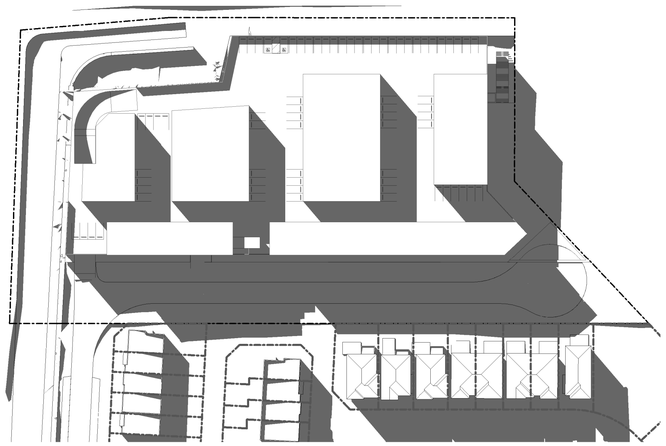
1200 JUN22



1300 JUN22



1400 JUN22



1500 JUN22

PLANNING PROPOSAL

Revisions				
	P1	20.12.22	FOR CLIENT REVIEW	DM
	P2	31.03.23	FOR CLIENT REVIEW	DM

5/07/2023 3:52:29 PM

Project: **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing: **WINTER SOLSTICE**

Project No: **214205**

Date: **20.12.22**

Author: **DM**

Scale: @ A1: **1 : 1000**

Drawing No.: **SK03.01 P2**

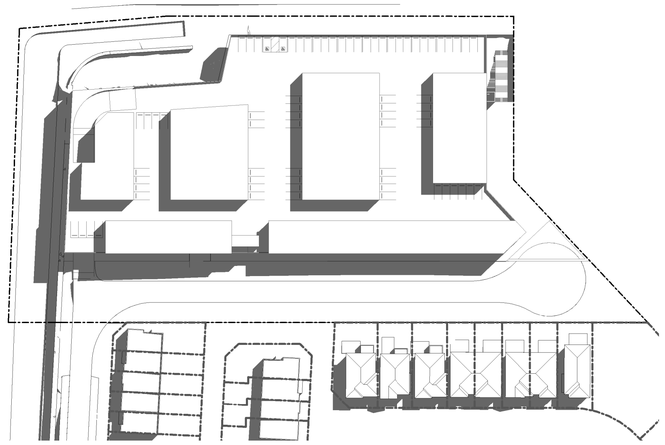
Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman

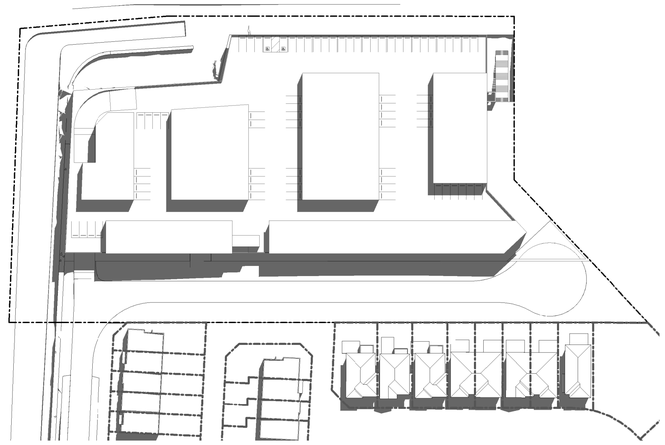
Brisbane, Melbourne, Sydney
www.rothelowman.com.au



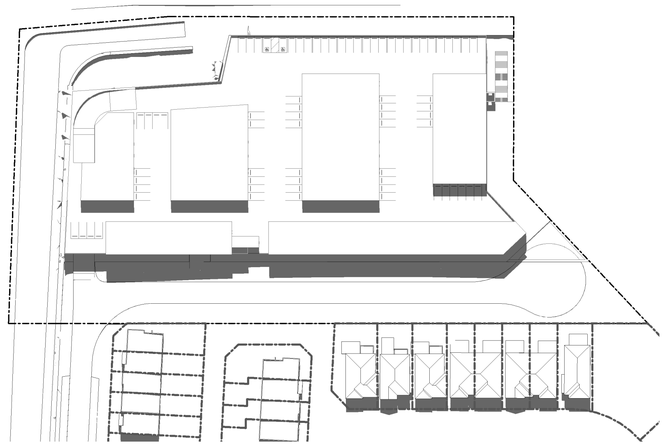
0900 SEP22



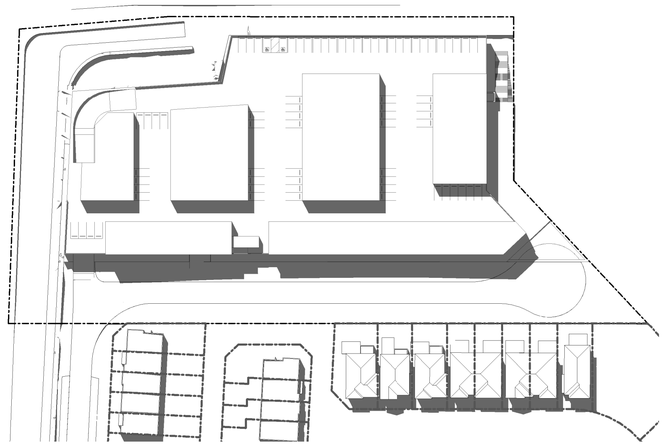
1000 SEP22



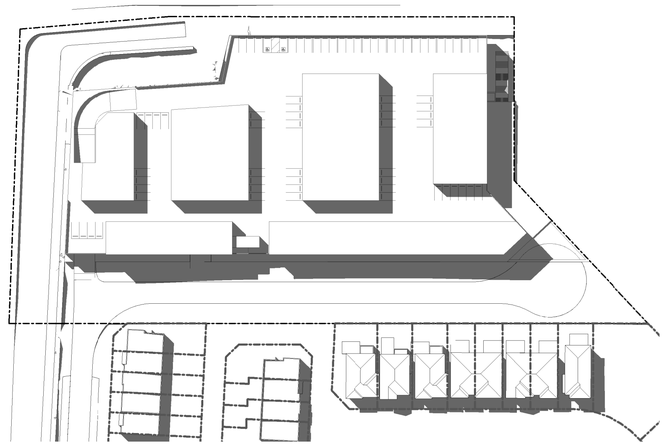
1100 SEP22



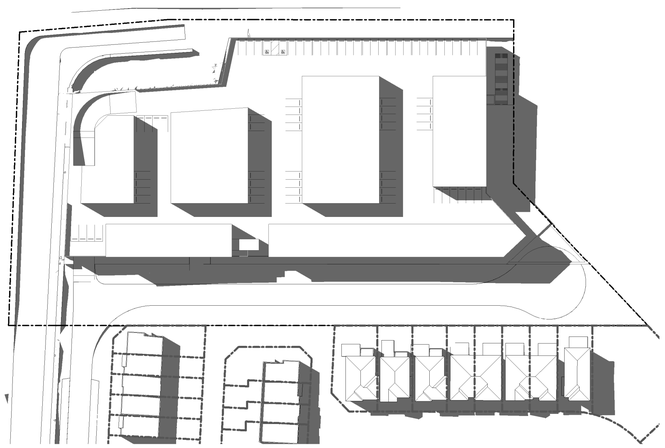
1200 SEP22



1300 SEP22



1400 SEP22



1500 SEP22

PLANNING PROPOSAL

Revisions				
	P1	20.12.22	FOR CLIENT REVIEW	DM
	P2	31.03.23	FOR CLIENT REVIEW	DM

5/07/2023 3:52:42 PM

Project: **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing: **EQUINOX**

Project No: **214205**

Date: **20.12.22**

Author: **DM**

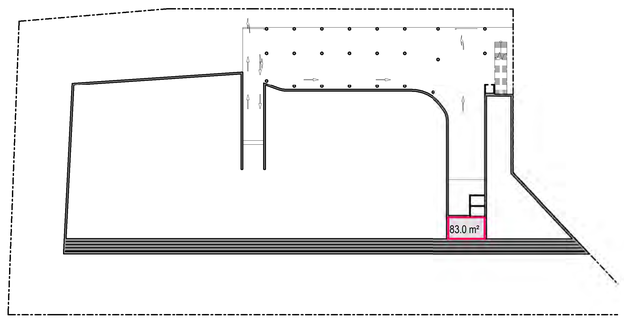
Scale: @ A1: **1 : 1000**

Drawing No.: **SK03.02 P2**

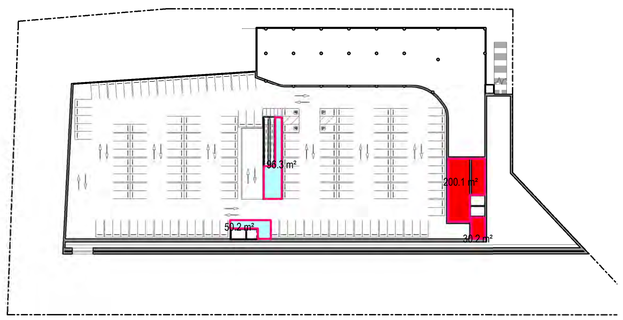
Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman

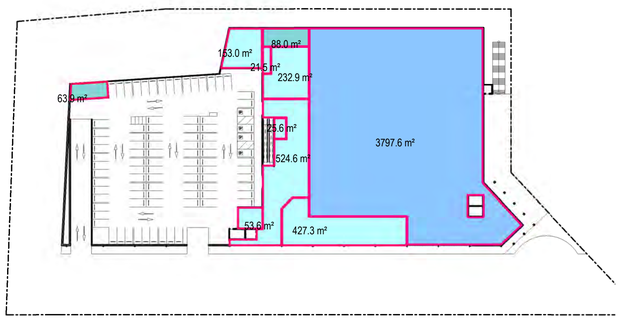
Brisbane, Melbourne, Sydney
www.rothelowman.com.au



LEVEL 1 - DOCK



LEVEL 2 - PARKING



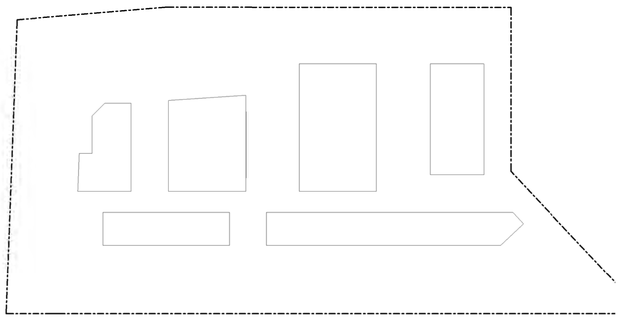
LEVEL 3 - SUPERMARKET



LEVEL 4 - INDUSTRIAL



LEVEL 5 - INDUSTRIAL MEZZANINE



LEVEL 6 - ROOF

GFA SUMMARY

LEVEL	GFA
LEVEL 1 - DOCK	83.0 m²
LEVEL 2 - PARKING	376.7 m²
LEVEL 3 - SUPERMARKET	5388.0 m²
LEVEL 4 - INDUSTRIAL	3243.4 m²
LEVEL 5 - INDUSTRIAL MEZZANINE	1297.0 m²
	10388.1 m²

GFA SCHEDULE

NAME	AREA
Core	83.0 m²
GFA_Office	4692.3 m²
GFA_Retail/Commercial	1585.0 m²
GFA_Supermarket	3797.6 m²
Services	230.2 m²
	10388.1 m²

AREA DEFINITIONS:

RESIDENTIAL:
Draft Strata Area - measured to inside finished face of corridor walls, parti walls and external walls.

OFFICE:
Net Lettable Area - measured as per the PCA method of measurement.

RETAIL:
Gross Lettable Area Retail - measured as per the PCA method of measurement.

GFA:
Gross Floor Area - measured as defined by the relevant LEP (Local Environmental Plan).

GBA:
Gross Building Area - measured to the slab edge of the building at all floor levels as the total enclosed and unenclosed area of the building.

*For preliminary feasibility purposes. Areas are not to be used for purpose of lease or sale agreements. Layouts may not comply with building regulations or other regulatory requirements. The information contained in this schedule is believed to be correct at the time of printing. Areas are generally measured in accordance with the Property Council of Australia Method of Measurement.

Rothe Lowman Property Pty. Ltd. retain all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.
The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd.
Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document.

PLANNING PROPOSAL

Revisions			
P1	27.03.19	ISSUE FOR CLIENT REVIEW	SM
P2	24.05.19	FOR INFORMATION	JG
P3	20.12.22	FOR CLIENT REVIEW	DM
P4	31.03.23	FOR CLIENT REVIEW	DM

5/07/2023 3:52:49 PM

Project: **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing: **GFA PLANS**

Project No: **214205**

Date: **20.12.22**

Author: **DM**

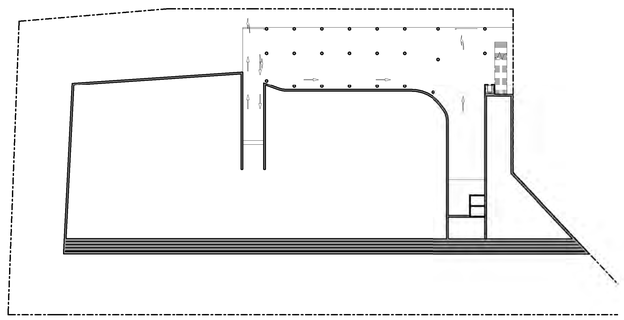
Scale: @ A1 **1 : 1000**

Drawing No.: **SK05.01 P4**

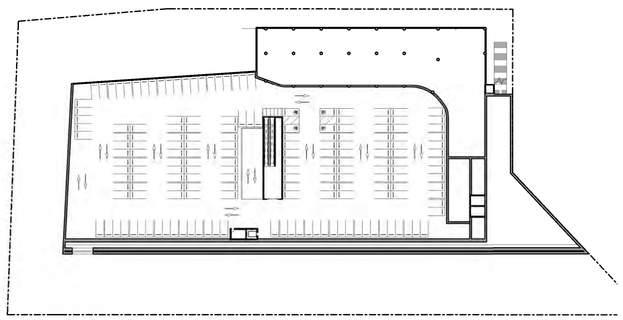
Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman

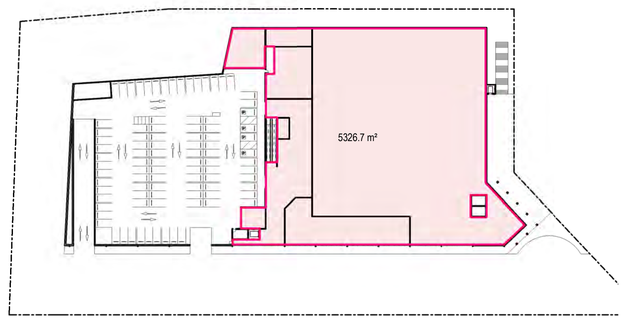
Brisbane, Melbourne, Sydney
www.rothelowman.com.au



LEVEL 1 - DOCK



LEVEL 2 - PARKING



LEVEL 3 - SUPERMARKET



LEVEL 4 - INDUSTRIAL



LEVEL 5 - INDUSTRIAL MEZZANINE

Area Schedule (NLA - RETAIL)

Level	Area
LEVEL 3 - SUPERMARKET	5326.7 m²
	5326.7 m²

Area Schedule (NLA - INDUSTRIAL)

Level	Area
LEVEL 4 - INDUSTRIAL	3627.5 m²
LEVEL 5 - INDUSTRIAL MEZZANINE	1275.6 m²
	4903.0 m²

Area Schedule (NLA - RETAIL PARKING RATE)

Area	Parking Rate (RETAIL)
5326.7 m²	266

Area Schedule (NLA - INDUSTRIAL PARKING RATE)

Area	Parking Rate
4903.0 m²	140

Area Schedule (NLA - FACTORY PARKING RATE)

Area	Parking Rate
4903.0 m²	65

Liverpool DCP:

1 disabled parking per 100 retail/commercial

Current Industrial LFA: 4923.5m^2

1 carpark per **35m^2** of **Office LFA**

1 carpark per **75m^2** of **Factory/Warehouse LFA**

Current Retail LFA: 5331.7m^2

1 carpark per **20m^2** of **Retail LFA**

LINK:
https://eplanning.liverpool.nsw.gov.au/Pages/Plan/Book.aspx?exhibit=OnlineControls&hid=4992&s=b6+enterprise+corridor

Liverpool Development Control Plan 2008 > Part 1 (General Controls for all Development) > 20 (Car Parking and Access) > 20.3 (On site parking)

PLANNING PROPOSAL

Revisions

P1	27.03.19	ISSUE FOR CLIENT REVIEW	SM
P2	24.05.19	FOR INFORMATION	JG
P3	20.12.22	FOR CLIENT REVIEW	DM
P4	31.03.23	FOR CLIENT REVIEW	DM

5/07/2023 3:52:57 PM

Project **GEORGES COVE VILLAGE**
146 Newbridge Rd
MOOREBANK, NSW

Drawing **NLA PLANS**

Project No **214205**

Date **20.12.22**

Author **DM**

Scale: @ A1 **1 : 1000**

Drawing No. **SK05.02 P4**

Disclaimer: Rothe Lowman Property Pty. Ltd. retains all common law, statutory law and other rights including copyright and intellectual property rights in respect of this document.The recipient indemnifies Rothe Lowman Property Pty. Ltd. against all claims resulting from use of this document for any purpose other than its intended use, unauthorized changes or reuse of the document on other projects without the permission of Rothe Lowman Property Pty. Ltd. Under no circumstance shall transfer of this document be deemed a sale or constitute a transfer of the license to use this document. ABN 76 005 783 997

rothelowman
Brisbane, Melbourne, Sydney
www.rothelowman.com.au

Appendix B

Traffic survey data

EMM
creating opportunities

TRANS TRAFFIC SURVEY

trafficsurvey.com.au

TURNING MOVEMENT SURVEY

Intersection of Brickmakers Dr and Promontory Wy, Moo

GPS	-33.931536, 150.962727
Date:	Thu 22/06/23
Weather:	Overcast
Suburban:	Moorebank
Customer:	EMM

North:	Brickmakers Dr
East:	Promontory Wy
South:	Brickmakers Dr
West:	N/A

Survey Period	AM:	7:00 AM-9:00 AM
	PM:	4:00 PM-6:00 PM
Traffic Peak	AM:	8:00 AM-9:00 AM
	PM:	4:30 PM-5:30 PM

All Vehicles

Time		rth Approach Brickmakers			st Approach Promontory			uth Approach Brickmakers			Hourly Total	
Period Start	Period End	U	SB	L	U	R	L	U	R	NB	Hour	Peak
7:00	7:15	0	112	4	0	1	1	0	3	139	1085	
7:15	7:30	1	94	2	0	6	2	0	1	155	1073	
7:30	7:45	0	92	2	0	4	0	0	2	198	1107	
7:45	8:00	4	114	3	0	4	2	0	1	138	1112	
8:00	8:15	0	118	2	0	1	2	0	0	125	1197	Peak
8:15	8:30	1	134	1	0	2	1	0	2	154		
8:30	8:45	4	117	1	0	2	4	0	2	173		
8:45	9:00	1	155	1	0	2	0	0	3	189		
16:00	16:15	0	214	0	0	2	0	1	1	121	1315	
16:15	16:30	0	212	2	0	3	1	0	0	91	1299	
16:30	16:45	1	183	2	0	4	3	0	1	137	1338	Peak
16:45	17:00	0	211	2	0	2	0	0	0	121	1310	
17:00	17:15	1	208	0	0	6	0	0	2	106	1263	
17:15	17:30	0	228	1	0	1	3	0	1	114		
17:30	17:45	0	207	6	0	0	1	0	0	89		
17:45	18:00	0	188	1	0	2	1	0	3	94		

Peak Time		rth Approach Brickmakers			st Approach Promontory			uth Approach Brickmakers			Peak total
Period Start	Period End	U	SB	L	U	R	L	U	R	NB	
8:00	9:00	6	524	5	0	7	7	0	7	641	1197
16:30	17:30	2	830	5	0	13	6	0	4	478	1338

Pedestrians Crossing

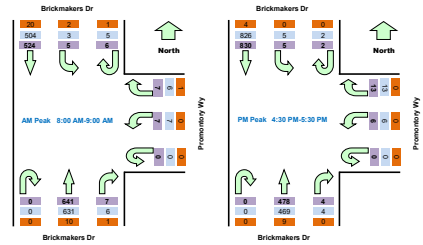
Time		pproach Brickma		pproach Promont		pproach Brickma		Hourly Tot
Period Start	Period End	Vestbour	Eastboun	orthboun	outhbou	Vestbour	Eastboun	
7:00	7:15	0	0	0	0	0	0	3
7:15	7:30	1	0	0	0	0	0	6
7:30	7:45	2	0	0	0	0	0	5
7:45	8:00	0	0	0	0	0	0	6
8:00	8:15	0	3	0	0	0	0	6
8:15	8:30	0	0	0	0	0	0	
8:30	8:45	3	0	0	0	0	0	
8:45	9:00	0	0	0	0	0	0	
16:00	16:15	0	0	0	0	0	0	0
16:15	16:30	0	0	0	0	0	0	1
16:30	16:45	0	0	0	0	0	0	1
16:45	17:00	0	0	0	0	0	0	1
17:00	17:15	1	0	0	0	0	0	1
17:15	17:30	0	0	0	0	0	0	
17:30	17:45	0	0	0	0	0	0	
17:45	18:00	0	0	0	0	0	0	

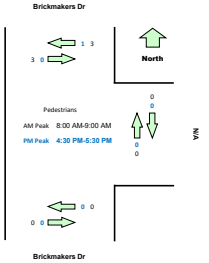
Peak Time		pproach Brickma		pproach Promont		pproach Brickma		Peak total
Period Start	Period End	Vestbour	Eastboun	orthboun	outhbou	Vestbour	Eastboun	
8:00	9:00	3	3	0	0	0	0	6
16:30	17:30	1	0	0	0	0	0	1

Note: Site sketch is for illustrating traffic flows. Direction is indicative only, drawing is not to scale and not an exact streets configuration.

Graphic

Total
Light
Heavy





Light Vehicles

Time		rth Approach Brickmakers			st Approach Promontory			uth Approach Brickmakers		
Period Start	Period End	U	SB	L	U	R	L	U	R	NB
7:00	7:15	0	108	4	0	1	1	0	3	136
7:15	7:30	1	90	2	0	6	2	0	1	153
7:30	7:45	0	92	2	0	4	0	0	2	193
7:45	8:00	4	109	3	0	4	2	0	1	137
8:00	8:15	0	117	1	0	1	2	0	0	121
8:15	8:30	1	129	1	0	1	1	0	2	152
8:30	8:45	4	113	1	0	2	4	0	2	170
8:45	9:00	0	145	0	0	2	0	0	2	188
16:00	16:15	0	208	0	0	1	0	1	1	119
16:15	16:30	0	209	2	0	3	1	0	0	90
16:30	16:45	1	182	2	0	4	3	0	1	133
16:45	17:00	0	210	2	0	2	0	0	0	119
17:00	17:15	1	206	0	0	6	0	0	2	104
17:15	17:30	0	228	1	0	1	3	0	1	113
17:30	17:45	0	203	6	0	0	1	0	0	87
17:45	18:00	0	188	1	0	2	1	0	3	92

Peak Time		rth Approach Brickmakers			st Approach Promontory			uth Approach Brickmakers			Peak total
Period Start	Period End	U	SB	L	U	R	L	U	R	NB	
8:00	9:00	5	504	3	0	6	7	0	6	631	1162
16:30	17:30	2	826	5	0	13	6	0	4	469	1325

Heavy Vehicles

Time		rth Approach Brickmakers			st Approach Promontory			uth Approach Brickmakers		
Period Start	Period End	U	SB	L	U	R	L	U	R	NB
7:00	7:15	0	4	0	0	0	0	0	0	3
7:15	7:30	0	4	0	0	0	0	0	0	2
7:30	7:45	0	0	0	0	0	0	0	0	5
7:45	8:00	0	5	0	0	0	0	0	0	1
8:00	8:15	0	1	1	0	0	0	0	0	4
8:15	8:30	0	5	0	0	1	0	0	0	2
8:30	8:45	0	4	0	0	0	0	0	0	3
8:45	9:00	1	10	1	0	0	0	0	1	1
16:00	16:15	0	6	0	0	1	0	0	0	2
16:15	16:30	0	3	0	0	0	0	0	0	1
16:30	16:45	0	1	0	0	0	0	0	0	4
16:45	17:00	0	1	0	0	0	0	0	0	2
17:00	17:15	0	2	0	0	0	0	0	0	2
17:15	17:30	0	0	0	0	0	0	0	0	1
17:30	17:45	0	4	0	0	0	0	0	0	2
17:45	18:00	0	0	0	0	0	0	0	0	2

Peak Time		rth Approach Brickmakers			st Approach Promontory			uth Approach Brickmakers			Peak total
Period Start	Period End	U	SB	L	U	R	L	U	R	NB	
8:00	9:00	1	20	2	0	1	0	0	1	10	35
16:30	17:30	0	4	0	0	0	0	0	0	9	13

Cyclists

Time		rth Approach Brickmakers			st Approach Promontory			uth Approach Brickmakers		
Period Start	Period End	U	SB	L	U	R	L	U	R	NB
7:00	7:15	0	0	0	0	0	0	0	0	0
7:15	7:30	0	0	0	0	0	0	0	0	0
7:30	7:45	0	0	0	0	0	0	0	0	0
7:45	8:00	0	0	0	0	0	0	0	0	0
8:00	8:15	0	0	0	0	0	0	0	0	0
8:15	8:30	0	0	0	0	0	0	0	0	0
8:30	8:45	0	0	0	0	0	0	0	0	0
8:45	9:00	0	0	0	0	0	0	0	0	0
16:00	16:15	0	0	0	0	0	0	0	0	0
16:15	16:30	0	0	0	0	0	0	0	0	0
16:30	16:45	0	0	0	0	0	0	0	0	0
16:45	17:00	0	0	0	0	0	0	0	0	0
17:00	17:15	0	0	0	0	0	0	0	0	0
17:15	17:30	0	0	0	0	0	0	0	0	0
17:30	17:45	0	0	0	0	0	0	0	0	0
17:45	18:00	0	0	0	0	0	0	0	0	0

TRANS TRAFFIC SURVEY

TURNING MOVEMENT SURVEY trafficsurvey.com.au

Intersection of Newbridge Rd and Gov Macquarie Dr, Moorebank

GPS	-33.928747, 150.962336
Date:	Thu 22/06/23
Weather:	Overcast
Suburban:	Moorebank
Customer:	EMM

North:	Gov Macquarie Dr
East:	Newbridge Rd
South:	Brickmakers Dr
West:	Newbridge Rd

Survey Period	AM:	7:00 AM-9:00 AM
	PM:	4:00 PM-6:00 PM
Traffic Peak	AM:	7:15 AM-8:15 AM
	PM:	4:45 PM-5:45 PM

All Vehicles

Time		North Approach Gov Macquarie Dr				East Approach Newbridge Rd				South Approach Brickmakers Dr				West Approach Newbridge Rd				Hourly Total	
Period Start	Period End	U	R	SB	L	U	R	WB	L	U	R	NB	L	U	R	EB	L	Hour	Peak
7:00	7:15	0	19	20	88	0	129	207	92	0	114	20	1	0	3	453	22	4969	
7:15	7:30	0	16	22	106	0	123	220	75	0	114	42	0	0	1	491	29	5006	Peak
7:30	7:45	0	21	23	141	0	139	194	73	0	164	42	2	0	1	461	37	4946	
7:45	8:00	0	21	21	125	0	151	233	96	0	103	36	2	0	0	437	39	4859	
8:00	8:15	0	23	30	112	1	147	206	95	0	83	35	4	0	0	432	37	4827	
8:15	8:30	0	16	29	130	1	140	185	100	0	89	58	7	1	3	382	38		
8:30	8:45	0	26	40	117	0	146	211	78	0	86	85	2	0	5	372	43		
8:45	9:00	0	28	58	133	0	109	193	90	0	111	84	2	0	7	357	60		
16:00	16:15	0	47	73	120	0	159	356	139	0	87	35	5	0	2	274	38	5694	
16:15	16:30	0	34	53	120	0	166	472	155	0	62	22	6	0	7	274	31	5755	
16:30	16:45	0	45	70	123	1	142	413	115	0	105	29	12	1	4	304	29	5754	
16:45	17:00	0	36	53	131	0	165	541	149	0	89	22	8	0	8	340	22	5777	Peak
17:00	17:15	0	40	48	133	0	135	446	154	0	79	27	9	0	7	289	29	5514	
17:15	17:30	0	42	76	148	0	128	442	153	0	83	26	10	0	2	260	31		
17:30	17:45	0	34	47	97	0	127	442	159	0	68	12	6	0	5	380	39		
17:45	18:00	0	39	44	91	0	147	424	145	0	70	24	5	0	3	291	18		

Peak Time		North Approach Gov Macquarie Dr				East Approach Newbridge Rd				South Approach Brickmakers Dr				West Approach Newbridge Rd				Peak total
Period Start	Period End	U	R	SB	L	U	R	WB	L	U	R	NB	L	U	R	EB	L	
7:15	8:15	0	81	96	484	1	560	853	339	0	464	155	8	0	2	1821	142	5006
16:45	17:45	0	152	224	509	0	555	1871	615	0	319	87	33	0	22	1269	121	5777

Pedestrians Crossing

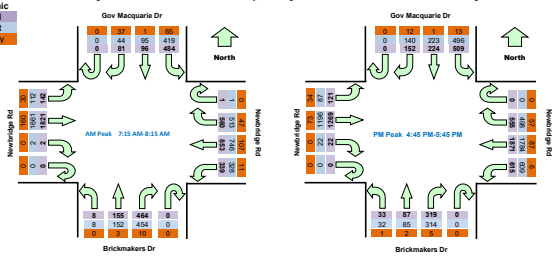
Time		Approach Gov Mac		Approach Newbrid		Approach Brickma		Approach Newbrid		Hourly Tot
Period Start	Period End	Westbound	Eastbound	Southbound	Northbound	Westbound	Eastbound	Southbound	Northbound	
7:00	7:15	0	0	0	0	0	0	0	2	5
7:15	7:30	0	0	0	0	0	0	0	0	6
7:30	7:45	0	0	0	0	0	0	0	0	22
7:45	8:00	0	0	0	1	0	0	0	2	32
8:00	8:15	1	0	0	0	0	0	2	0	29
8:15	8:30	0	0	0	1	0	1	1	13	
8:30	8:45	0	0	0	1	0	1	0	8	
8:45	9:00	0	0	0	0	0	0	0	0	
16:00	16:15	1	0	0	0	0	0	2	0	12
16:15	16:30	0	0	0	0	0	0	3	0	9
16:30	16:45	0	0	0	0	0	0	1	3	9
16:45	17:00	0	0	1	0	1	0	0	0	6
17:00	17:15	0	0	0	0	0	0	0	0	4
17:15	17:30	0	0	0	0	1	0	0	2	
17:30	17:45	0	0	0	0	0	0	0	1	
17:45	18:00	0	0	0	0	0	0	0	0	

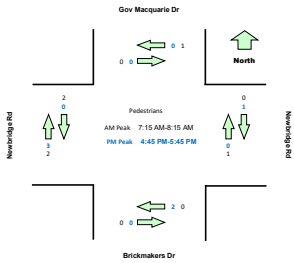
Peak Time		Approach Gov Mac		Approach Newbrid		Approach Brickma		Approach Newbrid		Peak hour
Period Start	Period End	Westbound	Eastbound	Southbound	Northbound	Westbound	Eastbound	Southbound	Northbound	
7:15	8:15	1	0	0	1	0	0	2	2	6
16:45	17:45	0	0	1	0	2	0	0	3	6

Note: Site sketch is for illustrating traffic flows. Direction is indicative only, drawing is not to scale and not an exact streets configuration.

Graphic

Total
Light
Heavy





Light Vehicles

Time		North Approach Gov Macquarie Dr				East Approach Newbridge Rd				South Approach Brickmakers Dr				West Approach Newbridge Rd			
Period Start	Period End	U	R	SB	L	U	R	WB	L	U	R	NB	L	U	R	EB	L
7:00	7:15	0	10	20	73	0	116	168	88	0	113	19	0	0	3	411	13
7:15	7:30	0	9	22	91	0	117	191	71	0	112	42	0	0	1	462	20
7:30	7:45	0	9	23	126	0	131	164	73	0	159	42	2	0	1	419	28
7:45	8:00	0	11	21	101	0	138	206	91	0	103	35	2	0	0	389	32
8:00	8:15	0	15	29	101	1	127	185	93	0	80	33	4	0	0	391	32
8:15	8:30	0	9	28	113	1	116	156	96	0	88	58	6	1	3	339	29
8:30	8:45	0	13	38	96	0	128	174	76	0	85	84	1	0	5	311	30
8:45	9:00	0	18	54	100	0	92	170	83	0	110	83	2	0	7	322	48
16:00	16:15	0	41	72	105	0	144	334	134	0	86	33	5	0	2	252	26
16:15	16:30	0	29	53	117	0	150	449	152	0	61	22	6	0	7	249	24
16:30	16:45	0	39	70	118	1	123	395	114	0	102	28	12	1	4	286	22
16:45	17:00	0	32	53	129	0	149	521	148	0	87	22	8	0	8	324	19
17:00	17:15	0	40	48	128	0	118	413	152	0	77	26	9	0	7	273	23
17:15	17:30	0	39	76	144	0	120	426	153	0	82	26	10	0	2	248	21
17:30	17:45	0	29	46	95	0	111	424	156	0	68	11	5	0	5	351	24
17:45	18:00	0	33	44	86	0	131	403	145	0	69	23	5	0	3	282	13

Peak Time		North Approach Gov Macquarie Dr				East Approach Newbridge Rd				South Approach Brickmakers Dr				West Approach Newbridge Rd				Peak total
Period Start	Period End	U	R	SB	L	U	R	WB	L	U	R	NB	L	U	R	EB	L	
7:15	8:15	0	44	95	419	1	513	746	328	0	454	152	8	0	2	1661	112	4535
16:45	17:45	0	140	223	496	0	498	1784	609	0	314	85	32	0	22	1196	87	5486

Heavy Vehicles

Time		North Approach Gov Macquarie Dr				East Approach Newbridge Rd				South Approach Brickmakers Dr				West Approach Newbridge Rd			
Period Start	Period End	U	R	SB	L	U	R	WB	L	U	R	NB	L	U	R	EB	L
7:00	7:15	0	9	0	15	0	13	39	4	0	1	1	1	0	0	42	9
7:15	7:30	0	7	0	15	0	6	29	4	0	2	0	0	0	0	29	9
7:30	7:45	0	12	0	15	0	8	30	0	0	5	0	0	0	0	42	9
7:45	8:00	0	10	0	24	0	13	27	5	0	0	1	0	0	0	48	7
8:00	8:15	0	8	1	11	0	20	21	2	0	3	2	0	0	0	41	5
8:15	8:30	0	7	1	17	0	24	29	4	0	1	0	1	0	0	43	9
8:30	8:45	0	13	2	21	0	18	37	2	0	1	1	1	0	0	61	13
8:45	9:00	0	10	4	33	0	17	23	7	0	1	1	0	0	0	35	12
16:00	16:15	0	6	1	15	0	15	22	5	0	1	2	0	0	0	22	12
16:15	16:30	0	5	0	3	0	16	23	3	0	1	0	0	0	0	25	7
16:30	16:45	0	6	0	5	0	19	18	1	0	3	1	0	0	0	18	7
16:45	17:00	0	4	0	2	0	16	20	1	0	2	0	0	0	0	16	3
17:00	17:15	0	0	0	5	0	17	33	2	0	2	1	0	0	0	16	6
17:15	17:30	0	3	0	4	0	8	16	0	0	1	0	0	0	0	12	10
17:30	17:45	0	5	1	2	0	16	18	3	0	0	1	1	0	0	29	15
17:45	18:00	0	6	0	5	0	16	21	0	0	1	1	0	0	0	9	5

Peak Time		North Approach Gov Macquarie Dr				East Approach Newbridge Rd				South Approach Brickmakers Dr				West Approach Newbridge Rd				Peak total
Period Start	Period End	U	R	SB	L	U	R	WB	L	U	R	NB	L	U	R	EB	L	
7:15	8:15	0	37	1	65	0	47	107	11	0	10	3	0	0	0	160	30	471
16:45	17:45	0	12	1	13	0	57	87	6	0	5	2	1	0	0	73	34	291

Cyclists

Time		North Approach Gov Macquarie Dr				East Approach Newbridge Rd				South Approach Brickmakers Dr				West Approach Newbridge Rd			
Period Start	Period End	U	R	SB	L	U	R	WB	L	U	R	NB	L	U	R	EB	L
7:00	7:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15	7:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30	7:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45	8:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00	8:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15	8:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30	8:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45	9:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00	16:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:15	16:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:30	16:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45	17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00	17:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15	17:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30	17:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TRANS TRAFFIC SURVEY

trafficsurvey.com.au

TURNING MOVEMENT SURVEY

Intersection of Newbridge Rd and Unnamed Rd, Moore

GPS	-33.928659, 150.964611
Date:	Thu 22/06/23
Weather:	Overcast
Suburban:	Moorebank
Customer:	EMM

North:	N/A
East:	Newbridge Rd
South:	Unnamed Rd
West:	Newbridge Rd

Survey	AM:	7:00 AM-9:00 AM
Period	PM:	4:00 PM-6:00 PM
Traffic	AM:	7:15 AM-8:15 AM
Peak	PM:	4:45 PM-5:45 PM

All Vehicles

Time		East Approach Newbridge R		South Approach Unnamed			West Approach Newbridge R			Hourly Total	
Period Start	Period End	U	WB	L	U	R	L	U	R	EB	Hour	Peak
7:00	7:15	0	429	7	0	0	1	0	0	646	4562	
7:15	7:30	0	416	4	0	0	1	0	0	710	4577	Peak
7:30	7:45	0	425	5	0	0	0	0	0	777	4473	
7:45	8:00	0	472	4	0	0	3	0	0	662	4266	
8:00	8:15	0	448	8	0	0	2	0	0	640	4132	
8:15	8:30	0	420	1	0	0	3	0	0	603		
8:30	8:45	0	438	2	0	0	2	0	0	558		
8:45	9:00	0	396	5	0	0	2	0	0	604		
16:00	16:15	0	686	1	0	0	1	0	0	470	4972	
16:15	16:30	0	753	0	0	0	1	0	0	455	5074	
16:30	16:45	0	724	1	0	0	1	0	0	543	5064	
16:45	17:00	0	807	1	0	0	4	0	0	524	5092	Peak
17:00	17:15	0	748	0	0	0	2	0	0	510	4967	
17:15	17:30	0	728	0	0	0	0	0	0	471		
17:30	17:45	0	727	0	0	0	0	0	0	570		
17:45	18:00	0	728	0	0	0	0	0	0	483		

Peak Time		East Approach Newbridge R		South Approach Unnamed			West Approach Newbridge R			Peak
Period Start	Period End	U	WB	L	U	R	L	U	R	EB	total
7:15	8:15	0	1761	21	0	0	6	0	0	2789	4577
16:45	17:45	0	3010	1	0	0	6	0	0	2075	5092

Pedestrians Crossing

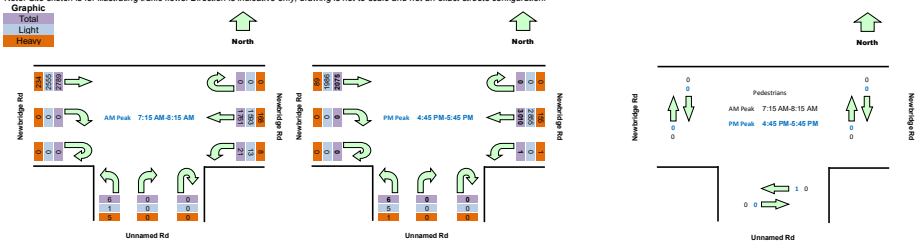
Time		Approach Newbrid	Approach Unnam	Approach Newbrid	Hourly Tot
Period Start	Period End	outhboun	orthboun	estboun	astboun	outhboun	orthboun	
7:00	7:15	0	0	0	0	0	0	0
7:15	7:30	0	0	0	0	0	0	0
7:30	7:45	0	0	0	0	0	0	0
7:45	8:00	0	0	0	0	0	0	0
8:00	8:15	0	0	0	0	0	0	0
8:15	8:30	0	0	0	0	0	0	
8:30	8:45	0	0	0	0	0	0	
8:45	9:00	0	0	0	0	0	0	
16:00	16:15	0	0	0	0	0	0	0
16:15	16:30	0	0	0	0	0	0	0
16:30	16:45	0	0	0	0	0	0	1
16:45	17:00	0	0	0	0	0	0	1
17:00	17:15	0	0	0	0	0	0	1
17:15	17:30	0	0	1	0	0	0	
17:30	17:45	0	0	0	0	0	0	
17:45	18:00	0	0	0	0	0	0	

Peak Time		Approach Newbrid	Approach Unnam	Approach Newbrid	Peak
Period Start	Period End	outhboun	orthboun	estboun	astboun	outhboun	orthboun	total
7:15	8:15	0	0	0	0	0	0	0
16:45	17:45	0	0	1	0	0	0	1

Note: Site sketch is for illustrating traffic flows. Direction is indicative only, drawing is not to scale and not an exact streets configuration.

Graphic

Total
Light
Heavy



Light Vehicles

Time		East Approach Newbridge R		South Approach Unnamed			West Approach Newbridge R			
Period Start	Period End	U	WB	L	U	R	L	U	R	EB
7:00	7:15	0	381	4	0	0	0	0	0	587
7:15	7:30	0	377	4	0	0	1	0	0	665
7:30	7:45	0	384	4	0	0	0	0	0	713
7:45	8:00	0	427	2	0	0	0	0	0	593
8:00	8:15	0	405	3	0	0	0	0	0	584
8:15	8:30	0	369	0	0	0	0	0	0	548
8:30	8:45	0	378	2	0	0	1	0	0	472
8:45	9:00	0	349	3	0	0	0	0	0	539
16:00	16:15	0	639	0	0	0	1	0	0	434
16:15	16:30	0	722	0	0	0	0	0	0	425
16:30	16:45	0	687	0	0	0	0	0	0	514
16:45	17:00	0	768	0	0	0	4	0	0	507
17:00	17:15	0	695	0	0	0	1	0	0	485
17:15	17:30	0	699	0	0	0	0	0	0	455
17:30	17:45	0	693	0	0	0	0	0	0	539
17:45	18:00	0	687	0	0	0	0	0	0	465

Peak Time		East Approach Newbridge R		South Approach Unnamed			West Approach Newbridge R			Peak
Period Start	Period End	U	WB	L	U	R	L	U	R	EB	total
7:15	8:15	0	1593	13	0	0	1	0	0	2555	4162
16:45	17:45	0	2855	0	0	0	5	0	0	1986	4846

Heavy Vehicles

Time		East Approach Newbridge R		South Approach Unnamed			West Approach Newbridge R			
Period Start	Period End	U	WB	L	U	R	L	U	R	EB
7:00	7:15	0	48	3	0	0	1	0	0	59
7:15	7:30	0	39	0	0	0	0	0	0	45
7:30	7:45	0	41	1	0	0	0	0	0	64
7:45	8:00	0	45	2	0	0	3	0	0	69
8:00	8:15	0	43	5	0	0	2	0	0	56
8:15	8:30	0	51	1	0	0	3	0	0	55
8:30	8:45	0	60	0	0	0	1	0	0	86
8:45	9:00	0	47	2	0	0	2	0	0	65
16:00	16:15	0	47	1	0	0	0	0	0	36
16:15	16:30	0	31	0	0	0	1	0	0	30
16:30	16:45	0	37	1	0	0	1	0	0	29
16:45	17:00	0	39	1	0	0	0	0	0	17
17:00	17:15	0	53	0	0	0	1	0	0	25
17:15	17:30	0	29	0	0	0	0	0	0	16
17:30	17:45	0	34	0	0	0	0	0	0	31
17:45	18:00	0	41	0	0	0	0	0	0	18

Peak Time		East Approach Newbridge R		South Approach Unnamed			West Approach Newbridge R			Peak
Period Start	Period End	U	WB	L	U	R	L	U	R	EB	total
7:15	8:15	0	168	8	0	0	5	0	0	234	415
16:45	17:45	0	155	1	0	0	1	0	0	89	246

Cyclists

Time		East Approach Newbridge R		South Approach Unnamed			West Approach Newbridge R			
Period Start	Period End	U	WB	L	U	R	L	U	R	EB
7:00	7:15	0	0	0	0	0	0	0	0	0
7:15	7:30	0	0	0	0	0	0	0	0	0
7:30	7:45	0	0	0	0	0	0	0	0	0
7:45	8:00	0	0	0	0	0	0	0	0	0
8:00	8:15	0	0	0	0	0	0	0	0	0
8:15	8:30	0	0	0	0	0	0	0	0	0
8:30	8:45	0	0	0	0	0	0	0	0	0
8:45	9:00	0	0	0	0	0	0	0	0	0
16:00	16:15	0	0	0	0	0	0	0	0	0
16:15	16:30	0	0	0	0	0	0	0	0	0
16:30	16:45	0	0	0	0	0	0	0	0	0
16:45	17:00	0	0	0	0	0	0	0	0	0
17:00	17:15	0	0	0	0	0	0	0	0	0
17:15	17:30	0	0	0	0	0	0	0	0	0
17:30	17:45	0	1	0	0	0	0	0	0	0
17:45	18:00	0	0	0	0	0	0	0	0	0

TRANS TRAFFIC SURVEY

trafficsurvey.com.au

TURNING MOVEMENT SURVEY

Intersection of Newbridge Rd and Davy Robinson Dr, Mc

GPS	-33.928536, 150.968867
Date:	Thu 22/06/23
Weather:	Overcast
Suburban:	Moorebank
Customer:	EMM

North:	N/A
East:	Newbridge Rd
South:	Davy Robinson Dr
West:	Newbridge Rd

Survey	AM:	7:00 AM-9:00 AM
Period	PM:	4:00 PM-6:00 PM
Traffic	AM:	7:15 AM-8:15 AM
Peak	PM:	4:45 PM-5:45 PM

All Vehicles

Time		East Approach Newbridge Rd			North Approach Davy Robinson Dr			West Approach Newbridge Rd			Hourly Total	
Period Start	Period End	U	WB	L	U	R	L	U	R	EB	Hour	Peak
7:00	7:15	1	423	0	0	0	2	5	3	652	4586	
7:15	7:30	0	403	1	0	0	0	2	3	704	4595	Peak
7:30	7:45	0	419	0	0	1	2	3	4	779	4552	
7:45	8:00	0	481	0	0	0	4	2	3	689	4342	
8:00	8:15	0	439	0	0	0	2	4	2	648	4173	
8:15	8:30	0	410	1	0	0	0	1	0	658		
8:30	8:45	1	436	0	0	0	1	1	0	559		
8:45	9:00	2	382	1	0	0	1	4	1	619		
16:00	16:15	0	687	2	0	0	6	7	1	455	5124	
16:15	16:30	0	729	2	0	1	3	4	1	502	5278	
16:30	16:45	0	711	3	0	0	4	0	3	602	5276	
16:45	17:00	0	815	1	0	0	4	1	4	576	5311	Peak
17:00	17:15	0	734	1	0	0	3	5	2	567	5174	
17:15	17:30	0	699	0	0	0	1	3	0	537		
17:30	17:45	0	732	2	0	0	0	2	1	621		
17:45	18:00	1	683	2	0	0	4	2	0	572		

Peak Time		East Approach Newbridge Rd			North Approach Davy Robinson Dr			West Approach Newbridge Rd			Peak
Period Start	Period End	U	WB	L	U	R	L	U	R	EB	total
7:15	8:15	0	1742	1	0	1	8	11	12	2820	4595
16:45	17:45	0	2980	4	0	0	8	11	7	2301	5311

Pedestrians Crossing

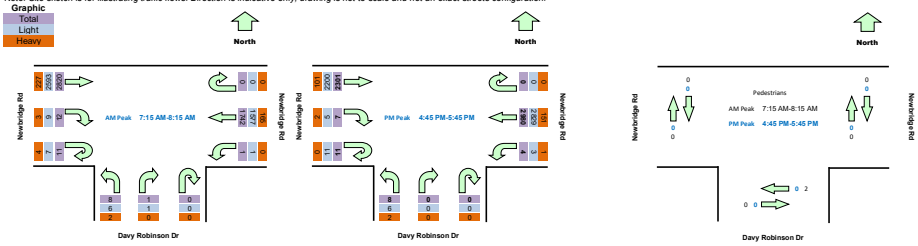
Time		Approach Newbridg	Approach Davy Rob		Approach Newbridg		Hourly Tot
Period Start	Period End	outbound	orthbound	Vestbound	astbound	outbound	orthbound	
7:00	7:15	0	0	0	0	0	0	2
7:15	7:30	0	0	0	0	0	0	2
7:30	7:45	0	0	0	0	0	0	2
7:45	8:00	0	0	2	0	0	0	3
8:00	8:15	0	0	0	0	0	0	1
8:15	8:30	0	0	0	0	0	0	
8:30	8:45	0	0	0	1	0	0	
8:45	9:00	0	0	0	0	0	0	
16:00	16:15	0	0	0	0	0	0	0
16:15	16:30	0	0	0	0	0	0	0
16:30	16:45	0	0	0	0	0	0	0
16:45	17:00	0	0	0	0	0	0	0
17:00	17:15	0	0	0	0	0	0	0
17:15	17:30	0	0	0	0	0	0	
17:30	17:45	0	0	0	0	0	0	
17:45	18:00	0	0	0	0	0	0	

Peak Time		Approach Newbridg	Approach Davy Rob		Approach Newbridg		Peak
Period Start	Period End	outbound	orthbound	Vestbound	astbound	outbound	orthbound	total
7:15	8:15	0	0	2	0	0	0	2
16:45	17:45	0	0	0	0	0	0	0

Note: Site sketch is for illustrating traffic flows. Direction is indicative only, drawing is not to scale and not an exact streets configuration.

Graphic

Total
Light
Heavy



Light Vehicles

Time		East Approach Newbridge Rd			North Approach Davy Robinson Dr			West Approach Newbridge Rd		
Period Start	Period End	U	WB	L	U	R	L	U	R	EB
7:00	7:15	1	374	0	0	0	0	4	1	597
7:15	7:30	0	367	1	0	0	0	2	3	661
7:30	7:45	0	376	0	0	1	2	2	3	714
7:45	8:00	0	439	0	0	0	2	1	1	626
8:00	8:15	0	395	0	0	0	2	2	2	592
8:15	8:30	0	359	1	0	0	0	0	0	602
8:30	8:45	1	380	0	0	0	0	1	0	475
8:45	9:00	2	336	1	0	0	0	3	0	551
16:00	16:15	0	642	2	0	0	4	7	0	426
16:15	16:30	0	696	2	0	1	2	4	1	474
16:30	16:45	0	676	2	0	0	3	0	2	567
16:45	17:00	0	775	0	0	0	2	1	2	557
17:00	17:15	0	687	1	0	0	3	5	2	540
17:15	17:30	0	671	0	0	0	1	3	0	515
17:30	17:45	0	696	2	0	0	0	2	1	588
17:45	18:00	1	647	2	0	0	4	2	0	550

Peak Time		East Approach Newbridge Rd			North Approach Davy Robinson Dr			West Approach Newbridge Rd			Peak
Period Start	Period End	U	WB	L	U	R	L	U	R	EB	total
7:15	8:15	0	1577	1	0	1	6	7	9	2593	4194
16:45	17:45	0	2829	3	0	0	6	11	5	2200	5054

Heavy Vehicles

Time		East Approach Newbridge Rd			North Approach Davy Robinson Dr			West Approach Newbridge Rd		
Period Start	Period End	U	WB	L	U	R	L	U	R	EB
7:00	7:15	0	49	0	0	0	2	1	2	55
7:15	7:30	0	36	0	0	0	0	0	0	43
7:30	7:45	0	43	0	0	0	0	1	1	65
7:45	8:00	0	42	0	0	0	2	1	2	63
8:00	8:15	0	44	0	0	0	0	2	0	56
8:15	8:30	0	51	0	0	0	0	1	0	56
8:30	8:45	0	56	0	0	0	1	0	0	84
8:45	9:00	0	46	0	0	0	1	1	1	68
16:00	16:15	0	45	0	0	0	2	0	1	29
16:15	16:30	0	33	0	0	0	1	0	0	28
16:30	16:45	0	35	1	0	0	1	0	1	35
16:45	17:00	0	40	1	0	0	2	0	2	19
17:00	17:15	0	47	0	0	0	0	0	0	27
17:15	17:30	0	28	0	0	0	0	0	0	22
17:30	17:45	0	36	0	0	0	0	0	0	33
17:45	18:00	0	36	0	0	0	0	0	0	22

Peak Time		East Approach Newbridge Rd			North Approach Davy Robinson Dr			West Approach Newbridge Rd			Peak
Period Start	Period End	U	WB	L	U	R	L	U	R	EB	total
7:15	8:15	0	165	0	0	0	2	4	3	227	401
16:45	17:45	0	151	1	0	0	2	0	2	101	257

Cyclists

Time		East Approach Newbridge Rd			North Approach Davy Robinson Dr			West Approach Newbridge Rd		
Period Start	Period End	U	WB	L	U	R	L	U	R	EB
7:00	7:15	0	0	0	0	0	0	0	0	0
7:15	7:30	0	0	0	0	0	0	0	0	0
7:30	7:45	0	0	0	0	0	0	0	0	0
7:45	8:00	0	0	0	0	0	0	0	0	0
8:00	8:15	0	0	0	0	0	0	0	0	0
8:15	8:30	0	1	0	0	0	0	0	0	1
8:30	8:45	0	0	0	0	0	0	0	0	0
8:45	9:00	0	0	0	0	0	0	0	0	0
16:00	16:15	0	0	0	0	0	0	0	0	0
16:15	16:30	0	0	0	0	0	0	0	0	0
16:30	16:45	0	0	0	0	0	0	0	0	0
16:45	17:00	0	0	0	0	0	0	0	0	0
17:00	17:15	0	0	0	0	0	0	0	0	0
17:15	17:30	0	0	0	0	0	0	0	0	0
17:30	17:45	0	1	0	0	0	0	0	0	0
17:45	18:00	0	0	0	0	0	0	0	0	0

Appendix C
SIDRA results

EMM
creating opportunities

MOVEMENT SUMMARY

Site: 101 [Ex Newbridge Rd/Gov Macquarie Dr/Brickmakers Dr AM (Site Folder: Existing)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Ex AM (Network Folder: General)]

Four Way Intersection
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site User-Given Phase Times)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Brickmakers Drive															
1	L2	All MCs	8	0.0	8	0.0	0.696	70.7	LOS F	11.6	82.6	1.00	0.85	1.04	25.0
2	T1	All MCs	163	1.9	163	1.9	*0.696	65.1	LOS E	11.6	82.6	1.00	0.85	1.04	24.8
3	R2	All MCs	488	2.2	488	2.2	0.890	79.6	LOS F	18.6	132.4	1.00	1.01	1.26	10.9
Approach			660	2.1	660	2.1	0.890	75.9	LOS F	18.6	132.4	1.00	0.97	1.20	14.9
East: Newbridge Road															
4	L2	All MCs	357	3.2	357	3.2	0.252	7.4	LOS A	2.8	20.3	0.16	0.62	0.16	40.8
5	T1	All MCs	898	12.5	898	12.5	0.273	13.6	LOS A	9.4	72.9	0.50	0.44	0.50	50.9
6	R2	All MCs	589	8.4	589	8.4	*1.177	256.7	LOS F	37.7	283.2	1.00	1.39	2.19	8.8
Approach			1844	9.4	1844	9.4	1.177	90.1	LOS F	37.7	283.2	0.60	0.78	0.97	18.2
North: Governor Macquarie Drive															
7	L2	All MCs	509	13.4	509	13.4	0.501	49.1	LOS D	14.3	111.7	0.88	0.82	0.88	23.2
8	T1	All MCs	101	1.0	101	1.0	0.406	62.8	LOS E	6.5	45.6	0.96	0.77	0.96	20.3
9	R2	All MCs	85	45.7	85	45.7	0.305	45.3	LOS D	4.3	42.1	0.89	0.76	0.89	31.2
Approach			696	15.6	696	15.6	0.501	50.6	LOS D	14.3	111.7	0.89	0.80	0.89	24.1
West: Newbridge Road															
10	L2	All MCs	149	21.1	149	21.1	*0.894	36.9	LOS C	48.0	368.8	1.00	0.99	1.11	33.0
11	T1	All MCs	1917	8.8	1917	8.8	0.894	60.2	LOS E	48.8	367.5	1.00	0.99	1.11	24.5
12	R2	All MCs	2	0.0	2	0.0	0.008	56.3	LOS D	0.1	0.6	0.60	0.64	0.60	32.2
Approach			2068	9.7	2068	9.7	0.894	58.5	LOS E	48.8	368.8	1.00	0.99	1.11	25.3
All Vehicles			5268	9.4	5268	9.4	1.177	70.7	LOS F	48.8	368.8	0.84	0.89	1.04	20.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Brickmakers Drive											
P1	Full	1	16.0	LOS B	0.0	0.0	0.48	0.48	32.7	20.0	0.61
East: Newbridge Road											

P2 Full	1	64.1	LOS F	0.0	0.0	0.96	0.96	80.8	20.0	0.25
North: Governor Macquarie Drive										
P3 Full	1	34.3	LOS D	0.0	0.0	0.70	0.70	51.0	20.0	0.39
West: Newbridge Road										
P4 Full	16	64.2	LOS F	0.1	0.1	0.96	0.96	80.8	20.0	0.25
All Pedestrians	19	59.8	LOS E	0.1	0.1	0.92	0.92	76.5	20.0	0.26

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 102 [Ex Brickmakers Dr/Promontory Way AM (Site Folder: Existing)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Ex AM (Network Folder: General)]

Intersection with Stop Sign
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Brickmakers Drive															
2	T1	All MCs	648	1.9	648	1.9	0.337	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	49.8
3	R2	All MCs	4	0.0	4	0.0	0.005	6.5	LOS A	0.0	0.1	0.46	0.57	0.46	41.8
Approach			653	1.9	653	1.9	0.337	0.2	NA	0.0	0.1	0.00	0.00	0.00	49.8
East: Promontory Way															
4	L2	All MCs	6	0.0	6	0.0	0.009	9.9	LOS A	0.0	0.2	0.46	0.85	0.46	40.0
6	R2	All MCs	16	0.0	16	0.0	0.030	11.6	LOS A	0.1	0.8	0.53	0.90	0.53	20.6
Approach			22	0.0	22	0.0	0.030	11.1	LOS A	0.1	0.8	0.51	0.88	0.51	31.3
North: Brickmakers Drive															
7	L2	All MCs	9	11.1	9	11.1	0.006	4.7	LOS A	0.0	0.0	0.00	0.53	0.00	40.1
8	T1	All MCs	440	2.4	440	2.4	0.229	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	49.9
Approach			449	2.6	449	2.6	0.229	0.1	NA	0.0	0.0	0.00	0.01	0.00	49.8
All Vehicles			1124	2.2	1124	2.2	0.337	0.4	NA	0.1	0.8	0.01	0.02	0.01	49.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 103 [Ex Newbridge Rd/Site Access Rd AM (Site Folder: Existing)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Ex AM (Network Folder: General)]

Site Access
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Site Access Road															
1	L2	All MCs	6	83.3	6	83.3	0.028	13.4	LOS A	0.1	1.0	0.75	0.75	0.75	9.3
Approach			6	83.3	6	83.3	0.028	13.4	LOS A	0.1	1.0	0.75	0.75	0.75	9.3
East: Newbridge Road															
4	L2	All MCs	22	38.1	22	38.1	0.015	10.2	LOS A	0.0	0.0	0.00	0.80	0.00	44.3
5	T1	All MCs	1854	9.5	1854	9.5	0.398	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	69.6
Approach			1876	9.9	1876	9.9	0.398	0.2	NA	0.0	0.0	0.00	0.01	0.00	68.6
West: Newbridge Road															
11	T1	All MCs	2936	8.4	2936	8.4	0.529	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	69.5
Approach			2936	8.4	2936	8.4	0.529	0.1	NA	0.0	0.0	0.00	0.00	0.00	69.5
All Vehicles			4818	9.1	4818	9.1	0.529	0.2	NA	0.1	1.0	0.00	0.00	0.00	67.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 104 [Ex Newbridge Rd/Davy Robinson Dr AM (Site Folder: Existing)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Ex AM (Network Folder: General)]

Intersection with Give Way Sign
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Davy Robinson Drive															
1	L2	All MCs	8	25.0	8	25.0	1.013	159.7	LOS F	1.9	15.4	1.00	0.94	1.09	10.2
3	R2	All MCs	1	0.0	1	0.0	1.013	35.7	LOS C	1.9	15.4	1.00	0.94	1.09	17.3
Approach			9	22.2	9	22.2	1.013	146.0	LOS F	1.9	15.4	1.00	0.94	1.09	11.1
East: Newbridge Road															
4	L2	All MCs	1	0.0	1	0.0	0.333	6.4	LOS A	0.0	0.0	0.00	0.00	0.00	65.5
5	T1	All MCs	1834	9.5	1834	9.5	0.333	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	69.7
Approach			1835	9.5	1835	9.5	0.333	0.1	NA	0.0	0.0	0.00	0.00	0.00	69.7
West: Newbridge Road															
11	T1	All MCs	2968	8.0	2968	8.0	0.534	0.2	LOS A	0.0	0.0	0.00	0.00	0.00	69.5
12	R2	All MCs	13	25.0	13	25.0	0.645	151.8	LOS F	1.1	9.3	0.99	1.03	1.16	15.2
Approach			2981	8.1	2981	8.1	0.645	0.8	NA	1.1	9.3	0.00	0.00	0.00	68.4
All Vehicles			4825	8.7	4825	8.7	1.013	0.8	NA	1.9	15.4	0.00	0.00	0.01	68.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

MOVEMENT SUMMARY

Site: 101 [Ex Newbridge Rd/Gov Macquarie Dr/Brickmakers Dr PM (Site Folder: Existing)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Ex PM (Network Folder: General)]

Four Way Intersection
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site User-Given Phase Times)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Brickmakers Drive															
1	L2	All MCs	35	3.0	35	3.0	0.366	37.6	LOS C	7.6	54.3	0.92	0.75	0.92	27.1
2	T1	All MCs	92	2.3	92	2.3	0.366	61.9	LOS E	7.6	54.3	0.92	0.75	0.92	27.0
3	R2	All MCs	336	1.6	336	1.6	* 1.067	156.6	LOS F	17.3	122.7	1.00	1.32	1.83	6.2
Approach			462	1.8	462	1.8	1.067	128.9	LOS F	17.3	122.7	0.98	1.17	1.58	10.1
East: Newbridge Road															
4	L2	All MCs	647	1.0	647	1.0	0.483	48.7	LOS D	11.8	83.1	0.36	1.16	0.36	35.7
5	T1	All MCs	1969	4.6	1969	4.6	* 1.128	195.6	LOS F	40.4	293.8	1.00	1.67	1.91	11.6
6	R2	All MCs	584	10.3	584	10.3	* 0.656	58.0	LOS E	10.4	79.1	0.95	0.85	0.95	32.0
Approach			3201	4.9	3201	4.9	1.128	140.8	LOS F	40.4	293.8	0.86	1.42	1.42	14.1
North: Governor Macquarie Drive															
7	L2	All MCs	536	2.6	536	2.6	0.312	20.5	LOS B	8.4	60.0	0.66	0.75	0.66	36.1
8	T1	All MCs	236	0.4	236	0.4	* 0.679	59.9	LOS E	15.2	107.1	0.99	0.83	0.99	20.9
9	R2	All MCs	160	7.9	160	7.9	0.499	48.4	LOS D	8.7	65.4	0.92	0.79	0.92	33.4
Approach			932	2.9	932	2.9	0.679	35.3	LOS C	15.2	107.1	0.79	0.78	0.79	30.5
West: Newbridge Road															
10	L2	All MCs	127	28.1	127	28.1	0.948	61.7	LOS E	39.0	300.4	1.00	1.12	1.29	26.5
11	T1	All MCs	1336	5.8	1336	5.8	0.948	88.5	LOS F	40.8	299.7	1.00	1.13	1.28	18.1
12	R2	All MCs	23	0.0	23	0.0	0.056	83.6	LOS F	0.8	5.4	0.82	0.69	0.82	32.1
Approach			1486	7.6	1486	7.6	0.948	86.1	LOS F	40.8	300.4	1.00	1.12	1.27	19.2
All Vehicles			6081	5.0	6081	5.0	1.128	110.3	LOS F	40.8	300.4	0.89	1.23	1.30	16.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Brickmakers Drive											
P1	Full	1	34.3	LOS D	0.0	0.0	0.70	0.70	51.0	20.0	0.39
East: Newbridge Road											

P2 Full	1	64.1	LOS F	0.0	0.0	0.96	0.96	80.8	20.0	0.25
North: Governor Macquarie Drive										
P3 Full	1	49.7	LOS E	0.0	0.0	0.84	0.84	66.4	20.0	0.30
West: Newbridge Road										
P4 Full	16	64.2	LOS F	0.1	0.1	0.96	0.96	80.8	20.0	0.25
All Pedestrians	19	61.7	LOS F	0.1	0.1	0.94	0.94	78.4	20.0	0.26

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 102 [Ex Brickmakers Dr/Promontory Way PM (Site Folder: Existing)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Ex PM (Network Folder: General)]

Intersection with Stop Sign
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Brickmakers Drive															
2	T1	All MCs	453	1.6	453	1.6	0.235	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	49.9
3	R2	All MCs	3	0.0	3	0.0	0.007	10.9	LOS A	0.0	0.2	0.68	0.72	0.68	38.5
Approach			456	1.6	456	1.6	0.235	0.1	NA	0.0	0.2	0.00	0.01	0.00	49.8
East: Promontory Way															
4	L2	All MCs	4	0.0	4	0.0	0.013	16.2	LOS B	0.0	0.3	0.72	0.93	0.72	36.2
6	R2	All MCs	9	0.0	9	0.0	0.044	22.7	LOS B	0.1	1.0	0.79	1.00	0.79	13.0
Approach			14	0.0	14	0.0	0.044	20.7	LOS B	0.1	1.0	0.77	0.98	0.77	24.2
North: Brickmakers Drive															
7	L2	All MCs	9	0.0	9	0.0	0.005	4.6	LOS A	0.0	0.0	0.00	0.53	0.00	40.6
8	T1	All MCs	899	0.8	899	0.8	0.463	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	49.7
Approach			908	0.8	908	0.8	0.463	0.2	NA	0.0	0.0	0.00	0.01	0.00	49.7
All Vehicles			1378	1.1	1378	1.1	0.463	0.4	NA	0.1	1.0	0.01	0.02	0.01	49.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

MOVEMENT SUMMARY

Site: 103 [Ex Newbridge Rd/Site Access Rd PM (Site Folder: Existing)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Ex PM (Network Folder: General)]

Site Access
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Site Access Road															
1	L2	All MCs	6	16.7	6	16.7	0.067	17.2	LOS B	0.1	0.8	0.83	0.83	0.83	9.2
Approach			6	16.7	6	16.7	0.067	17.2	LOS B	0.1	0.8	0.83	0.83	0.83	9.2
East: Newbridge Road															
4	L2	All MCs	1	100.0	1	100.0	0.001	11.4	LOS A	0.0	0.0	0.00	0.79	0.00	42.1
5	T1	All MCs	3168	5.1	3168	5.1	0.560	0.2	LOS A	56.6	413.5	0.00	0.00	0.00	69.4
Approach			3169	5.2	3169	5.2	0.560	0.2	NA	56.6	413.5	0.00	0.00	0.00	69.4
West: Newbridge Road															
11	T1	All MCs	2184	4.3	2163	4.3	0.380	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	69.7
Approach			2184	4.3	2163	4.3	0.380	0.0	NA	0.0	0.0	0.00	0.00	0.00	69.7
All Vehicles			5360	4.8	5339	4.9	0.560	0.1	NA	56.6	413.5	0.00	0.00	0.00	68.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

MOVEMENT SUMMARY

Site: 104 [Ex Newbridge Rd/Davy Robinson Dr PM (Site Folder: Existing)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Ex PM (Network Folder: General)]

Intersection with Give Way Sign
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Davy Robinson Drive															
1	L2	All MCs	8	25.0	8	25.0	1.031	186.9	LOS F	1.8	15.3	1.00	1.05	1.18	8.8
3	R2	All MCs	1	0.0	1	0.0	1.031	68.6	LOS E	1.8	15.3	1.00	1.05	1.18	15.3
Approach			9	22.2	9	22.2	1.031	173.8	LOS F	1.8	15.3	1.00	1.05	1.18	9.6
East: Newbridge Road															
4	L2	All MCs	4	25.0	4	25.0	0.584	6.9	LOS A	0.0	0.0	0.00	0.00	0.00	57.3
5	T1	All MCs	3137	5.1	3137	5.1	0.584	0.3	LOS A	0.0	0.0	0.00	0.00	0.00	69.3
Approach			3141	5.1	3141	5.1	0.584	0.3	NA	0.0	0.0	0.00	0.00	0.00	69.2
West: Newbridge Road															
11	T1	All MCs	2422	4.4	2401	4.4	0.422	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	69.7
12	R2	All MCs	7	28.6	7	28.7	1.219	448.7	LOS F	2.8	24.6	1.00	1.08	1.41	6.3
Approach			2429	4.5	2409	4.5	1.219	1.5	NA	2.8	24.6	0.00	0.00	0.00	67.6
All Vehicles			5580	4.8	5559	4.9	1.219	1.1	NA	2.8	24.6	0.00	0.00	0.00	67.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 101 [Dev Newbridge Rd/Gov Macquarie Dr/Brickmakers Dr AM - Copy (2) (Site Folder: Development Scenario A)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Dev A AM GCV+cumul excl. DCP Road connection (Network Folder: General)]

Four Way Intersection
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site Practical Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Brickmakers Drive															
1	L2	All MCs	99	9.6	99	9.6	1.092	174.3	LOS F	33.0	239.8	1.00	1.48	1.85	13.0
2	T1	All MCs	202	2.1	202	2.1	* 1.092	168.5	LOS F	33.0	239.8	1.00	1.48	1.85	13.1
3	R2	All MCs	604	3.7	604	3.7	1.113	189.7	LOS F	34.4	248.7	1.00	1.43	1.93	5.2
Approach			905	4.0	905	4.0	1.113	183.3	LOS F	34.4	248.7	1.00	1.44	1.91	7.9
East: Newbridge Road															
4	L2	All MCs	409	6.2	409	6.2	0.369	11.3	LOS A	6.9	51.0	0.42	0.71	0.42	33.7
5	T1	All MCs	907	13.5	907	13.4	0.295	16.3	LOS B	10.4	81.3	0.55	0.48	0.55	48.3
6	R2	All MCs	592	8.7	591	8.7	* 1.079	170.9	LOS F	31.7	238.4	1.00	1.24	1.81	12.2
Approach			1908	10.4	1908	10.4	1.079	63.2	LOS E	31.7	238.4	0.66	0.76	0.91	22.8
North: Governor Macquarie Drive															
7	L2	All MCs	509	13.4	509	13.4	0.429	42.9	LOS D	13.2	103.2	0.82	0.80	0.82	25.2
8	T1	All MCs	143	1.5	143	1.5	0.494	61.0	LOS E	9.1	64.6	0.97	0.79	0.97	20.7
9	R2	All MCs	85	45.7	85	45.7	0.328	44.3	LOS D	4.2	40.8	0.92	0.76	0.92	31.5
Approach			738	14.8	738	14.8	0.494	46.6	LOS D	13.2	103.2	0.86	0.80	0.86	25.2
West: Newbridge Road															
10	L2	All MCs	149	21.1	149	21.1	* 1.107	150.6	LOS F	84.9	651.7	1.00	1.55	1.80	16.2
11	T1	All MCs	1917	8.8	1917	8.8	1.107	175.8	LOS F	86.2	649.0	1.00	1.59	1.81	9.7
12	R2	All MCs	107	9.8	107	9.8	0.507	69.6	LOS E	5.9	44.8	0.82	0.80	0.82	26.4
Approach			2174	9.7	2174	9.7	1.107	168.8	LOS F	86.2	651.7	0.99	1.55	1.76	10.6
All Vehicles			5725	9.7	5725	9.7	1.113	120.1	LOS F	86.2	651.7	0.87	1.17	1.39	13.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Brickmakers Drive											
P1	Full	1	18.5	LOS B	0.0	0.0	0.51	0.51	35.2	20.0	0.57

East: Newbridge Road										
P2 Full	1	64.1	LOS F	0.0	0.0	0.96	0.96	80.8	20.0	0.25
North: Governor Macquarie Drive										
P3 Full	1	39.4	LOS D	0.0	0.0	0.75	0.75	56.0	20.0	0.36
West: Newbridge Road										
P4 Full	16	64.2	LOS F	0.1	0.1	0.96	0.96	80.8	20.0	0.25
All Pedestrians	19	60.3	LOS F	0.1	0.1	0.92	0.92	76.9	20.0	0.26

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 102 [Dev Brickmakers Dr/Promontory Way AM - Copy (2) (Site Folder: Development Scenario A)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Dev A AM GCV+cumul excl. DCP Road connection (Network Folder: General)]

Signalised intersection
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Brickmakers Drive															
2	T1	All MCs	648	1.9	648	1.9	*0.566	18.4	LOS B	26.3	186.9	0.66	0.60	0.66	33.7
3	R2	All MCs	63	3.3	63	3.3	0.163	23.0	LOS B	2.2	15.9	0.54	0.69	0.54	31.9
Approach			712	2.1	712	2.1	0.566	18.8	LOS B	26.3	186.9	0.65	0.60	0.65	33.5
East: Promontory Way															
4	L2	All MCs	126	1.7	126	1.7	0.219	59.5	LOS E	6.3	44.6	0.78	0.75	0.78	24.9
6	R2	All MCs	261	8.5	261	8.5	*0.573	64.9	LOS E	14.8	111.5	0.89	0.82	0.89	6.8
Approach			387	6.3	387	6.3	0.573	63.1	LOS E	14.8	111.5	0.85	0.80	0.85	14.6
North: Brickmakers Drive															
7	L2	All MCs	209	12.6	209	12.6	0.205	18.1	LOS B	6.4	49.4	0.49	0.69	0.49	28.8
8	T1	All MCs	440	2.4	440	2.4	0.382	6.9	LOS A	8.5	60.5	0.31	0.28	0.31	44.6
Approach			649	5.7	649	5.7	0.382	10.5	LOS A	8.5	60.5	0.37	0.41	0.37	40.5
All Vehicles			1748	4.3	1748	4.3	0.573	25.5	LOS B	26.3	186.9	0.59	0.57	0.59	31.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
North: Brickmakers Drive											
P3	Full	6	40.1	LOS E	0.0	0.0	0.76	0.76	56.8	20.0	0.35
All Pedestrians		6	40.1	LOS E	0.0	0.0	0.76	0.76	56.8	20.0	0.35

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 103 [Dev Newbridge Rd/Site Access Rd AM - Copy (2) (Site Folder: Development Scenario A)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Dev A AM GCV+cumul excl. DCP Road connection (Network Folder: General)]

Site Access
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
East: Newbridge Road															
4	L2	All MCs	83	24.1	83	24.0	0.052	9.9	LOS A	0.0	0.0	0.00	0.80	0.00	47.4
5	T1	All MCs	1918	10.5	1918	10.5	0.390	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	69.7
Approach			2001	11.1	2001	11.1	0.390	0.5	NA	0.0	0.0	0.00	0.03	0.00	66.8
West: Newbridge Road															
11	T1	All MCs	3052	8.5	2805	8.5	0.506	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	69.5
Approach			3052	8.5	2805	8.5	0.506	0.1	NA	0.0	0.0	0.00	0.00	0.00	69.5
All Vehicles			5053	9.5	4805	10.0	0.506	0.3	NA	0.0	0.0	0.00	0.01	0.00	67.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 104 [Dev Newbridge Rd/Davy Robinson Dr AM - Copy (2) (Site Folder: Development Scenario A)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Dev A AM GCV+cumul excl. DCP Road connection (Network Folder: General)]

Intersection with Give Way Sign
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Davy Robinson Drive															
1	L2	All MCs	15	50.0	15	50.0	1.029	121.6	LOS F	2.1	20.7	1.00	1.08	1.25	12.1
3	R2	All MCs	1	0.0	1	0.0	1.029	48.7	LOS D	2.1	20.7	1.00	1.08	1.25	20.1
Approach			16	46.7	16	46.7	1.029	116.7	LOS F	2.1	20.7	1.00	1.08	1.25	12.7
East: Newbridge Road															
4	L2	All MCs	1	0.0	1	0.0	0.355	6.4	LOS A	0.0	0.0	0.00	0.00	0.00	65.4
5	T1	All MCs	1947	10.2	1947	10.2	0.355	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	69.7
Approach			1948	10.2	1948	10.2	0.355	0.1	NA	0.0	0.0	0.00	0.00	0.00	69.7
West: Newbridge Road															
11	T1	All MCs	3084	8.1	2839	8.2	0.511	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	69.5
12	R2	All MCs	13	25.0	12	25.2	0.868	184.8	LOS F	1.4	11.9	1.00	1.05	1.25	13.2
Approach			3097	8.2	2850	8.3	0.868	0.9	NA	1.4	11.9	0.00	0.00	0.01	68.3
All Vehicles			5061	9.1	4814	9.6	1.029	1.0	NA	2.1	20.7	0.01	0.01	0.01	68.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 101 [Dev Newbridge Rd/Gov Macquarie Dr/Brickmakers Dr PM - Copy (2) (Site Folder: Development Scenario A)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Dev A PM GCV+cumul excl. DCP Road connection (Network Folder: General)]

Four Way Intersection
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site Practical Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Brickmakers Drive															
1	L2	All MCs	172	4.9	172	4.9	0.970	88.9	LOS F	27.7	199.7	1.00	1.16	1.41	19.6
2	T1	All MCs	147	1.4	147	1.4	*0.970	102.6	LOS F	27.7	199.7	1.00	1.16	1.41	19.7
3	R2	All MCs	469	3.1	469	3.1	0.952	93.8	LOS F	19.6	140.7	1.00	1.11	1.41	9.6
Approach			788	3.2	788	3.2	0.970	94.4	LOS F	27.7	199.7	1.00	1.13	1.41	14.2
East: Newbridge Road															
4	L2	All MCs	733	2.0	732	2.0	0.670	40.9	LOS C	17.9	127.3	0.61	1.28	0.61	25.8
5	T1	All MCs	1979	5.1	1979	5.1	*0.982	88.5	LOS F	40.2	293.8	1.00	1.23	1.33	21.9
6	R2	All MCs	586	10.6	586	10.6	0.950	84.0	LOS F	15.4	117.8	1.00	1.01	1.37	23.2
Approach			3298	5.4	3297	5.4	0.982	77.1	LOS F	40.2	293.8	0.91	1.20	1.18	22.4
North: Governor Macquarie Drive															
7	L2	All MCs	536	2.6	536	2.6	0.381	24.4	LOS B	9.0	64.1	0.76	0.78	0.76	33.6
8	T1	All MCs	298	0.4	298	0.4	0.932	82.4	LOS F	23.8	167.4	1.00	1.10	1.32	16.8
9	R2	All MCs	160	7.9	160	7.9	0.545	45.5	LOS D	8.1	60.5	0.97	0.80	0.97	34.2
Approach			994	2.8	994	2.8	0.932	45.2	LOS D	23.8	167.4	0.87	0.88	0.96	26.7
West: Newbridge Road															
10	L2	All MCs	127	28.1	127	28.1	*0.867	35.7	LOS C	34.2	262.8	1.00	0.98	1.11	31.0
11	T1	All MCs	1336	5.8	1336	5.8	0.867	66.2	LOS E	35.9	263.7	1.00	0.98	1.12	22.5
12	R2	All MCs	173	3.7	173	3.7	*0.872	97.1	LOS F	9.1	65.9	1.00	0.91	1.27	22.9
Approach			1636	7.3	1636	7.3	0.872	67.1	LOS E	35.9	263.7	1.00	0.97	1.13	23.5
All Vehicles			6716	5.2	6715	5.2	0.982	72.0	LOS F	40.2	293.8	0.94	1.09	1.16	21.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Brickmakers Drive											
P1	Full	1	27.7	LOS C	0.0	0.0	0.63	0.63	44.3	20.0	0.45

East: Newbridge Road										
P2 Full	1	64.1	LOS F	0.0	0.0	0.96	0.96	80.8	20.0	0.25
North: Governor Macquarie Drive										
P3 Full	1	45.6	LOS E	0.0	0.0	0.81	0.81	62.3	20.0	0.32
West: Newbridge Road										
P4 Full	16	64.2	LOS F	0.1	0.1	0.96	0.96	80.8	20.0	0.25
All Pedestrians	19	61.1	LOS F	0.1	0.1	0.93	0.93	77.8	20.0	0.26

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 102 [Dev Brickmakers Dr/Promontory Way PM - Copy (2) (Site Folder: Development Scenario A)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Dev A PM GCV+cumul excl. DCP Road connection (Network Folder: General)]

Signalised intersection
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 50 seconds (Site Practical Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Brickmakers Drive															
2	T1	All MCs	453	1.6	453	1.6	0.434	7.5	LOS A	6.7	47.7	0.64	0.56	0.64	41.5
3	R2	All MCs	122	0.9	122	0.9	0.630	26.9	LOS B	3.1	22.0	0.95	0.87	1.11	30.0
Approach			575	1.5	575	1.5	0.630	11.7	LOS A	6.7	47.7	0.71	0.62	0.74	38.0
East: Promontory Way															
4	L2	All MCs	97	2.2	97	2.2	0.241	22.7	LOS B	2.0	14.5	0.86	0.75	0.86	32.0
6	R2	All MCs	338	5.0	338	5.0	* 0.856	32.5	LOS C	9.9	72.2	1.00	1.05	1.43	9.3
Approach			435	4.4	435	4.4	0.856	30.3	LOS C	9.9	72.2	0.97	0.98	1.30	16.8
North: Brickmakers Drive															
7	L2	All MCs	307	4.8	307	4.8	0.317	11.6	LOS A	4.2	30.7	0.59	0.72	0.59	33.6
8	T1	All MCs	899	0.8	899	0.8	* 0.858	11.7	LOS A	20.2	142.4	0.79	0.85	0.96	41.5
Approach			1206	1.8	1206	1.8	0.858	11.7	LOS A	20.2	142.4	0.74	0.82	0.87	40.1
All Vehicles			2216	2.2	2216	2.2	0.858	15.3	LOS B	20.2	142.4	0.78	0.80	0.92	35.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
North: Brickmakers Drive											
P3	Full	1	19.4	LOS B	0.0	0.0	0.88	0.88	36.0	20.0	0.56
All Pedestrians		1	19.4	LOS B	0.0	0.0	0.88	0.88	36.0	20.0	0.56

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 103 [Dev Newbridge Rd/Site Access Rd PM - Copy (2) (Site Folder: Development Scenario A)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Dev A PM GCV+cumul excl. DCP Road connection (Network Folder: General)]

Site Access
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
East: Newbridge Road															
4	L2	All MCs	80	15.8	80	15.8	0.048	9.8	LOS A	0.0	0.0	0.00	0.81	0.00	49.4
5	T1	All MCs	3265	5.6	3265	5.6	0.578	0.2	LOS A	33.8	247.6	0.00	0.00	0.00	69.4
Approach			3345	5.9	3345	5.8	0.578	0.4	NA	33.8	247.6	0.00	0.02	0.00	67.9
West: Newbridge Road															
11	T1	All MCs	2318	4.5	2318	4.5	0.408	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	69.7
Approach			2318	4.5	2318	4.5	0.408	0.0	NA	0.0	0.0	0.00	0.00	0.00	69.7
All Vehicles			5663	5.3	5662	5.3	0.578	0.3	NA	33.8	247.6	0.00	0.01	0.00	68.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

MOVEMENT SUMMARY

Site: 104 [Dev Newbridge Rd/Davy Robinson Dr PM - Copy (2) (Site Folder: Development Scenario A)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Dev A PM GCV+cumul excl. DCP Road connection (Network Folder: General)]

Intersection with Give Way Sign
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Davy Robinson Drive															
1	L2	All MCs	15	21.4	15	21.4	1.052	147.2	LOS F	2.2	17.9	1.00	1.12	1.41	10.3
3	R2	All MCs	1	0.0	1	0.0	1.052	77.7	LOS F	2.2	17.9	1.00	1.12	1.41	17.5
Approach			16	20.0	16	20.0	1.052	142.6	LOS F	2.2	17.9	1.00	1.12	1.41	10.9
East: Newbridge Road															
4	L2	All MCs	4	25.0	4	25.0	0.585	6.9	LOS A	0.0	0.0	0.00	0.00	0.00	57.2
5	T1	All MCs	3301	5.4	3301	5.4	0.585	0.3	LOS A	0.0	0.0	0.00	0.00	0.00	69.3
Approach			3305	5.4	3305	5.4	0.585	0.3	NA	0.0	0.0	0.00	0.00	0.00	69.3
West: Newbridge Road															
11	T1	All MCs	2556	4.5	2556	4.5	0.450	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	69.6
12	R2	All MCs	7	28.6	7	28.6	1.228	436.0	LOS F	2.8	24.6	1.00	1.08	1.43	6.5
Approach			2563	4.6	2563	4.6	1.228	1.4	NA	2.8	24.6	0.00	0.00	0.00	67.7
All Vehicles			5884	5.1	5884	5.1	1.228	1.1	NA	2.8	24.6	0.00	0.00	0.01	67.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 101 [Dev Newbridge Rd/Gov Macquarie Dr/Brickmakers Dr AM - Copy (Site Folder: Development Scenario B)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Dev B AM GCV+cumul incl. DCP Road connection (Network Folder: General)]

Four Way Intersection
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site Practical Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Brickmakers Drive															
1	L2	All MCs	86	11.0	86	11.0	1.045	139.9	LOS F	28.8	210.0	1.00	1.37	1.68	15.3
2	T1	All MCs	202	2.1	202	2.1	* 1.045	134.1	LOS F	28.8	210.0	1.00	1.37	1.68	15.5
3	R2	All MCs	537	3.1	537	3.1	1.034	132.4	LOS F	26.3	189.0	1.00	1.26	1.65	7.2
Approach			825	3.7	825	3.7	1.045	133.6	LOS F	28.8	210.0	1.00	1.30	1.66	10.4
East: Newbridge Road															
4	L2	All MCs	384	4.9	384	4.9	0.323	9.6	LOS A	4.6	33.8	0.34	0.68	0.34	36.6
5	T1	All MCs	920	13.3	920	13.3	0.295	15.8	LOS B	10.4	81.2	0.54	0.47	0.54	48.8
6	R2	All MCs	592	8.7	592	8.7	* 1.079	171.1	LOS F	31.7	238.6	1.00	1.24	1.81	12.2
Approach			1896	10.2	1896	10.2	1.079	63.0	LOS E	31.7	238.6	0.65	0.76	0.90	23.0
North: Governor Macquarie Drive															
7	L2	All MCs	509	13.4	509	13.4	0.429	42.9	LOS D	13.2	103.2	0.82	0.80	0.82	25.2
8	T1	All MCs	143	1.5	143	1.5	0.494	61.0	LOS E	9.1	64.6	0.97	0.79	0.97	20.7
9	R2	All MCs	85	45.7	85	45.7	0.342	45.1	LOS D	4.2	41.3	0.93	0.76	0.93	31.3
Approach			738	14.8	738	14.8	0.494	46.7	LOS D	13.2	103.2	0.86	0.80	0.86	25.2
West: Newbridge Road															
10	L2	All MCs	149	21.1	149	21.1	* 1.081	130.8	LOS F	80.5	617.7	1.00	1.48	1.69	17.8
11	T1	All MCs	1951	8.6	1951	8.6	1.081	155.8	LOS F	81.8	614.9	1.00	1.51	1.70	10.9
12	R2	All MCs	75	14.1	75	14.1	0.365	67.9	LOS E	3.8	30.0	0.76	0.77	0.76	27.6
Approach			2175	9.7	2175	9.7	1.081	151.1	LOS F	81.8	617.7	0.99	1.49	1.67	11.7
All Vehicles			5634	9.6	5634	9.6	1.081	105.2	LOS F	81.8	617.7	0.86	1.12	1.30	15.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Brickmakers Drive											
P1	Full	1	18.0	LOS B	0.0	0.0	0.51	0.51	34.7	20.0	0.58

East: Newbridge Road										
P2 Full	1	64.1	LOS F	0.0	0.0	0.96	0.96	80.8	20.0	0.25
North: Governor Macquarie Drive										
P3 Full	1	38.6	LOS D	0.0	0.0	0.74	0.74	55.3	20.0	0.36
West: Newbridge Road										
P4 Full	16	64.2	LOS F	0.1	0.1	0.96	0.96	80.8	20.0	0.25
All Pedestrians	19	60.2	LOS F	0.1	0.1	0.92	0.92	76.9	20.0	0.26

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 102 [Dev Brickmakers Dr/Promontory Way AM - Copy (Site Folder: Development Scenario B)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Dev B AM GCV+cumul incl. DCP Road connection (Network Folder: General)]

Signalised intersection
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 40 seconds (Site Practical Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Brickmakers Drive															
2	T1	All MCs	648	1.9	648	1.9	*0.641	7.5	LOS A	9.3	66.3	0.77	0.68	0.77	41.5
3	R2	All MCs	63	3.3	63	3.3	0.143	12.0	LOS A	0.8	5.5	0.62	0.69	0.62	37.8
Approach			712	2.1	712	2.1	0.641	7.9	LOS A	9.3	66.3	0.75	0.68	0.75	41.1
East: Promontory Way															
4	L2	All MCs	126	1.7	126	1.7	0.393	21.6	LOS B	2.4	16.7	0.93	0.77	0.93	32.5
6	R2	All MCs	180	8.8	180	8.8	*0.588	22.8	LOS B	3.6	26.9	0.97	0.83	1.04	12.3
Approach			306	5.8	306	5.8	0.588	22.3	LOS B	3.6	26.9	0.95	0.80	0.99	24.6
North: Brickmakers Drive															
7	L2	All MCs	149	12.7	149	12.7	0.167	10.1	LOS A	1.6	12.0	0.55	0.68	0.55	34.6
8	T1	All MCs	440	2.4	440	2.4	0.436	3.8	LOS A	3.8	27.2	0.46	0.40	0.46	46.9
Approach			589	5.0	589	5.0	0.436	5.4	LOS A	3.8	27.2	0.48	0.47	0.48	44.6
All Vehicles			1607	3.9	1607	3.9	0.641	9.7	LOS A	9.3	66.3	0.69	0.63	0.70	39.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
North: Brickmakers Drive											
P3	Full	6	14.5	LOS B	0.0	0.0	0.85	0.85	31.1	20.0	0.64
All Pedestrians		6	14.5	LOS B	0.0	0.0	0.85	0.85	31.1	20.0	0.64

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 103 [Dev Newbridge Rd/Site Access Rd AM - Copy (Site Folder: Development Scenario B)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Dev B AM GCV+cumul incl. DCP Road connection (Network Folder: General)]

Site Access
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
East: Newbridge Road															
4	L2	All MCs	83	24.1	83	24.1	0.052	9.9	LOS A	0.0	0.0	0.00	0.80	0.00	47.4
5	T1	All MCs	1905	10.3	1905	10.3	0.387	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	69.7
Approach			1988	10.9	1988	10.9	0.387	0.5	NA	0.0	0.0	0.00	0.03	0.00	66.8
West: Newbridge Road															
11	T1	All MCs	3018	8.4	2853	8.4	0.514	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	69.5
Approach			3018	8.4	2853	8.4	0.514	0.1	NA	0.0	0.0	0.00	0.00	0.00	69.5
All Vehicles			5006	9.4	4842	9.7	0.514	0.3	NA	0.0	0.0	0.00	0.01	0.00	67.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 104 [Dev Newbridge Rd/Davy Robinson Dr AM - Copy (Site Folder: Development Scenario B)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Dev B AM GCV+cumul incl. DCP Road connection (Network Folder: General)]

Signalised intersection
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 90 seconds (Site Practical Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Davy Robinson Drive															
1	L2	All MCs	27	26.9	27	26.9	0.232	34.6	LOS C	3.4	26.9	0.84	0.75	0.84	26.0
3	R2	All MCs	68	9.2	68	9.2	* 0.232	34.4	LOS C	3.4	26.9	0.84	0.75	0.84	35.5
Approach			96	14.3	96	14.3	0.232	34.5	LOS C	3.4	26.9	0.84	0.75	0.84	33.4
East: Newbridge Road															
4	L2	All MCs	28	25.9	28	25.9	0.594	20.0	LOS B	17.5	133.9	0.67	0.61	0.67	47.3
5	T1	All MCs	1922	10.0	1922	10.0	0.594	11.9	LOS A	17.7	134.3	0.67	0.61	0.67	48.0
Approach			1951	10.3	1951	10.3	0.594	12.1	LOS A	17.7	134.3	0.67	0.61	0.67	48.0
West: Newbridge Road															
11	T1	All MCs	3017	8.1	2855	8.1	* 0.894	29.4	LOS C	45.2	338.3	0.94	0.98	1.08	43.5
12	R2	All MCs	46	6.8	44	6.8	0.380	36.1	LOS C	1.5	11.4	0.76	0.77	0.76	36.4
Approach			3063	8.1	2899	8.1	0.894	29.5	LOS C	45.2	338.3	0.93	0.97	1.08	43.4
All Vehicles			5109	9.0	4945	9.3	0.894	22.7	LOS B	45.2	338.3	0.83	0.83	0.91	44.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Davy Robinson Drive											
P1	Full	53	39.3	LOS D	0.1	0.1	0.94	0.94	206.0	200.0	0.97
East: Newbridge Road											
P2	Full	53	39.3	LOS D	0.1	0.1	0.94	0.94	206.0	200.0	0.97
West: Newbridge Road											
P4	Full	53	39.3	LOS D	0.1	0.1	0.94	0.94	206.0	200.0	0.97
All Pedestrians		158	39.3	LOS D	0.1	0.1	0.94	0.94	206.0	200.0	0.97

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 101 [Dev Newbridge Rd/Gov Macquarie Dr/Brickmakers Dr PM - Copy (Site Folder: Development Scenario B)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Dev B PM GCV+cumul incl. DCP Road connection (Network Folder: General)]

Four Way Intersection
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site Practical Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Brickmakers Drive															
1	L2	All MCs	126	6.7	126	6.7	0.816	61.5	LOS E	19.2	138.9	1.00	0.94	1.12	24.2
2	T1	All MCs	147	1.4	147	1.4	0.816	70.8	LOS F	19.2	138.9	1.00	0.94	1.12	24.4
3	R2	All MCs	368	2.6	368	2.6	0.884	82.0	LOS F	14.0	100.2	1.00	1.01	1.28	10.7
Approach			642	3.1	642	3.1	0.884	75.4	LOS F	19.2	138.9	1.00	0.98	1.21	16.9
East: Newbridge Road															
4	L2	All MCs	689	1.4	689	1.4	0.564	32.9	LOS C	15.8	111.6	0.51	1.33	0.51	28.7
5	T1	All MCs	2024	5.0	2024	5.0	* 0.930	62.5	LOS E	40.2	293.8	1.00	1.08	1.18	27.8
6	R2	All MCs	586	10.6	586	10.6	0.914	79.5	LOS F	16.4	125.5	1.00	1.00	1.28	23.7
Approach			3300	5.2	3300	5.2	0.930	59.3	LOS E	40.2	293.8	0.90	1.12	1.06	26.9
North: Governor Macquarie Drive															
7	L2	All MCs	536	2.6	536	2.6	0.367	23.9	LOS B	9.0	64.4	0.75	0.77	0.75	33.8
8	T1	All MCs	298	0.4	298	0.4	* 0.893	74.4	LOS F	22.5	158.1	1.00	1.04	1.23	18.1
9	R2	All MCs	160	7.9	160	7.9	0.614	47.5	LOS D	8.3	62.4	0.99	0.80	0.99	33.6
Approach			994	2.8	994	2.8	0.893	42.9	LOS D	22.5	158.1	0.86	0.86	0.93	27.4
West: Newbridge Road															
10	L2	All MCs	127	28.1	127	28.1	* 0.866	35.8	LOS C	34.8	266.9	1.00	0.99	1.11	31.1
11	T1	All MCs	1381	5.6	1381	5.6	0.866	65.7	LOS E	36.5	267.8	1.00	0.98	1.11	22.7
12	R2	All MCs	127	5.0	127	5.0	* 0.806	92.8	LOS F	6.1	44.8	1.00	0.85	1.20	24.7
Approach			1636	7.3	1636	7.3	0.866	65.5	LOS E	36.5	267.8	1.00	0.97	1.12	23.8
All Vehicles			6572	5.2	6572	5.2	0.930	60.0	LOS E	40.2	293.8	0.93	1.03	1.07	24.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Brickmakers Drive											
P1	Full	1	24.6	LOS C	0.0	0.0	0.59	0.59	41.3	20.0	0.48

East: Newbridge Road										
P2 Full	1	64.1	LOS F	0.0	0.0	0.96	0.96	80.8	20.0	0.25
North: Governor Macquarie Drive										
P3 Full	1	44.8	LOS E	0.0	0.0	0.80	0.80	61.5	20.0	0.33
West: Newbridge Road										
P4 Full	16	64.2	LOS F	0.1	0.1	0.96	0.96	80.8	20.0	0.25
All Pedestrians	19	60.9	LOS F	0.1	0.1	0.93	0.93	77.6	20.0	0.26

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 102 [Dev Brickmakers Dr/Promontory Way PM - Copy (Site Folder: Development Scenario B)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Dev B PM GCV+cumul incl. DCP Road connection (Network Folder: General)]

Signalised intersection
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 40 seconds (Site Practical Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Brickmakers Drive															
2	T1	All MCs	453	1.6	453	1.6	0.447	6.5	LOS A	5.6	39.9	0.66	0.57	0.66	42.5
3	R2	All MCs	122	0.9	122	0.9	0.548	22.9	LOS B	2.5	17.3	0.96	0.81	1.03	31.8
Approach			575	1.5	575	1.5	0.548	10.0	LOS A	5.6	39.9	0.72	0.62	0.74	39.3
East: Promontory Way															
4	L2	All MCs	97	2.2	97	2.2	0.303	21.2	LOS B	1.8	12.6	0.91	0.75	0.91	32.7
6	R2	All MCs	191	6.1	191	6.1	* 0.612	22.9	LOS B	3.8	28.1	0.97	0.84	1.06	12.3
Approach			287	4.8	287	4.8	0.612	22.4	LOS B	3.8	28.1	0.95	0.81	1.01	23.0
North: Brickmakers Drive															
7	L2	All MCs	219	4.3	219	4.3	0.231	10.3	LOS A	2.4	17.1	0.57	0.70	0.57	34.7
8	T1	All MCs	899	0.8	899	0.8	* 0.883	13.1	LOS A	19.0	133.8	0.85	0.97	1.13	40.7
Approach			1118	1.5	1118	1.5	0.883	12.5	LOS A	19.0	133.8	0.79	0.92	1.02	40.0
All Vehicles			1980	2.0	1980	2.0	0.883	13.2	LOS A	19.0	133.8	0.80	0.82	0.94	38.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
North: Brickmakers Drive											
P3	Full	1	14.5	LOS B	0.0	0.0	0.85	0.85	31.1	20.0	0.64
All Pedestrians		1	14.5	LOS B	0.0	0.0	0.85	0.85	31.1	20.0	0.64

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 103 [Dev Newbridge Rd/Site Access Rd PM - Copy (Site Folder: Development Scenario B)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Dev B PM GCV+cumul incl. DCP Road connection (Network Folder: General)]

Site Access
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
East: Newbridge Road															
4	L2	All MCs	80	15.8	80	15.8	0.048	9.8	LOS A	0.0	0.0	0.00	0.81	0.00	49.4
5	T1	All MCs	3267	5.4	3267	5.4	0.667	0.3	LOS A	23.7	173.4	0.00	0.00	0.00	68.9
Approach			3347	5.7	3347	5.7	0.667	0.5	NA	23.7	173.4	0.00	0.02	0.00	67.5
West: Newbridge Road															
11	T1	All MCs	2262	4.3	2262	4.3	0.398	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	69.7
Approach			2262	4.3	2262	4.3	0.398	0.0	NA	0.0	0.0	0.00	0.00	0.00	69.7
All Vehicles			5609	5.1	5609	5.1	0.667	0.3	NA	23.7	173.4	0.00	0.01	0.00	68.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 104 [Dev Newbridge Rd/Davy Robinson Dr PM - Copy (Site Folder: Development Scenario B)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [Dev B PM GCV+cumul incl. DCP Road connection (Network Folder: General)]

Signalised intersection
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 110 seconds (Site Practical Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Davy Robinson Drive															
1	L2	All MCs	60	5.3	60	5.3	0.445	46.9	LOS D	7.7	55.8	0.93	0.79	0.93	22.2
3	R2	All MCs	100	4.2	100	4.2	* 0.445	46.9	LOS D	7.7	55.8	0.93	0.79	0.93	32.0
Approach			160	4.6	160	4.6	0.445	46.9	LOS D	7.7	55.8	0.93	0.79	0.93	29.0
East: Newbridge Road															
4	L2	All MCs	46	9.1	46	9.1	* 0.882	30.5	LOS C	52.0	381.1	0.88	0.86	0.94	42.3
5	T1	All MCs	3258	5.3	3258	5.3	0.882	21.4	LOS B	52.2	382.0	0.88	0.86	0.94	38.5
Approach			3304	5.4	3304	5.4	0.882	21.5	LOS B	52.2	382.0	0.88	0.86	0.94	38.6
West: Newbridge Road															
11	T1	All MCs	2455	4.5	2455	4.5	0.669	12.7	LOS A	26.9	195.5	0.66	0.60	0.66	55.5
12	R2	All MCs	53	4.0	53	4.0	0.731	66.6	LOS E	3.2	23.5	0.99	0.90	1.31	26.2
Approach			2507	4.5	2507	4.5	0.731	13.8	LOS A	26.9	195.5	0.66	0.61	0.67	54.2
All Vehicles			5972	5.0	5972	5.0	0.882	18.9	LOS B	52.2	382.0	0.79	0.75	0.83	45.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Davy Robinson Drive											
P1	Full	53	49.3	LOS E	0.2	0.2	0.95	0.95	215.9	200.0	0.93
East: Newbridge Road											
P2	Full	53	49.3	LOS E	0.2	0.2	0.95	0.95	215.9	200.0	0.93
West: Newbridge Road											
P4	Full	53	49.3	LOS E	0.2	0.2	0.95	0.95	215.9	200.0	0.93
All Pedestrians		158	49.3	LOS E	0.2	0.2	0.95	0.95	215.9	200.0	0.93

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2023 Akcelik and Associates Pty Ltd | sidrasolutions.com

Australia

SYDNEY
Ground floor, 20 Chandos Street
St Leonards NSW 2065
T 02 9493 9500

NEWCASTLE
Level 3, 175 Scott Street
Newcastle NSW 2300
T 02 4907 4800

BRISBANE
Level 1, 87 Wickham Terrace
Spring Hill QLD 4000
T 07 3648 1200

CANBERRA
Level 2, Suite 2.04
15 London Circuit
Canberra City ACT 2601

ADELAIDE
Level 4, 74 Pirie Street
Adelaide SA 5000
T 08 8232 2253

MELBOURNE
188 Normanby Road
Southbank VIC 3006

PERTH
Level 9, Suite 9.02
109 St Georges Terrace
Perth WA 6831

Canada

TORONTO
2345 Yonge Street, Suite 300
Toronto ON M4P 2E5

VANCOUVER
60 W 6th Ave Suite 200
Vancouver BC V5Y 1K1


linkedin.com/company/emm-consulting-pty-limited



emmconsulting.com.au

Appendix H

Social impact assessment

Social Impact Assessment Addendum

Planning Proposal 146 Newbridge Road, Moorebank

Prepared for Benedict Industries Pty Ltd

July 2023

Social Impact Assessment Addendum

Planning Proposal 146 Newbridge Road, Moorebank

Benedict Industries Pty Ltd

J17103 RP#6

July 2023

Version	Date	Prepared by	Approved by	Comments
1.0	21 July 2023	A Young	C Mahoney	

Approved by



Chris Mahoney
Associate Director- National Technical Leader, Social Impact Assessment
21 July 2023

Ground floor 20 Chandos Street
St Leonards NSW 2065
PO Box 21
St Leonards NSW 1590

This report has been prepared in accordance with the brief provided by Benedict Industries Pty Ltd and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of Benedict Industries Pty Ltd and no responsibility will be taken for its use by other parties. Benedict Industries Pty Ltd may, at its discretion, use the report to inform regulators and the public.

© Reproduction of this report for educational or other non-commercial purposes is authorised without prior written permission from EMM provided the source is fully acknowledged. Reproduction of this report for resale or other commercial purposes is prohibited without EMM's prior written permission.

TABLE OF CONTENTS

1 Introduction 1

1.1 Planning proposal 1

1.2 Background 1

1.3 Employment zone reforms 2

2 Previous social impact assessment 3

2.1 Introduction 3

2.2 Key findings of the previous social impact assessment 3

2.3 Policy and planning context 4

2.4 Community profile 5

3 Conclusion 8

1 Introduction

1.1 Planning proposal

A planning proposal has been prepared by EMM Consulting Pty Limited (EMM) on behalf of Benedict Industries Pty Limited (the applicant) to amend Schedule 1 of the Liverpool Local Environmental Plan 2008 (LLEP 2008) to provide for an additional permitted use on the subject site at 146 Newbridge Road, Moorebank.

Under clause 7.22 of the *Liverpool Local Environmental Plan 2008* ('LLEP'), the subject site is identified as being within 'Area A' as mapped in the Land Zoning Map and in this regard clause 7.23 of LLEP 2008 applies to the subject site.

Clause 7.23(2) states that development consent must not be granted to development for the purposes of retail premises on land identified as "Area A" on the Land Zoning Map if the gross floor area of the retail premises is more than 1,600 square metres (m^2).

Specifically, an amendment is sought to Schedule 1 of the LLEP 2008 to permit a retail premises for this site with a maximum gross floor area (GFA) of 4,000 m^2.

1.2 Background

An earlier planning proposal, prepared by the applicant, was referred to the Liverpool Local Planning Panel and was considered at a Council meeting in September 2020. Council subsequently forwarded the proposal to the Department of Planning and Environment (DPE) for Gateway determination. DPE returned the Gateway Request in December 2020 noting a need to further address issues regarding flooding and evacuation.

The applicant has since revised the design and function of the proposed development, and hence the earlier planning proposal is being revised.

Note that the earlier planning proposal sought:

- provision of a child care centre, being prohibited development pursuant to the (then) land zoning of B6 Enterprise Corridor
- exceedance of the permissible 15 m building height control
- exceedance of the permissible floor space ratio of 0.75:1
- a gross floor area of 15,500 m^2 as per an existing Voluntary Planning Agreement (VPA).

These matters are no longer proposed.

In April 2023, Council was provided revised concept architectural plans and in June 2023 Council issued advice regarding the information required in order to progress the revised planning proposal, based on the revised drawings.

Specifically, Council requested the following:

> The most recent Social Impact Assessment report is prepared by Cred Consulting, dated 13 October 2017 and is based on previous planning proposal land uses which are no longer sought.
>
> In this regard an updated Social Impact Assessment report is to be submitted to Council. This may be in the form of an addendum as the development intensity of the subject site has been reduced as per the planning proposal concept architectural plans submitted in April 2023.

This report provides the addendum required by Council.

1.3 Employment zone reforms

At the time of lodgement of the earlier planning proposal, the subject site was zoned B6 Enterprise Corridor which permitted the land use of 'commercial premises'.

Since lodgement of the earlier proposal, the Employment Zone reforms initiated by the DPE – specifically via the Standard Instrument (Local Environmental Plans) Amendment (Land Use Zones) Order 2022 - revised the zoning of the land to E3 Productivity Support. The new zonings took effect on 26 April 2023.

There is a savings provision provided under item 5 of Schedule 3 of the 2022 Order, being:

> Development that is permitted with development consent on land in a former zone under a local environmental plan, as in force immediately before 26 April 2023, continues to be permitted with development consent on the land until 26 April 2025.

This means any land use which was previously permissible on land under a former zone continues to be permitted with development consent until 26 April 2025. Pursuant to these savings provisions, a supermarket land use is permitted with consent on the subject site until 26 April 2025.

2 Previous social impact assessment

2.1 Introduction

A Social Impact Assessment was prepared by Cred Consulting (October 2017) with respect to the previous planning proposal. The SIA was completed in accordance with requirements of the *Environmental Planning and Assessment Act 1979*, and Liverpool City Council's adopted Social Impact Assessment Policy.

As noted at Section 1.2 of this Addendum, the previous Planning Proposal for the site included a range of changes however the current planning proposal only seeks one additional permitted use, being an increased floor area for retail premises.

As noted by Council, this represents a **decrease** in the intensity of use, relative to the previous Planning Proposal.

2.2 Key findings of the previous social impact assessment

Findings related to the additional floor area for retail premises were considered in the Cred SIA.

The Cred SIA considered a planning proposal which, in terms of the retail component, is generally but not entirely the same as is sought under the current planning proposal.

The design for the retail component of the previous planning proposal included 3,584.6 m^2 of retail space including:

- Supermarket (1,204 m^2)
- Retail specialty (699 m^2)

A medical centre (792.9 m^2) and gym (487.4 m^2) were also proposed.

The design for the retail component of the current proposal envisages:

- Supermarket (3,809 m^2),
- Retail specialty (873 m^2)

A medical centre and gym are no longer proposed.

This change is considered minor in terms of the potential social impact of the proposed additional retail space which is sought under the current planning proposal. The findings of the Cred report therefore remain valid in terms of the retail component and, subject to the consideration of the updated policy and planning context and the more contemporary data regarding the community profile (see Section 2.3 and Section 2.4 of this Addendum), the Cred findings can be relied upon.

Also note that economic impact is considered in a separate assessment report.

Broadly, the Cred SIA found that the proposed retail facilities, including a supermarket, would deliver a positive social impact. Other observations included the current forecast population growth for the area, which would require retail services such as a supermarket.

Other findings related to now-discontinued uses are not considered further under this Addendum as these matters are no longer part of the current Planning Proposal.

Other supermarket and retail space located nearby to the proposed development, but not within walking distance, were noted by Cred to include three facilities. Refer to Table 2.1. The nature of the surrounding development, both current and proposed, is generally medium to high density, and the supermarket and speciality retail would therefore tend to primarily service people within a walkable catchment.

No additional supermarket facilities have been identified.

Table 2.1 Nearby supermarket facilities

Facility name	Description	Distance from site
The Food Lovers Market	Small local supermarket	1 km
Moorebank Shopping Centre	Shopping centre with supermarket, post office and pharmacy	1.4 km
Aldi Bankstown Airport	Supermarket	1.6 km

As a result, Woolworths is extremely interested in locating a ~3800m2 supermarket at this location.

2.3 Policy and planning context

The Cred SIA referenced a number of policy and planning documents which have now been superseded.

Contemporary policy and planning documents are examined below.

2.3.1 Community Strategic Plan 2022-2032

The Liverpool Community Strategic Plan 2022-2032 makes no specific arrangement or policy setting for Moorebank East or for retail premises, however the planning proposal is consistent with the strategic objectives of the Community Strategic Plan, and in addressing the challenges and opportunities articulated in the Community Strategic Plan.

As an example, Strategic Objective 1 in the Community Strategic Plan expresses the vision to create vibrant places and facilities, and to increase community satisfaction with key social and liveability indicators. Strategic Objective 3 also expresses a need to market Liverpool as a business destination and attract investment; to create high-quality, inclusive urban environments; and to facilitate quality local employment opportunities.

2.3.2 Economic Development Strategy 2022-2032

The Liverpool Economic Development Strategy 2022-2032 is currently in draft form.

The Economic Development Strategy is aligned with the Community Strategic Plan and sets out five pillars to guide the future growth of the local government area:

- Attract and support business
- Local jobs for local people
- Innovation and education
- Global links and connections
- A thriving city of culture and collaboration

These pillars will direct Council's decision-making, as well as the development and implementation of supporting plans and strategies over the next 10 years to realise Liverpool's economic potential.

Liverpool's economy supports 98,400 local jobs15 and 20,800 local business. It is an economy transitioning away from Liverpool's traditional industrial roots, to a more advanced manufacturing and freight and logistics offering, and, more recently, strong knowledge intensive and population serving sectors, including retail.

Total output of the population-serving sector has more than doubled since 2010 to be $7.3 billion in 2020.

The jobs-to-worker ration for retail is noted to be 0.95:1, meaning that for each resident worker employed in these industries, there are at least 0.95 jobs in Liverpool. The proposed development would generate local jobs which could serve to improve this ratio.

The Economic Development Strategy states:

> Over the next decade, Liverpool's growth will continue to outpace much of Greater Sydney. The city will welcome more than 97,000 new residents between now and 2031, and it is expected the economy will grow alongside this population growth [p 13].

2.3.3 Economic Development Roadmap – Phase 1

The Western Parkland City Economic Development Roadmap – Phase 1 is currently in draft form. It provides an overarching strategy to maximise economic opportunities in the Western Parkland City district. It focuses on leveraging the City's existing strengths and supporting the advancing industries that will create jobs for the next generation.

The skills profile of the Western Parkland City is influenced by the strong presence of manufacturing, construction, retail, freight and logistics industries.

Over the next 40 years, the population of the Parkland City is forecast to increase by more than 1 million people. This is recognised as leveraging a continuing demand for people-oriented jobs such as retail, business and community services. This will in turn create demand for investment in local and regional centres.

The Roadmap notes:

> "Retail development is a major focus for most centres and with significant projected population growth, the demand for retail development will create the need to plan and deliver new centres as well as allowing the expansion of existing centres.
>
> Retail growth in existing and new centres is also critical to delivering walkable communities so goods and services are in close proximity to people's homes and jobs."
>
> Managing growth outside of the metropolitan and strategic centres and industrial areas is also important. [p 35].

2.4 Community profile

The Cred SIA utilised Census data from 2011.

The most recent Australian Census of Population and Housing was conducted in 2021.

An examination of whether the Cred SIA profiles have changed materially in the intervening period is therefore a valid consideration.

2.4.1 Liverpool local government area

i 2011 profile

The profile of Liverpool local government area (LGA) provided by Cred was as follows.

Compared to Greater Sydney, Liverpool LGA has:

- A younger median age (33 years compared to 36 years)
- A lower median household weekly income ($1,229/week compared to $1,447/week)

- A much higher proportion of couples with children households (46% compared to 35%). Around 14% of households are single parent households with children (higher than Greater Sydney at 10.8%)
- A higher proportion of children aged 0 to 4 (7.8% compared to 6.8%), 5 to 11 (11% compared to 8.7%) and 12 to 17 years (9.3% compared to 7.4%)
- A much lower proportion of medium and high density housing (26% compared to 40%)
- A much higher proportion of residents from Non-English speaking backgrounds (36% compared to 26%). The main non-English languages spoken at home were Arabic (9.5%), Hindi (4.5%), and Vietnamese (4.4%)
- Higher unemployment (7% compared to 5.8%), and
- A lower SEIFA Index (951 compared to 1011), which means it is more highly disadvantaged.

ii 2021 profile

There has been relatively little change in these overarching statistical indicators based on 2021 Census data.

For example, the median age is now 34 (compared to 33 in 2011), and the median household income is now $1,819. Unemployment was 6.6% of the population (compared to 7% in 2011) and 27% of housing stock is medium or high density (compared to 26% in 2011).

2.4.2 Moorebank statistical area

i 2011 profile

The Cred SIA provided the following profiles for the Moorebank statistical area.

Total population

The population for Moorebank was 7,593 with an average household size of 2.9 people per dwelling.

Age profile

Compared to Liverpool LGA, Moorebank had:

- A higher proportion of empty nesters and retirees 60 to 69 years (11.6% compared to 7.4%)
- A higher proportion of young workforce 25 to 34 years (15.9% compared to 14.6%)
- A higher proportion of children aged 0 to 4 (8.5% compared to 7.8%) and a lower proportion of children aged 12 to 17 years (8.3% compared to 9.9%)

Between 2006 and 2011 in Moorebank, the age groups with the greatest percentage increase were:

- Elderly aged 85 and over (+60% or +53 people).
- Primary school aged 5 to 11 years (+27% or +208 children)
- Parents and homebuilders aged 35 to 49 (+24% or +387 people)

Population density

At 6.08 persons per hectare, the current residential population density of Moorebank is low but similar to the Liverpool LGA (at 5.89 persons per hectare), given its small residential population and large areas of industrial

land and open space. This compares to the Liverpool suburb (with 47% high density dwellings) which has a population density of around 37.91 persons per hectare.

Household income

Moorebank has a higher median weekly household income ($1,445/week) comparable with Greater Sydney ($1,447) but higher than Liverpool LGA ($1,299).

Unemployment

Moorebank has a lower unemployment rate (4.3%) than Liverpool LGA (7.0%) or Greater Sydney (5.7%).

ii 2021 profile

Population

The estimated population of Moorebank in 2021 was 11,446, indicating a marked growth in population for the neighbourhood.

Age profile

Moorebank has a median age of 36, a marginal increase from 34 in 2011.

The proportion of the population which comprises couples with children is 47%, an increase of 0.7% since 2011.

As a cohort, older couples without children has conversely reduced to 9% from the 2011 result of 9.7%.

Population density

In 2021, Moorebank had a density of 12.32 people per hectare. This represents a doubling of density since 2011.

Total dwellings in Moorebank for 2021 was 3,808, up from 2,445 in 2011, which also aligns with the population growth noted above.

Dwelling types in 2021 were separate house (82%), medium and high density (18%). There has been a slight increase in the proportion on medium and high density, relative to separate dwellings, in the past 10 years.

Average household size in Moorebank in 2021 was 3.10.

Household income

Liverpool LGA had a slightly increased median household income of $1,834 in 2021, however Moorebank also increased to a median household income of $2,234 in 2021.

Unemployment

The unemployment rate for Moorebank in 2021 was 4.8%, which is slightly higher than 2011 however it remains slightly better than the Liverpool LGA which had an unemployment rate of 6.6% in 2021.

3 Conclusion

The policy and planning strategies, both at regional and local scale, point to

- A growing population.
- The need for retail and other services, at neighbourhood scale, in order to achieve place-making which is walkable and promotes liveability.
- A shift from traditional industries to greater reliance on people-oriented jobs, including retail.

The population profile of Moorebank reveals a shift to slightly higher density, and a recent marked uplift in population within the suburb. The incoming population reveals a slightly increasing household size and slightly better employment and income metrics than the Liverpool LGA as a whole.

In order to meet these population characteristics and to deliver these strategic outcomes, there needs to be provision for retail space and small/medium business support at a scale which is attractive and financially feasible for providers of supermarket or other retail services as well as for smaller businesses. The economic reality is that retailers make decisions based on location and available floor space. Small businesses preferably want their business/office premises located near their residences. Planning controls need to adapt to these contemporary needs if future developments are to attract the type of retail and commercial/light industrial businesses, and therefore the people-oriented jobs, which are envisioned under the new strategic planning instruments.

This suggests that the overall social impact of the proposed increase in floor area for retail and Commercial/Light Industrial premises at the site will be positive.

This finding remains consistent with the findings of the Cred SIA (2017).

Australia

SYDNEY
Ground floor, 20 Chandos Street
St Leonards NSW 2065
T 02 9493 9500

NEWCASTLE
Level 3, 175 Scott Street
Newcastle NSW 2300
T 02 4907 4800

BRISBANE
Level 1, 87 Wickham Terrace
Spring Hill QLD 4000
T 07 3648 1200

CANBERRA
Level 2, Suite 2.04
15 London Circuit
Canberra City ACT 2601

ADELAIDE
Level 4, 74 Pirie Street
Adelaide SA 5000
T 08 8232 2253

MELBOURNE
188 Normanby Road
Southbank VIC 3006

PERTH
Level 9, Suite 9.02
109 St Georges Terrace
Perth WA 6831

Canada

TORONTO
2345 Yonge Street, Suite 300
Toronto ON M4P 2E5

VANCOUVER
60 W 6th Ave Suite 200
Vancouver BC V5Y 1K1

linkedin.com/company/emm-consulting-pty-limited

emmconsulting.com.au

Appendix I

Economic impact assessment

July 2023

Georges Cove Village, Moorebank

Economic Impact Assessment

Prepared for Benedict Industries

locationiq.com.au

Contents

Contents 2

Introduction 3

Executive Summary 4

1 Location & Proposed Development 6
- 1.1. Regional Context and Local Context 6
- 1.2. Proposed Development 11
- 1.3. Planning Context 20

2 Trade Area Analysis 23
- 2.1. Trade Area Definition 23
- 2.2. Main Trade Area Population 25
- 2.3. Socio-economic Profile 27
- 2.4. Trade Area Retail Expenditure 30
- 2.5. Workers 34

3 Competitive Environment 36
- 3.1. Regional Shopping Centres 38
- 3.2. Sub-regional Shopping Centres 38
- 3.3. Supermarket Based Shopping Centres 38
- 3.4. Proposed Retail Developments 39
- 3.5. Supermarket Floorspace Provision 40
- 3.6. Summary 41

4 Assessment of Potential 42
- 4.1. Sales Overview and Methodology 42
- 4.2. Supermarket Sales Potential 43
- 4.3. Total Retail Sales Potential 45
- 4.4. Impacts 46
- 4.5. Employment and Consumer Impacts 50

5 Needs Analysis 53
- 5.1. Population and Supermarket Demand 53
- 5.2. Consumer Trends 54
- 5.3. Location 54
- 5.4. Impact on Existing Retailers 55
- 5.5. Impacts on Retail Hierarchy 55
- 5.6. Net Community Benefits 56

Introduction

This report presents an independent assessment of the need and demand for proposed retail facilities as part of a mixed-use development at 146 Newbridge Road in Moorebank, in the south-western suburbs of Sydney. The report also considers the likely economic impacts that would result from the proposed development. The proposal is referred to as Georges Cove Village or subject site throughout the remainder of this report.

This report is structured and presented in **five (5) sections** as follows:

- **Section 1** reviews the regional and local context of the subject site, in addition to an overview of the proposed development scheme and planning context.
- **Section 2** details the trade area likely to be served by a full-line supermarket based retail offer at the subject site, including current and projected population and retail spending levels over the period to 2041. A review of the socio-economic profile of the trade area population is also provided.
- **Section 3** summarises the current and future competitive retail environment within the surrounding region.
- **Section 4** outlines an assessment of the sales potential for proposed retail facilities at the planned Georges Cove Village, and provides an assessment of the range of economic impacts, both positive and negative that may result from the development at the subject site.
- **Section 5** outlines the conclusions or key findings of this report.

CommBank iQ Disclaimer

This report contains analysis by CommBank iQ, a joint venture between the Commonwealth Bank of Australia ABN 48 123 123 124 (**Commonwealth Bank**) and The Quantium Group Pty Ltd (**Quantium**), which is the subject of intellectual property (including copyright) and confidentiality rights of one or multiple owners, including the Commonwealth Bank, Quantium and where applicable, its third-party data owners (**Data Providers**), together **IP Owners**.

The information contained in this report may have been prepared using raw data owned by one or more of the Data Providers. The Data Providers have not been involved in the analysis of the raw data, the preparation of the report, or the information contained in the report. The IP Owners do not make any representation (express or implied) or give any guarantee or warranty in relation to the accuracy, completeness or appropriateness of the raw data, or the analysis contained in this report. The IP Owners will not be held liable for any use or disclosure of any information contained in, or derived from this report. To the extent permitted by law, the IP Owners take no responsibility for and have no liability for the preparation, contents, accuracy or completeness of this report, or the analysis on which it is based. Other than in accordance with any express terms and conditions agreed with CommBank iQ, the information contained within this report (or any extract thereof) is provided in confidence, may only be used for the purpose provided, and may not be copied, reproduced, distributed, disclosed or otherwise made available to a third party.

Executive Summary

Key points to note regarding the demand and market potential for retail facilities at the proposed Georges Cove Village development, include:

i. The proposed mixed-use development at 146 Newbridge Road in Moorebank, within the Liverpool City Council (LGA), some 27 km south-west of the Sydney Central Business District (CBD).

ii. The suburb of Moorebank generally comprises a mix of residential and light industrial uses, with the South Western Motorway (M5) and Newbridge Road facilitating regional and local connectivity.

iii. Newbridge Road is a major east-west arterial route through the region, connecting Liverpool with a range of suburbs throughout the south-west and inner-west of Sydney. Based on a review of the most recent traffic counts provided Transport for New South Wales, 40,006 vehicles travel along Newbridge Street (west of Henry Lawson Drive) on an average weekday. This equates to an annual traffic volume of 14.1 million vehicles.

iv. The northern portion of the subject site is planned to yield the Georges Cove Village mixed-use development, including total retail and commercial floorspace of 9,585 sq.m, comprising a full-line supermarket (3,809 sq.m), retail specialty shops (873 sq.m) and non-retail floorspace. The proposed development would offer a high degree of customer amenity and convenience by way of its high-profile site, easily accessible location, and quality design.

v. The Urbis Retail Averages (2021/22) for single supermarket based shopping centres indicate retail specialty floorspace of 1,346 sq.m across 14 shops. The provision of retail specialty floorspace at the planned Georges Cove Village at 873 sq.m is 473 sq.m smaller than the benchmark level. As such, the retail component of the development will provide a destinational convenience offer only, rather than a full range offer.

vi. The Georges Cove Village defined main trade area population is currently estimated at 24,712 (2023) and is projected to increase to 31,812 by 2041, representing an average annual growth rate of around 1.4%. The main trade area is characterised by an Australian born, traditional family-based population, who typically own their own homes. This demographic would have a strong affinity with convenience-based retail facilities within close proximity to their place of residence.

vii. There are currently no major full-line supermarkets over 3,200 sq.m within the main trade area. Reflecting this, existing supermarkets within the main trade area on inspection trade at levels above the Australian average of $10,000 - $11,000 per sq.m.

viii. Supermarkets within the main trade area are quite small by modern supermarket standards, with the nearest major full-line supermarkets to the subject site provided at Westfield Liverpool, more than 5 km away.

ix. The major supermarket chains target a population of 8,000 – 10,000 persons in order to support one full-line supermarket. The main trade area population at more than 24,500 persons could support almost three full-line supermarkets, and up to four by 2041, based on a projected population of almost 32,000.

x. Total retail forecast sales for the subject development are $44.4 million in 2025/26, including supermarket sales of $38.7 million (constant 2023 dollars and including GST).

xi. In terms of impacts, a total impact of around -$14.4 million is projected to come from retail facilities within the main trade area in 2025/26, including -$7.1 million (or -17.5%) on Moorebank Shopping Centre and some -$5.8 million (-12.5%) on Chipping Norton Market Plaza. Other retail facilities within Moorebank (primarily along Newbridge Road), including Big Fresh are projected to be impacted by some -$0.4 million, or approximately -5%. Additionally, within the primary east sector, Milperra Shopping Centre impact is estimated at -$0.8 million (or -10%). These levels of impacts would not affect the viability of any retail facilities.

xii. With no full-line supermarkets currently provided within the main trade area, the proposed full-line supermarket at the subject site would retain a significant proportion of food and grocery expenditure that is currently escaping the area. A total impact of -$26.3 million is projected to be from a reduction in spending from facilities beyond the main trade area.

xiii. The largest impact beyond the main trade area is projected to be on the Liverpool CBA, at a total of -$13.4 million, or some -1.7%. The various components of the CBA, including Westfield Liverpool (post development), Liverpool Plaza Shopping Centre and the balance or retail shopfront within the precinct are projected to be impacted by between -0.5% and -1% each. The next largest impact beyond the main trade area is likely to fall on Aldi at Bankstown Airport, at around -10% or some -$2.4million dollars in 2025/26.

xiv. Remaining impacts on other shopping centres within and beyond the main trade area are all lower than -5%, reflecting a redirection of spending from full-line offers at competing centres to the proposed supermarket.

xv. It is the conclusion of this report that a substantial net community benefit would result from the proposed Georges Cove Village development. Offsetting the trading impacts on some existing retailers, there are very substantial positive impacts including the following:

- Significant improvement in the range of retail facilities that would be available to residents, particularly in terms of convenient supermarket retailing.
- The full-line supermarket would improve choice of location and allow for price competition. The inclusion of a full-line supermarket would represent the only such offer within the defined main trade area.
- The addition of a supermarket at the subject site would also result in the retention of spending currently being directed to other large supermarkets at major shopping centres situated beyond the main trade area, thereby reducing the need for local residents to travel further afield for their supermarket and convenience-based shopping needs.
- The retail offer will enable the development to serve the growing population and the associated demand for additional retail floorspace.
- The creation of additional employment which would result from the project, both during the construction period, and more importantly, on an ongoing basis once the development is complete and operational. In total, some 999 jobs are likely to be created both directly and indirectly as a result of the retail and non-retail components of the proposed Georges Cove Village. This includes a number of youth employment opportunities with retail developments generally employing a large number of younger staff.

xvi. It is concluded that the combination of the substantial positive economic impacts serve to more than offset the trading impacts that could be anticipated for a small number of existing retail stores, particularly supermarkets, in the region. Further, the impacts would not threaten the viability of any retail facilities.

1 Location & Proposed Development

This section of the report reviews the regional and local context of the Georges Cove Village site and provides an overview of the proposed development scheme.

1.1. Regional Context and Local Context

i. Moorebank is a suburb of South-west Sydney, located some 27 km from the Sydney Central Business District (CBD) (refer Map 1.1), and 4.5 km to the Liverpool CBD.

ii. The suburb of Moorebank generally comprises a mix of residential and light industrial uses, with an established residential component in the eastern portion of the suburb (north of the South Western Motorway (M5) and commercial uses located in the west, bounded by the Georges River.

iii. The South Western Motorway (M5) provides a connection between the Sydney CBD in the east and the outer south-west suburbs of Sydney.

iv. Benedict Industries control a site at 146 Newbridge Road in Moorebank (the subject site), which extends approximately 1 km south from the road and is bounded by the Georges River in the east. The broader development site is referred to as the Georges Cove Precinct and provides residential, commercial, and community uses.

v. Newbridge Road is a major east-west arterial route through the region, connecting Liverpool with a range of suburbs throughout the south-west and inner-west of Sydney. Based on a review of the most recent traffic counts provided by Transport for New South Wales, 40,006 vehicles travel along Newbridge Street (west of Henry Lawson Drive) on an average weekday. This equates to an annual traffic volume of some 14.1 million vehicles.

vi. Charts 1.1 to 1.3 provide a breakdown of traffic data for Newbridge Road, with key points to note including:

- Average daily traffic volume has remained consistently high since data records began in 2015.
- The majority of traffic is recorded in a westbound direction, averaging around 51.3% over the period from 2015 to 2023.
- Peak traffic times for westbound traffic through the locality is around 2:00 pm to 6:00 pm, generally attributable to commuters heading home from work, likely from around Bankstown or Sydney CBD.
- Heavy vehicles frequent the area from 5:00 am to 6:00 pm, due to the access to the industrial and employment precinct, directly north of the subject site.

vii. This is important to note with regard to prospective retail facilities at the site, given peak supermarket/grocery shopping times would generally be after work. In this respect, the location of the subject site on the southern (westbound) side of Newbridge Road would facilitate convenient ingress/egress for peak traffic.

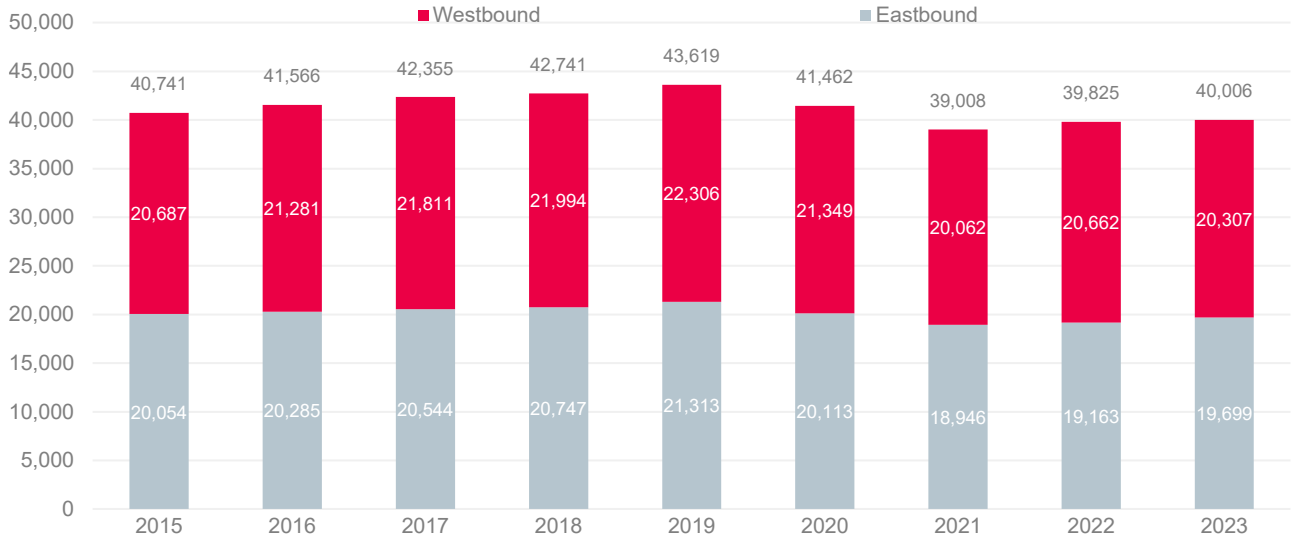
viii. The subject site is also served by the M90 bus route which runs between Liverpool Station and Westfield Burwood. Liverpool Station is around 4 km to the west of the subject site.

ix. Map 1.2 illustrates the local context of Georges Cove Village, with key points to note including:

- The proposed Georges Cove Marina will be located at the southern portion of the site, fronting the Georges River.
- The recently closed Flower Power site to the immediate east is a proposed residential estate.
- Land to the west and north-west of the site comprises established residential dwellings, while light-industrial and commercial uses are generally provided on the northern side of Newbridge Road.
- A range of public open spaces and sporting fields are located to the east of the site, on both sides of the Georges River.
- Several golf courses nearby, including Bankstown and Georges River Golf Clubs.
- A small retail precinct containing an Aldi supermarket, Hungry Jacks, KFC, and a BP truck stop is some 1.4 km to the east of the site, at the intersection of Newbridge Road and Henry Lawson Drive.
- A concentration of education facilities are provided to the north-west including, St Joseph's Primary School, Moorebank High School, and Chipping Norton Montessori Early Learning Centre. These are within a 1 km radius of the subject site.
- Bankstown Airport is some 2 km to the north-east of the site.

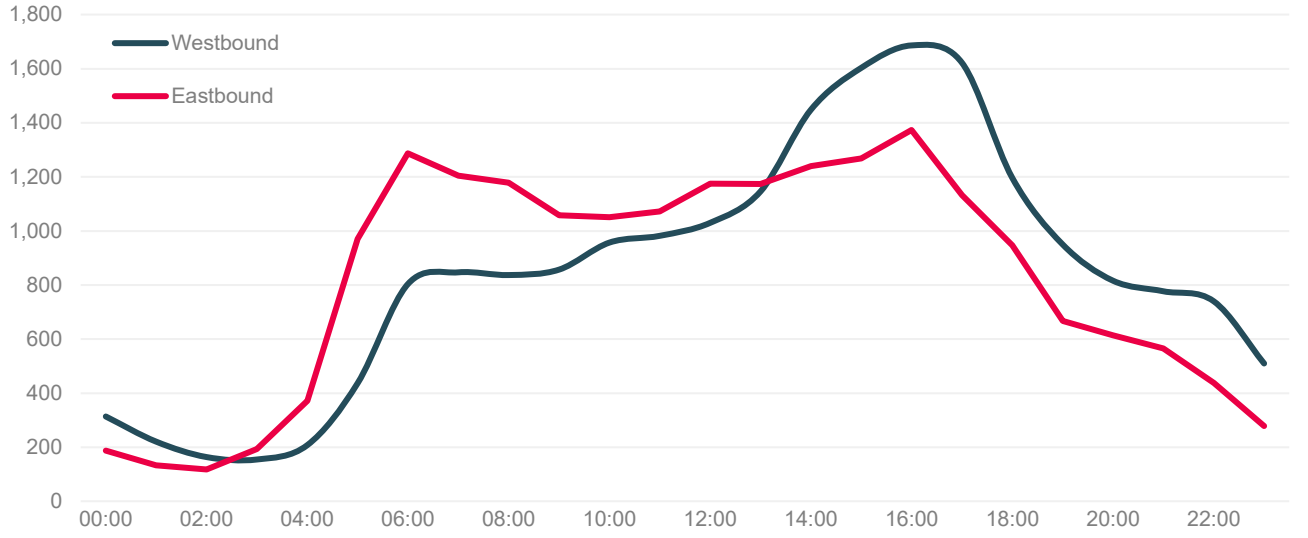
x. Overall, the Georges Cove Village site enjoys a high-profile and easily accessible location that is well-positioned to serve the local community.

CHART 1.1. AVERAGE ANNUAL DAILY TRAFFIC, NEWBRIDGE ROAD, 2015 – 2023



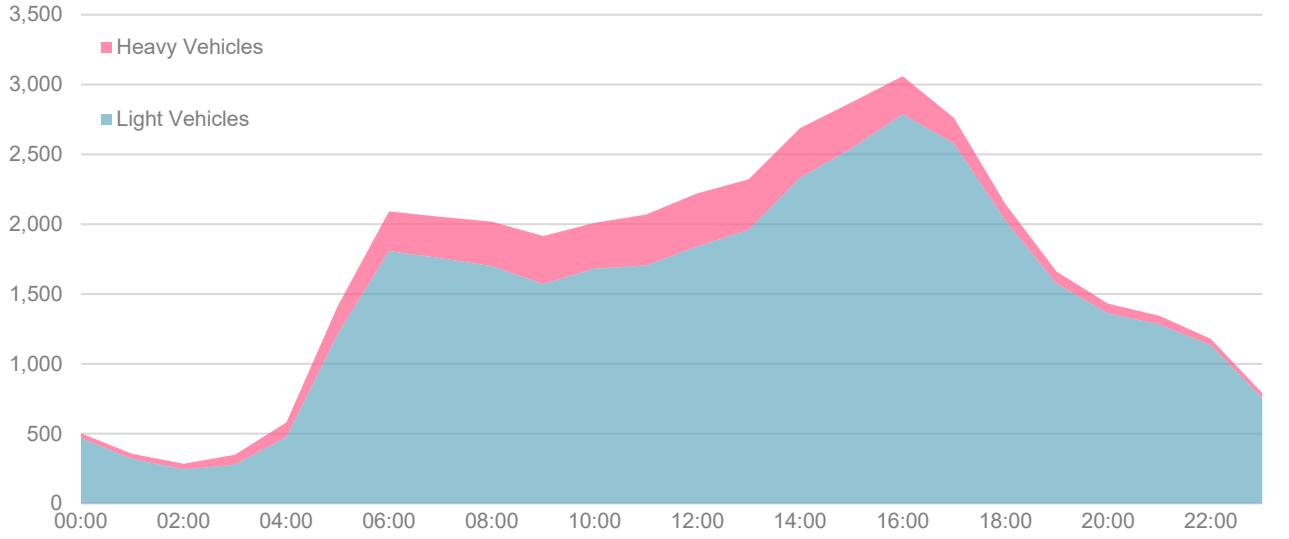
Source: Transport for NSW

CHART 1.2. TRAFFIC VOLUME BY HOUR AND DIRECTION, NEWBRIDGE ROAD, 2023



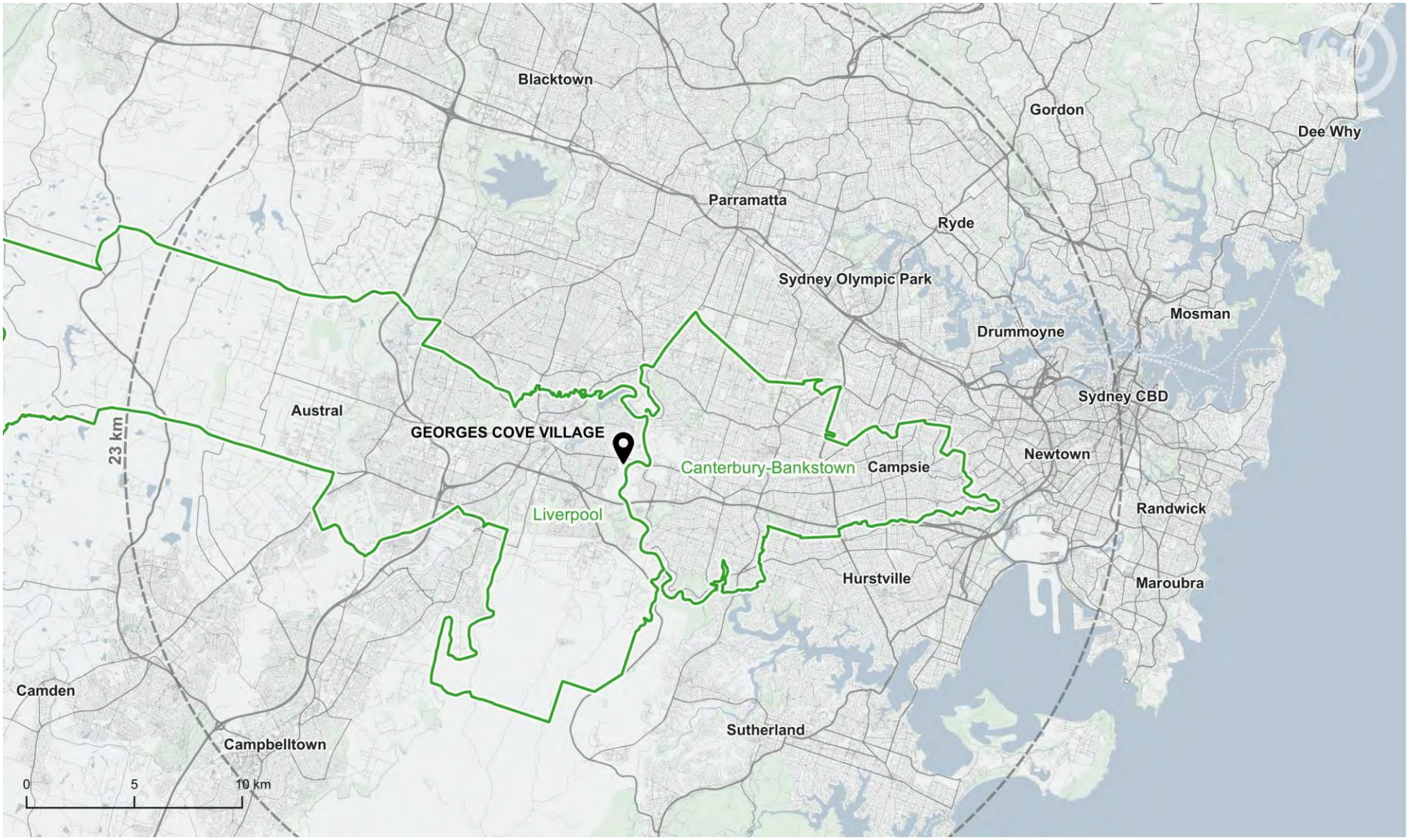
Source: Transport for NSW

CHART 1.3. TRAFFIC VOLUME BY HOUR AND VEHICLE TYPE (BOTH DIRECTIONS), NEWBRIDGE ROAD, 2023



Source: Transport for NSW

MAP 1.1. REGIONAL CONTEXT



MAP 1.2. LOCAL CONTEXT



1.2. Proposed Development

i. As outlined previously, the subject site is located at 146 Newbridge Road in Moorebank, with the northern portion of the site, refer Figure 1.1. Georges Cove Village is a mixed-use development that will anchor the broader Georges Cove Precinct and is planned to comprise residential, retail, and commercial uses, as well as public open space and pedestrian connectivity, illustrated in Figures 1.2 - 1.4

ii. The proposed mixed-use development would be provided across up to five levels with the summary composition demonstrated by Table 1.1. Key components include:

- **Supermarket:** a full-line supermarket (3,809 sq.m), provided on Level Three.
- **Retail Specialty**: totalling 873 sq.m across four tenancies.
- **Non-retail uses:** light industrial tenancies are provided on Level Four totalling 3,859 sq.m, along with mezzanine office totalling 1,253 sq.m on Level 5.

iii. The *Urbis Retail Averages (2021/22)* for single supermarket based shopping centres indicate retail specialty floorspace of 1,346 sq.m across 14 shops. The provision of retail specialty floorspace at the planned Georges Cove Village at 873 sq.m is 473 sq.m smaller than the benchmark level. As such, the retail component of the development will provide a destinational convenience offer only, rather than a full range offer.

iv. Plans for the proposed development are illustrated in Figures 1.6 – 1.10, with key points to note including:

- Vehicular access via Newbridge Road provides a ramp to car parking on Level 2 and Level 3.
- Access to Level 3 for vehicles is also provided via the proposed new road along the southern perimeter of the site.
- The retail component maximises frontage to the surrounding road network, including Newbridge Road in the north.

v. The broader Georges Cove Precinct will include a range of residential dwellings, a new road network, and modern marina at the southern portion of the site. The Georges Cove Marina to the south is prosed to include a range of amenities such as an entertainment, club, and public recreational facilities. Complementing the precinct, the proposed Georges Cove Village mixed-use development would offer a high degree of customer amenity and convenience by way of its high-profile site, easily accessible location, and quality design.

TABLE 1.1. GEORGES COVE VILLAGE - PLANNED COMPOSTION

Category	GLA (sq.m)	% of Retail
Supermarket	3,809	81.4%
Total Retail Spec.	873	18.6%
Total Centre - Retail	**4,682**	**100.0%**
Non-retail		
Light Industrial	3,859	
Office	1,253	
Total Centre	**9,794**	
Car Parking Bays (No.)		
Retail	287	
Industrial	74	
Total Car Parking Bays	**361**	

Source : Benedict Industries

FIGURE 1.1. GEORGES COVE PRECINCT PLAN

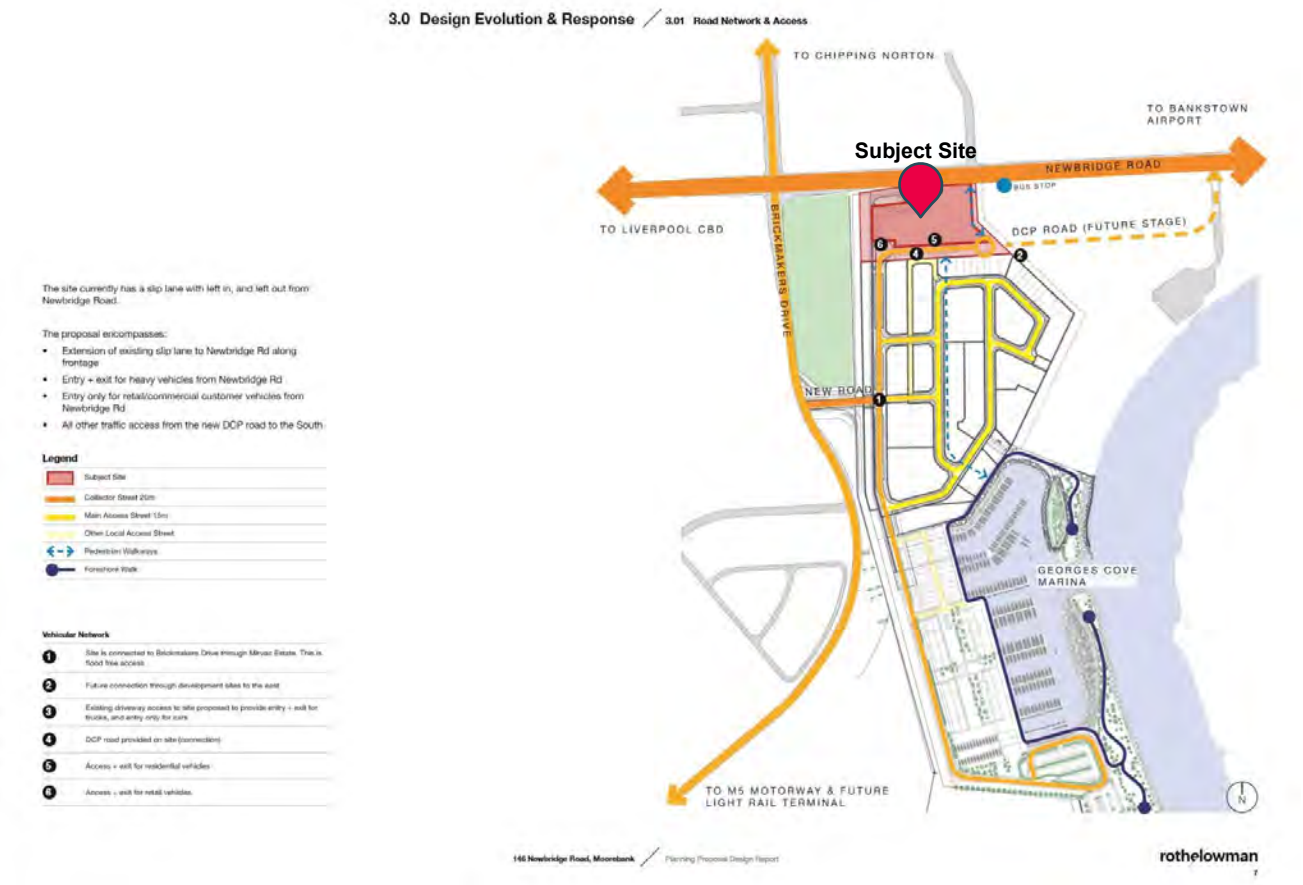


FIGURE 1.2. GEORGES COVE VILLAGE CONCEPT PLAN



FIGURE 1.3. GEORGES COVE VILLAGE CONCEPT PLAN

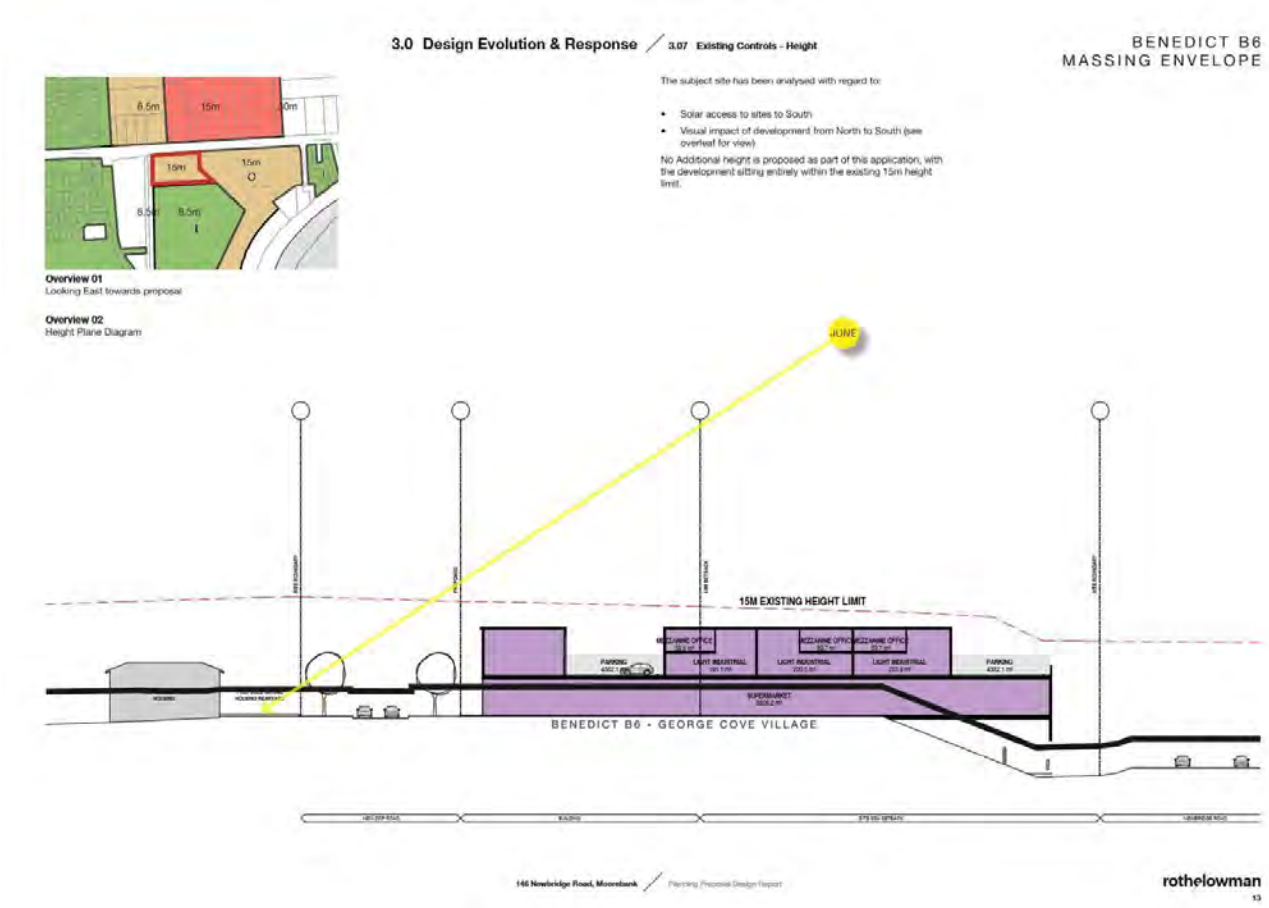


FIGURE 1.4. GEORGES COVE PRECINCT PLAN



FIGURE 1.5. SITE PLAN, LEVEL ONE – DOCK

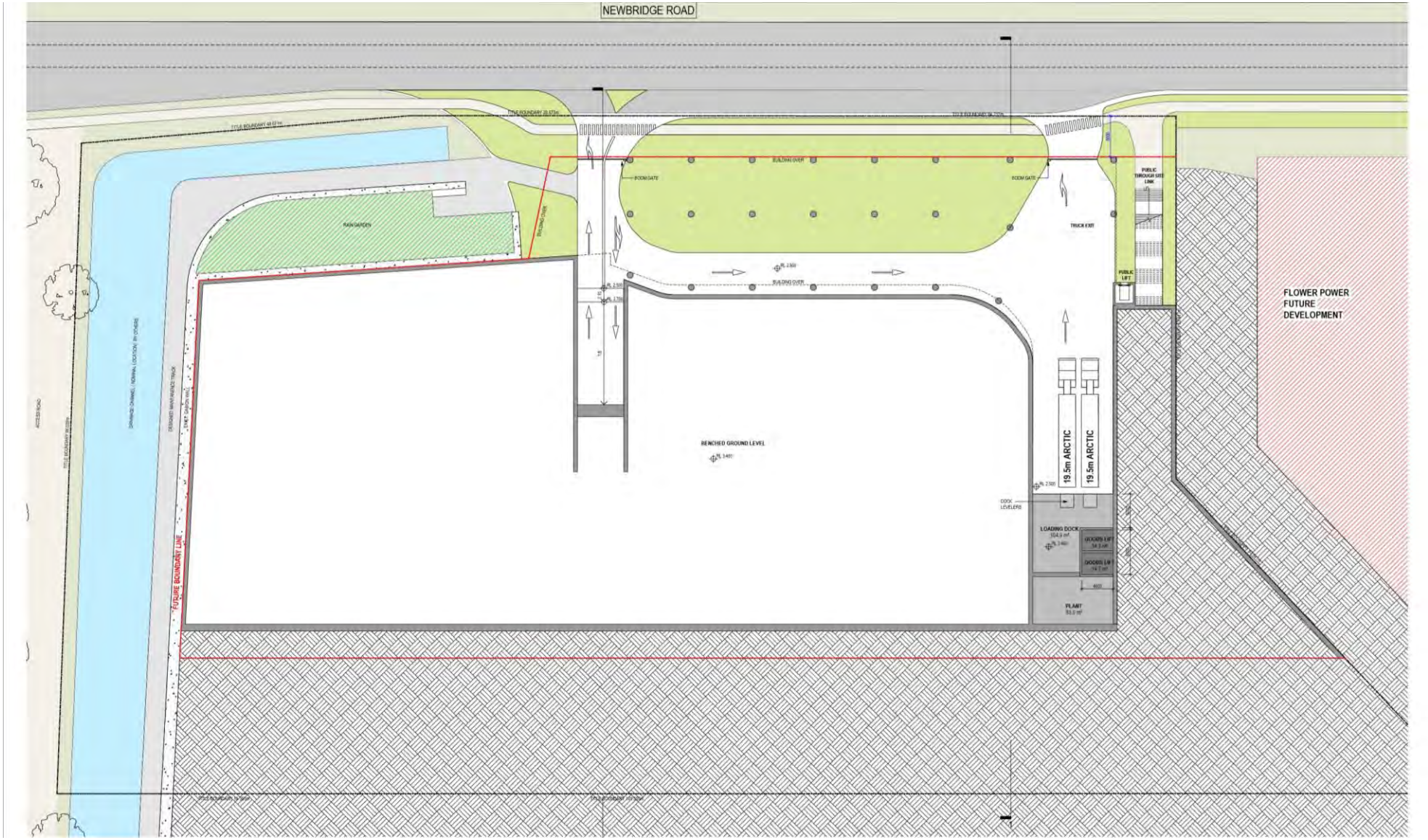


FIGURE 1.6. SITE PLAN, LEVEL TWO – CAR PARK

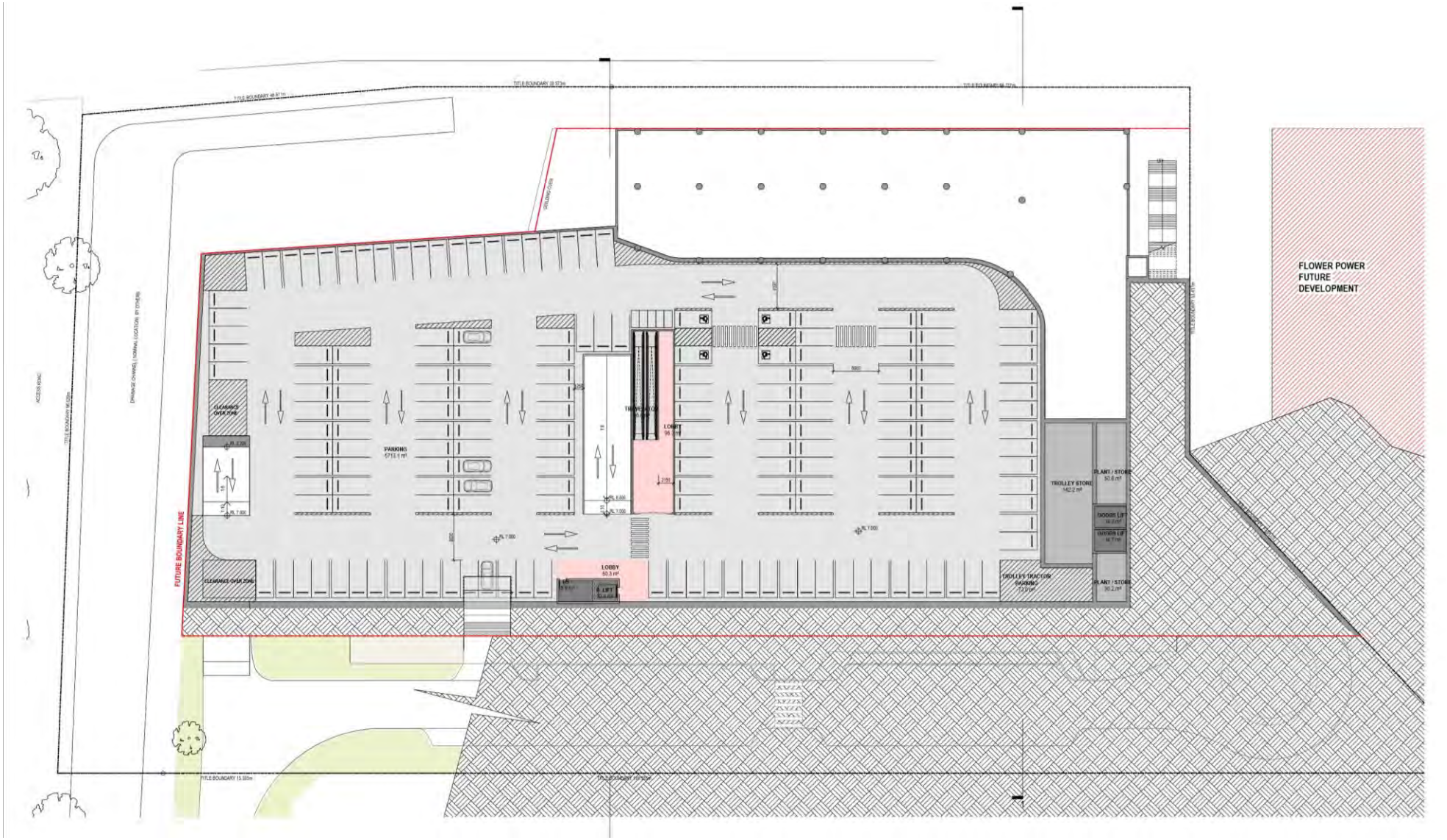


FIGURE 1.7. SITE PLAN. LEVEL THREE - SUPERMARKET AND SPECIALTY SHOPS

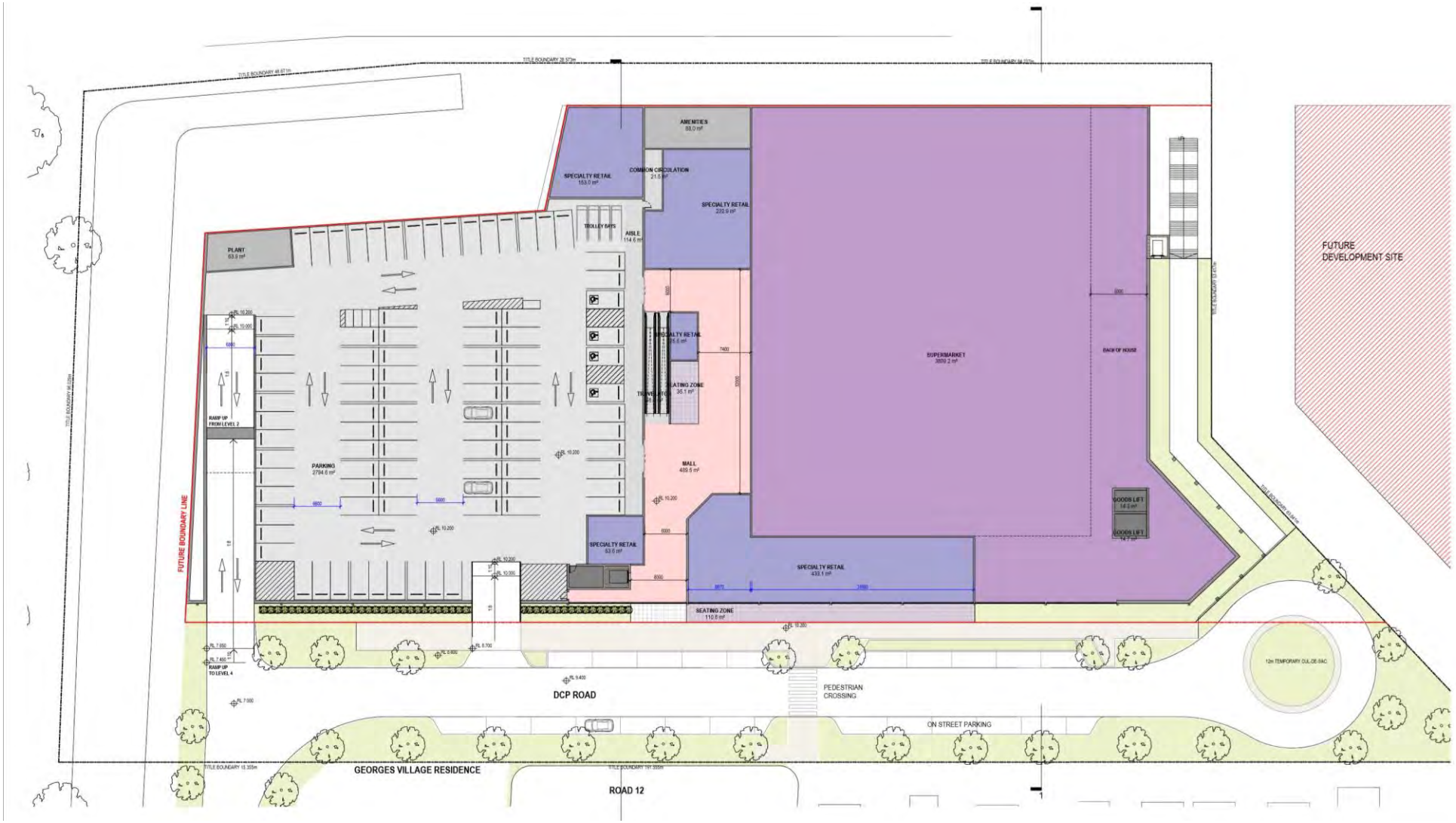


FIGURE 1.8. SITE PLAN, LEVEL FOUR – LIGHT INDUSTRIAL USES



FIGURE 1.9. SITE PLAN, LEVEL FIVE – MEZZANINE OFFICE



1.3. Planning Context

i. Based on the Liverpool Local Environment Plan (LEP) 2008, the subject site is zoned B6 - Enterprise Corridor (refer Figure 1.10). However, On 26 April 2023, the NSW Department of Planning & Environment amended the Liverpool LEP (and all LEP's across NSW), to replace Business and Industrial Land Use Zones with 'Employment Zones'. Subsequently, the zone B6 – Enterprise Corridor is now zoned as E3 – Productivity Support.

ii. The objective for E3 – zoned land is as follows:

- To provide a range of facilities and services, light industries, warehouses, and offices.
- To provide for land uses that are compatible with, but do not compete with, land uses in surrounding local and commercial centres.
- To maintain the economic viability of local and commercial centres by limiting certain retail and commercial activity.
- To provide for land uses that meet the needs of the community, businesses and industries but that are not suited to locations in other employment zones.
- To provide opportunities for new and emerging light industries.
- To enable other land uses that provide facilities and services to meet the day to day needs of workers, to sell goods of a large size, weight or quantity or to sell goods manufactured on-site.
- To provide for a larger regionally significant business development centre in a location that is highly accessible to the region.
- To provide primarily for businesses along key corridors entering Liverpool city centre, regionally significant business development centres, major local centres or retail centres.

iii. Various uses are currently permitted on E3-zoned land, with key uses with consent including:

- Centre-based childcare facilities
- Garden centres, hardware and building supplies
- Industrial retail outlets, industrial training facilities,
- Light industries
- Neighbourhood shops
- Office premises
- Service stations
- Specialised retail premises
- Storage premises
- Take away food and drink premises
- Recreation facilities
- Hotel or motel accommodation
- Timber yards
- Warehouse of distribution centres
- Wholesale supplies

iv. Development consent must not be granted to development that would result in total gross floor area of all retail premises (other than garden centres, hardware and building supplies, landscaping material supplies or vehicle sales or hire premises) in a single building being more than 8,000 sq.m.

v. The LEP dictates that development in E3-zoned land should maintain opportunities for business and retail types suited to high-exposure locations, while ensuring that centres remain the focus for business and retail activity and that active uses are provided at street level to encourage the presence and movement of people.

vi. Additionally specialised retail premises and retail premises in Zone E3 has the following exemptions:

- Development consent must not be granted to development for the purposes of specialised retail premises on land identified as “Area A” on the Land Zoning Map if the gross floor area of the specialised retail premises is more than 2,500 sq.m.

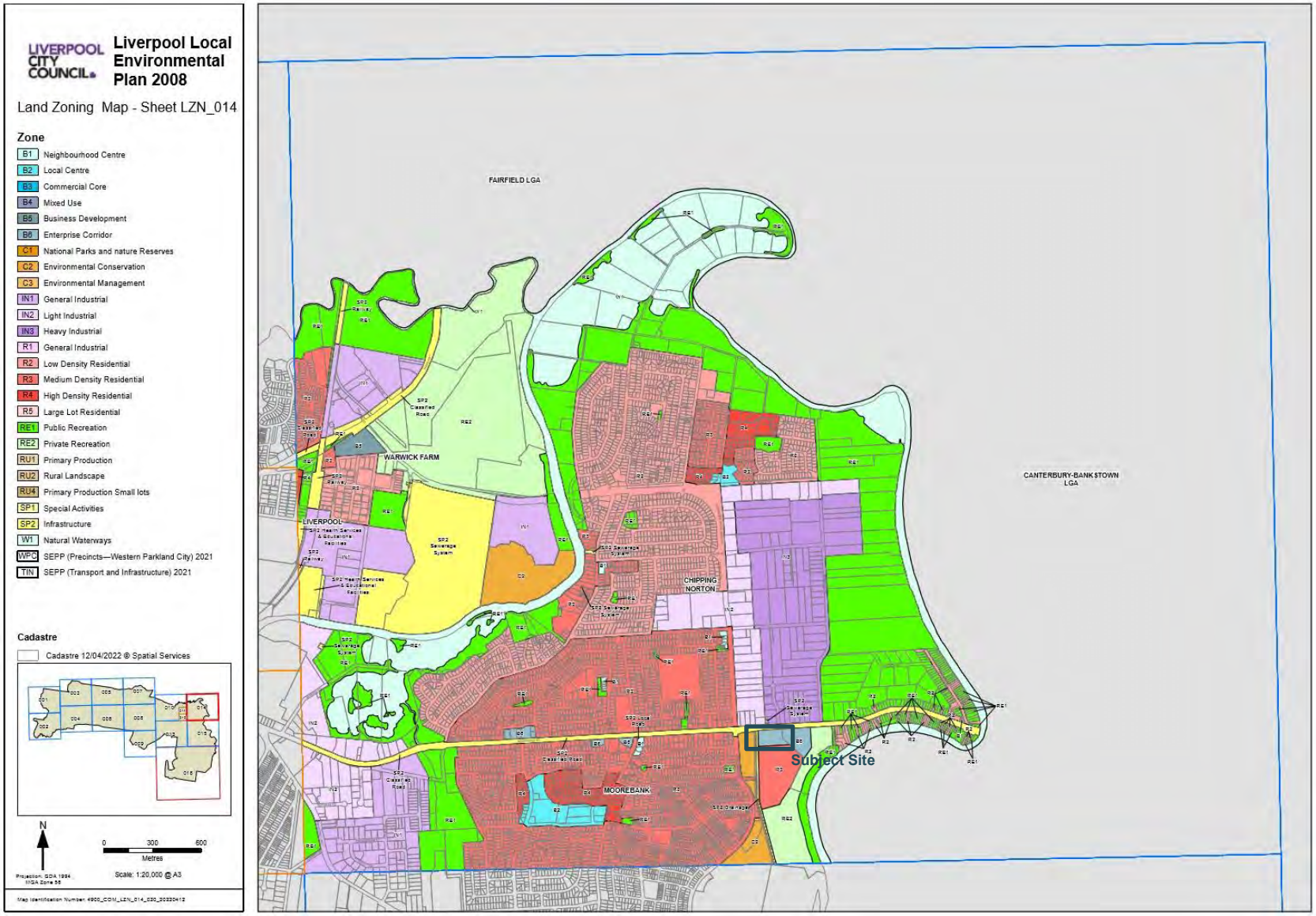
- Development consent must not be granted to development for the purposes of retail premises on land identified as “Area A” on the Land Zoning Map if the gross floor area of the retail premises is more than 1,600 sq.m.

vii. Upon review of the land zoning map (refer Figure 1.10), the subject site is not indicated as “Area A”.

viii. The proposed Georges Cove Village satisfies these requirements, with the total retail component totalling 4,682 sq.m.

ix. Zoning regulations such as these have the potential to limit the range of prospective retail and non-retail floorspace that could be approved at the subject site. These regulations have been considered, however, for the purposes of this assessment, the supportability and impacts of prospective retail floorspace at the subject site are based on projected demand, the emerging needs of the local community and other economic considerations.

FIGURE 1.10. LIVERPOOL CITY COUNCIL LAND ZONING MAP



2 Trade Area Analysis

This section of the report outlines the trade area likely to be served by the proposed Georges Cove Village, including current and projected population and retail spending levels, over the period to 2041. The socio-economic profile of the trade area population is also provided.

2.1. Trade Area Definition

i. The trade area served by Georges Cove Village has been defined taking into consideration the following:

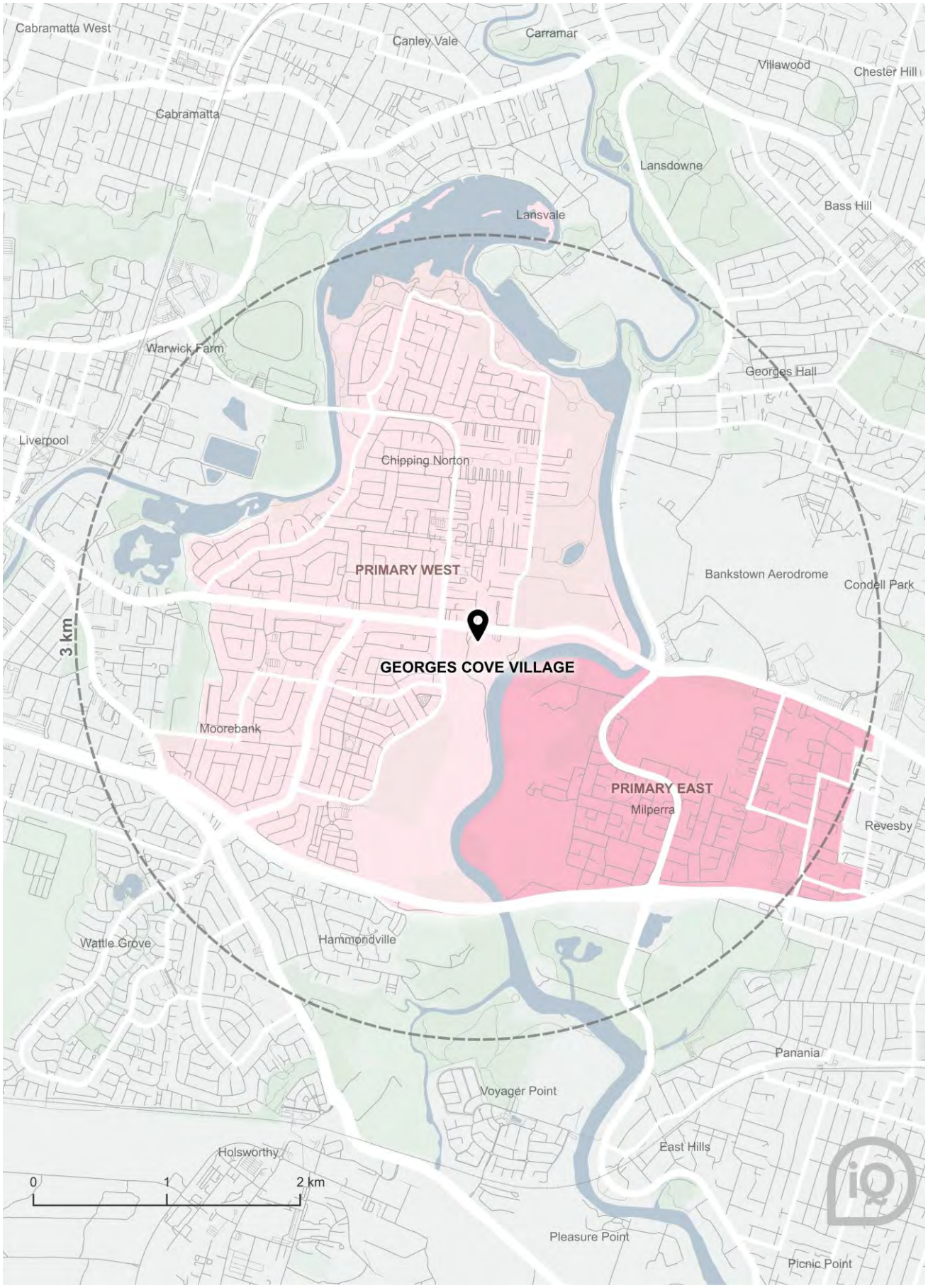
- The scale and composition of the development, including one full-line supermarket.
- The provision of existing and proposed retail facilities throughout the region.
- Regional and local accessibility
- The pattern of urban development
- Significant physical barriers such as rivers and major roads.

ii. Map 2.1 illustrates the defined trade area for the proposed development, which includes two primary sectors as follows:

- The **primary west sector** is bounded by the Georges River in the north, east and west, as well as the M5 Motorway in the south. This sector comprises the suburbs of Moorebank and Chipping Norton.
- The **primary east sector** encompasses the suburb of Milperra, extending to Newbridge Road in the north, Horsley Road in the east, the M5 Motorway in the south and the Georges River in the west.

iii. The combination of the primary sectors is referred to as the **main trade area** throughout the remainder of this report. This is the area from which retail facilities at the planned Georges Cove Village will draw most customers.

MAP 2.1. GEORGES COVE VILLAGE MAIN TRADE AREA AND SUBUBRBS



2.2. Main Trade Area Population

i. Tables 2.1 detail the main trade area current and projected population levels by sector. This information is sourced from the following:

- The 2011, 2016 and 2021 Census of Population and Housing undertaken by the Australian Bureau of Statistics (ABS).
- New dwelling approvals statistics from the ABS from 2011/12 to 2021/22 (refer Chart 2.1), which indicate an average of 157 new dwellings were approved for the main trade area annually over this timeframe.
- The latest population projections prepared at a Statistical Area 2 (SA2) level by NSW Department of Planning.
- Investigations by this office into new residential developments in the region.

ii. The main trade area population is currently estimated at 24,712 (2023), including 20,530 persons within the key primary west sector. The main trade area is projected to increase to 31,812 (+7,100 persons) by 2041, reflecting an average annual growth rate of 1.4%. Within the primary west sector, the population is projected to reach 25,980 persons by 2041, increasing at an average annual growth rate of 1.9%.

iii. Most of the population growth across the main trade area is projected to occur throughout the primary west sector, with key residential developments within the sector, including:

- The Georges Cove Precinct (subject development) stretches around 1 km south of Newbridge Road, along the Georges River and is planned to yield a range of detached, semi-detached and unit housing along the waterfront. The residential estate is currently under construction and will ultimately provide around 180 homes to be built by Mirvac.
- Adjacent to the subject site at 124 Newbridge Road, Flower Power closed, with an application submitted to council to rezone the site to allow for medium density residential Based on the proposal, the site is planned to include up 750 residential apartments. First residents have been assumed at the site from 2025/26.
- Immediately south of the subject site, an application has been submitted for a 2,000-home estate in 2020. However, the planning proposal was not supported by council, and it is likely an amended development application will be submitted. For the purpose of this assessment this development is not assumed to proceed over the forecast period.
- Siteworks have begun for two residential buildings comprising a combined 147 apartments (300 residents) along Nuwarra Road in Moorebank.
- Approval has been granted for a 76-apartment development across two buildings along Lucas Avenue in Moorebank.
- The continued development of higher density dwellings is generally in keeping with recent trends throughout the primary west sector, with multi-level unit developments expected to continue occurring

throughout R4 – High Density Residential zoned land in proximity to the Nuwarra Road and Maddecks Avenue intersection.

iv. Within the primary east sector, council has approved the redevelopment of the Riverlands Golf Course at Milperra. The development will deliver 180 residential dwellings across a range of housing types. First homes are assumed by 2026.

TABLE 2.1. MAIN TRADE AREA POPULATION PROJECTIONS, 2011 - 2041

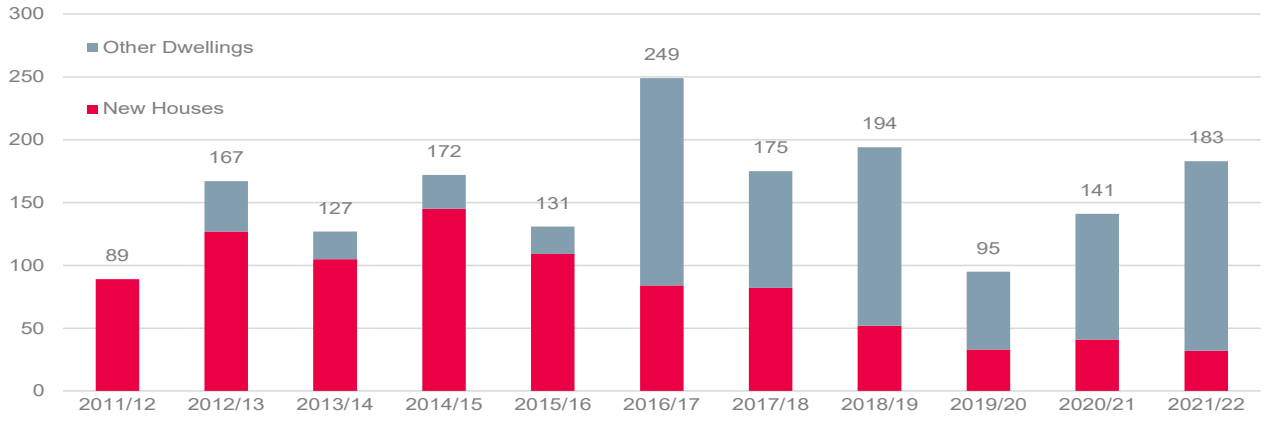
	Actual			Forecast					*Change*
Population	**2011**	**2016**	**2021**	**2023**	**2026**	**2031**	**2036**	**2041**	***2023-41***
Primary Sectors									
• East	3,991	4,070	4,082	4,182	4,332	5,082	5,582	5,832	*1,650*
• West	15,317	18,437	19,930	20,530	21,730	24,230	25,480	25,980	*5,450*
Main Trade Area	**19,308**	**22,507**	**24,012**	**24,712**	**26,062**	**29,312**	**31,062**	**31,812**	***7,100***

	Actual		Forecast					*Change*
Average Annual Change (No.)	**2011-16**	**2016-21**	**2021-23**	**2023-26**	**2026-31**	**2031-36**	**2036-41**	***2023-41***
Primary Sectors								
• East	16	2	50	50	150	100	50	*92*
• West	624	299	300	400	500	250	100	*303*
Main Trade Area	**640**	**301**	**350**	**450**	**650**	**350**	**150**	***394***

	Actual		Forecast					*Change*
Average Annual Change (%)	**2011-16**	**2016-21**	**2021-23**	**2023-26**	**2026-31**	**2031-36**	**2036-41**	***2023-41***
Primary Sectors								
• East	0.4%	0.1%	1.2%	1.2%	3.2%	1.9%	0.9%	*1.9%*
• West	3.8%	1.6%	1.5%	1.9%	2.2%	1.0%	0.4%	*1.3%*
Main Trade Area	**3.1%**	**1.3%**	**1.4%**	**1.8%**	**2.4%**	**1.2%**	**0.5%**	***1.4%***
Greater Sydney	*1.7%*	*1.3%*	*-0.3%*	*1.2%*	*1.2%*	*1.5%*	*1.3%*	*n.a.*
Australian Average	*1.6%*	*1.2%*	*0.3%*	*1.3%*	*1.3%*	*1.2%*	*1.1%*	*n.a.*

All figures as at June and based on 2021 SA1 boundary definition.
Sources : ABS; NSW DPIE

CHART 2.1. MAIN TRADE AREA, NEW DWELLING APPROVALS, 2011/12 – 2021/22



Source: ABS

2.3. Socio-economic Profile

i. Table 2.2 summarises the socio-economic characteristics of the main trade area population by sector, compared with the Greater Sydney and Australian benchmarks. This information is based on the 2021 Census of Population and Housing. Key points to note regarding the main trade area population include:

- Average per capita income levels are lower than the Greater Sydney benchmark. Average household income levels are broadly in line with the Greater Sydney average.
- The average age of residents is slightly younger than the benchmarks.
- Some 80.5% of households are owned. This is significantly higher than the Greater Sydney benchmark (62.3%). Homeownership levels in the primary east sector are particularly high at 89.0%.
- There is a high proportion of Australian born residents (69.8%) compared to the Greater Sydney benchmark (60.6%).
- The average household size at 3.1 persons is larger than both benchmarks.
- The main trade area comprises a high proportion of traditional families (i.e. couples with dependent), as compared with the Sydney benchmark.

ii. In summary, the main trade area is characterised by an Australian born, traditional family-based population, who typically own their own homes. This demographic would have a strong affinity with convenience-based retail facilities within close proximity to their place of residence.

iii. Table 2.3 outlines the key changes within the main trade area between the 2011 and 2021 Census periods. As shown, the main trade area is increasingly characterised by a young family market with the average household size and proportion of couples with dependent children, increasing at a faster rate than the benchmark.

TABLE 2.2. MAIN TRADE AREA SOCIO-ECONOMIC PROFILE, 2021 CENSUS

Characteristic	Primary Sectors East	Primary Sectors West	Main TA	Greater Sydney Average	Australia Average
People					
Age Distribution (% of Pop'n)					
Aged 0-14	20.7%	22.4%	**22.1%**	18.3%	18.0%
Aged 15-19	7.3%	6.2%	**6.4%**	5.6%	5.7%
Aged 20-29	11.1%	10.8%	**10.9%**	14.2%	13.3%
Aged 30-39	11.9%	14.5%	**14.0%**	16.0%	14.6%
Aged 40-49	13.8%	14.3%	**14.2%**	13.6%	13.0%
Aged 50-59	12.0%	11.7%	**11.8%**	12.0%	12.5%
Aged 60+	23.3%	20.1%	**20.6%**	20.4%	23.0%
Average Age	38.7	37.4	**37.6**	38.4	39.5
Birthplace (% of Pop'n)					
Australian	85.0%	66.6%	**69.8%**	60.6%	72.0%
Overseas	15.0%	33.4%	**30.2%**	39.4%	28.0%
• Asia	4.7%	12.8%	**11.5%**	20.3%	12.1%
• Europe	3.8%	6.4%	**5.9%**	6.9%	7.2%
• Other	6.5%	14.2%	**12.9%**	12.2%	8.7%
Family					
Average Household Size	3.0	3.1	**3.1**	2.7	2.5
Family Type (% of Pop'n)					
Couple with dep't children	52.0%	53.8%	**53.5%**	47.8%	44.2%
Couple with non-dep't child.	11.0%	12.2%	**12.0%**	8.9%	7.7%
Couple without children	19.4%	16.6%	**17.1%**	21.1%	23.8%
Single with dep't child.	8.2%	7.2%	**7.3%**	7.7%	8.6%
Single with non-dep't child.	3.4%	4.4%	**4.3%**	4.2%	4.0%
Other family	0.7%	0.8%	**0.8%**	1.1%	1.0%
Lone person	5.3%	5.0%	**5.0%**	9.2%	10.8%
Employment					
Income Levels					
Average Per Capita Income	$53,504	$53,359	**$53,385**	$60,644	$55,301
Per Capita Income Variation	-11.8%	-12.0%	**-12.0%**	n.a.	n.a.
Average Household Income	$124,772	$123,552	**$123,765**	$125,158	$109,594
Household Income Variation	-0.3%	-1.3%	**-1.1%**	n.a.	n.a.
Housing					
Tenure Type (% of Dwellings)					
Owned	89.0%	78.7%	**80.5%**	62.3%	67.4%
Rented	10.3%	21.1%	**19.2%**	36.1%	30.8%
Other Tenure Type	0.7%	0.2%	**0.3%**	1.6%	1.8%

Sources: ABS Census of Population and Housing 2021

TABLE 2.3. MAIN TRADE AREA SOCIO-ECONOMIC PROFILE COMPARISON, 2011 – 2021 CENSUS PERIODS

Characteristic	Macquarie Centre Main Trade Area			Change (%)			Greater Sydney			Change (%)		
	2011	2016	2021	2011-16	2016-21	2011-21	2011	2016	2021	2011-16	2016-21	2011-21
People												
Average Age	37.5	37.1	37.6	-0.2%	0.3%	0.0%	37.2	37.6	38.4	0.2%	0.4%	0.3%
Birthplace (% of Pop'n)												
Australian	72.3%	71.0%	69.8%	-1.3%	-1.3%	-2.6%	63.7%	61.9%	60.6%	-1.7%	-1.3%	-3.1%
Overseas	27.7%	29.0%	30.2%	1.3%	1.3%	2.6%	36.3%	38.1%	39.4%	1.7%	1.3%	3.1%
• Asia	7.7%	10.5%	11.5%	2.8%	1.0%	3.8%	13.7%	18.6%	20.3%	4.9%	1.7%	6.6%
• Europe	8.5%	7.0%	5.9%	-1.5%	-1.1%	-2.6%	9.1%	7.7%	6.9%	-1.4%	-0.8%	-2.3%
• Other	11.5%	11.5%	12.9%	0.0%	1.3%	1.3%	13.5%	11.8%	12.2%	-1.8%	0.5%	-1.3%
Family												
Average Household Size	2.9	3.0	3.1	0.6%	0.2%	0.4%	2.7	2.7	2.7	0.2%	-0.4%	-0.1%
Family Type (% of Pop'n)												
Couple with dep't children	47.8%	52.4%	53.5%	4.6%	1.1%	5.7%	48.2%	48.8%	47.8%	0.6%	-1.0%	-0.4%
Couple with non-dep't child.	14.0%	12.3%	12.0%	-1.7%	-0.4%	-2.1%	9.1%	9.2%	8.9%	0.1%	-0.3%	-0.2%
Couple without children	20.4%	18.1%	17.1%	-2.3%	-1.0%	-3.3%	20.1%	20.2%	21.1%	0.1%	0.9%	1.0%
Single with dep't child.	7.9%	7.5%	7.3%	-0.5%	-0.1%	-0.6%	8.5%	8.0%	7.7%	-0.5%	-0.3%	-0.8%
Single with non-dep't child.	4.1%	4.0%	4.3%	-0.2%	0.3%	0.1%	3.9%	4.1%	4.2%	0.2%	0.1%	0.2%
Other family	0.8%	0.9%	0.8%	0.1%	-0.1%	0.0%	1.2%	1.2%	1.1%	0.0%	-0.1%	-0.1%
Lone person	5.0%	4.8%	5.0%	-0.2%	0.2%	0.1%	9.0%	8.5%	9.2%	-0.5%	0.7%	0.2%
Employment												
Income Levels												
Average Per Capita Income	$39,856	$45,973	$53,385	2.9%	3.0%	3.0%	$42,494	$50,455	$60,644	3.5%	3.7%	3.6%
Per Capita Income Variation	-6.2%	-8.9%	-12.0%	-2.7%	-3.1%	-5.8%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Average Household Income	$92,813	$108,696	$123,765	3.2%	2.6%	2.9%	$91,262	$108,486	$125,158	3.5%	2.9%	3.2%
Household Income Variation	1.7%	0.2%	-1.1%	-1.5%	-1.3%	-2.8%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: ABS Census of Population and Housing 2011, 2016 & 2021

higher | lower than benchmark

2.4. Trade Area Retail Expenditure

i. The estimated retail expenditure capacity of the main trade area population is based on information sourced from CommBank iQ Retail Spend Insights.

ii. CommBank iQ Retail Spend Insights is a new dataset that was first released in April 2023 (Calendar Year 2022) and is to be released for each Financial Year and Calendar Year going forwards (i.e. released every six months). The dataset has initially been adopted by the four leading economic property consultants in Australia.

iii. Retail Spend Insights is a modelled view of retail spend per capita across Australia. It is provided at the granularity of SA1 allowing for the creation of bespoke catchments to facilitate a view on resident spend by category for the area. The dataset is based on de-identified, privacy treated retail banking transactions, normalised to be representative of the Australian population. Transactions may include purchases and refunds from credit card, debit card, EFTPOS cards, BPay and direct debit.

iv. CommBank iQ Retail Spend Insights excludes cash and buy now pay later services (CBNPL). The data provides the average annual (for CY22) spend across 81 categories for people aged 18 years and older. The data is also split out by instore and online transactions. Location IQ has adjusted the raw data for cash and CBNPL.

v. Chart 2.2 demonstrates the main trade area retail per capita spend as at 2022/23 compared with the Greater Sydney benchmark. As illustrated, the main trade area per capita spend levels are broadly in line with benchmark levels across all categories. Notably, supermarket expenditure at $4,326 is higher than the Greater Sydney benchmark ($4,200).

vi. Table 2.4 outlines the total retail expenditure levels generated by the main trade area population. The main retail expenditure level is currently estimated at $458.1 million and is projected to increase at an average rate of 2.2% to $675.0 million by 2041 (constant 2022/23 dollars and including GST). Table 2.5 details the main trade area retail expenditure generated by key commodity group.

vii. The projected growth rate in retail spending for the main trade area considers the following:

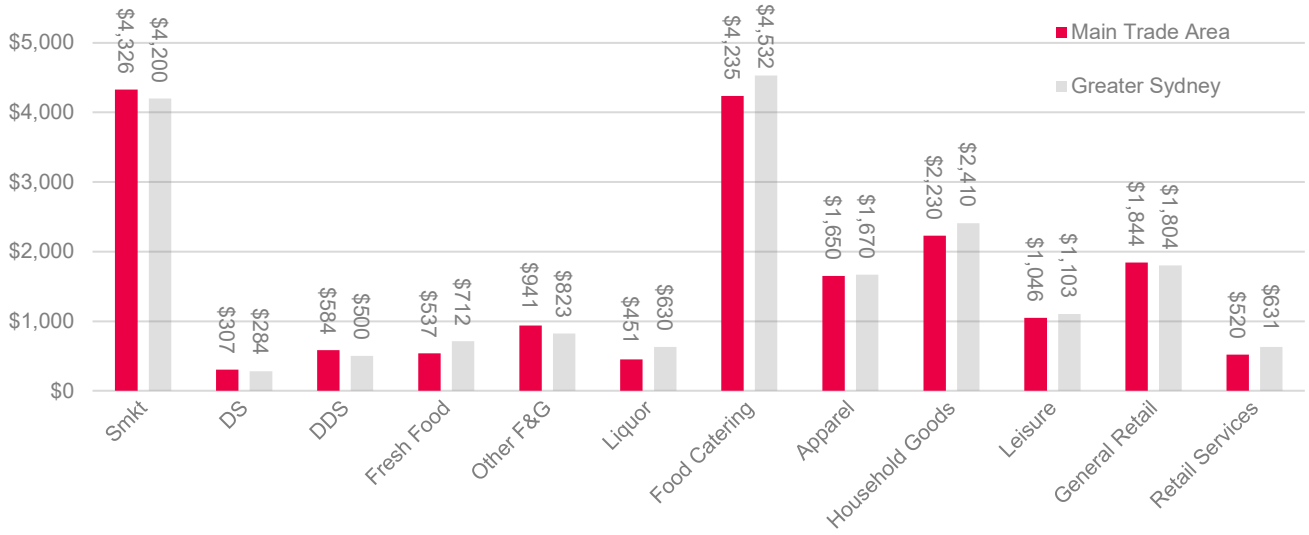
Real Growth

- Real growth in retail spending per capita of 0.0% is assumed over the period to 2025. From 2026 real growth per capita is assumed at 0.5% annually for food retail and 1.0% for non-food retail over the period to 2041.

Population Growth

- Main trade area population growth is projected at 1.4% per annum.

CHART 2.2. MAIN TRADE AREA RETAIL EXPENDITURE PER CAPITA, 2022/23



Source: CBAIQ, Location IQ

TABLE 2.4. MAIN TRADE AREA RETAIL EXPENDITURE, 2022 – 2041

Y/E June	Primary Sectors East	Primary Sectors West	Main TA
2023	81.1	377.0	**458.1**
2024	82.1	383.4	**465.5**
2025	83.0	390.7	**473.8**
2026	84.7	401.4	**486.1**
2027	87.3	413.0	**500.3**
2028	90.8	425.5	**516.3**
2029	94.5	438.4	**532.9**
2030	98.4	451.7	**550.1**
2031	102.4	465.4	**567.8**
2032	105.9	476.7	**582.6**
2033	108.8	485.4	**594.2**
2034	111.7	494.3	**606.0**
2035	114.8	503.4	**618.2**
2036	117.9	512.6	**630.5**
2037	120.5	520.4	**640.9**
2038	122.6	526.7	**649.3**
2039	124.6	533.1	**657.7**
2040	126.8	539.5	**666.3**
2041	128.9	546.0	**675.0**
Expenditure Growth			
2023-26	3.6	24.4	**28.0**
2026-31	17.7	64.0	**81.7**
2031-36	15.5	47.2	**62.7**
2036-41	11.0	33.4	**44.5**
2023-41	47.9	169.0	**216.9**
Average Annual Growth Rate			
2023-26	1.5%	2.1%	**2.0%**
2026-31	3.9%	3.0%	**3.2%**
2031-36	2.9%	2.0%	**2.1%**
2036-41	1.8%	1.3%	**1.4%**
2023-41	2.6%	2.1%	**2.2%**

**Constant 2022/23 dollars & including GST*

Source : CBA IQ, Location IQ

TABLE 2.5. MTA RETAIL EXPENDITURE BY KEY COMMODITY GROUP, 2022 – 2041

Y/E June	Supermarket	Department Store	Discount Dept Store	Food & Liquor	Food Catering	Apparel	H'hold Goods	Leisure	General Retail	Retail Services
2023	106.1	7.5	14.3	47.3	103.9	40.5	54.7	25.7	45.3	12.7
2024	107.9	7.6	14.6	48.1	105.6	41.1	55.6	26.1	46.0	13.0
2025	109.8	7.8	14.8	48.9	107.5	41.9	56.6	26.5	46.8	13.2
2026	112.3	8.0	15.2	50.0	110.5	43.1	58.1	27.3	48.1	13.6
2027	115.2	8.2	15.6	51.3	113.9	44.4	60.0	28.1	49.6	14.0
2028	118.5	8.4	16.0	52.8	117.8	45.9	62.0	29.1	51.3	14.5
2029	122.0	8.6	16.5	54.4	121.8	47.5	64.1	30.1	53.0	14.9
2030	125.5	8.9	16.9	56.0	125.9	49.1	66.3	31.1	54.9	15.5
2031	129.1	9.1	17.4	57.6	130.2	50.7	68.6	32.2	56.7	16.0
2032	132.1	9.4	17.8	59.0	133.9	52.1	70.5	33.1	58.3	16.4
2033	134.3	9.5	18.1	60.0	136.8	53.3	72.1	33.8	59.6	16.8
2034	136.5	9.7	18.4	61.0	139.8	54.4	73.6	34.6	60.9	17.2
2035	138.8	9.8	18.8	62.0	142.8	55.6	75.3	35.3	62.2	17.5
2036	141.1	10.0	19.1	63.1	145.9	56.8	76.9	36.1	63.6	17.9
2037	143.0	10.1	19.3	63.9	148.6	57.9	78.3	36.8	64.7	18.2
2038	144.4	10.2	19.5	64.6	150.8	58.7	79.5	37.3	65.7	18.5
2039	145.8	10.3	19.7	65.2	153.1	59.6	80.7	37.9	66.7	18.8
2040	147.2	10.4	19.9	65.8	155.3	60.5	81.9	38.5	67.6	19.1
2041	148.7	10.5	20.1	66.5	157.6	61.4	83.1	39.0	68.7	19.4
Expenditure Growth										
2023-26	6.2	0.4	0.8	2.7	6.6	2.6	3.4	1.6	2.9	0.8
2026-31	16.8	1.2	2.3	7.6	19.8	7.7	10.4	4.9	8.6	2.4
2031-36	12.0	0.8	1.6	5.4	15.7	6.1	8.3	3.9	6.8	1.9
2036-41	7.6	0.5	1.0	3.4	11.7	4.5	6.2	2.9	5.1	1.4
2023-41	42.5	3.0	5.8	19.2	53.8	20.9	28.4	13.4	23.4	6.6
Average Annual Growth Rate										
2023-26	1.9%	1.9%	1.9%	1.9%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%
2026-31	2.8%	2.8%	2.8%	2.9%	3.3%	3.3%	3.4%	3.4%	3.3%	3.3%
2031-36	1.8%	1.8%	1.8%	1.8%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%
2036-41	1.0%	1.0%	1.1%	1.1%	1.6%	1.5%	1.6%	1.6%	1.6%	1.6%
2023-41	1.9%	1.9%	1.9%	1.9%	2.3%	2.3%	2.4%	2.4%	2.3%	2.3%

**Constant 2022/23 dollars & including GST*

Source : CBA IQ, Location IQ

2.5. Workers

i. In addition to the permanent resident population and passing traffic, the site would also serve the worker population nearby. On the northern side of Newbridge Road, there is a large provision of industrial uses in the area east of Governor Macquarie Drive, and west of Riverside Road.

ii. Information in this sub-section is based on Journey to Work data released by the ABS 2016 Census of Population and Housing at a destination travel zone level. Map 2.2 illustrates the employment precinct.

iii. Within this employment area, there were 4,300 workers (2021 Census). Typically, it is estimated that 15% - 20% of workers expenditure will be directed to retail facilities near their place of work. The estimated retail expenditure of the worker population is $60.4 million, with around $9.1 – $12.1 million likely to be spent near their place of work, including the planned Georges Cove Village.

iv. It is important to note that a proportion of this market is likely to be a sub-set of the resident spending market, as some workers would live within the resident main trade area. However, residents who both live and work within the worker areas would have the opportunity to use the retail facilities at the site more regularly than if they worked elsewhere.

MAP 2.2. WORKER MAIN TRADE AREA



3 Competitive Environment

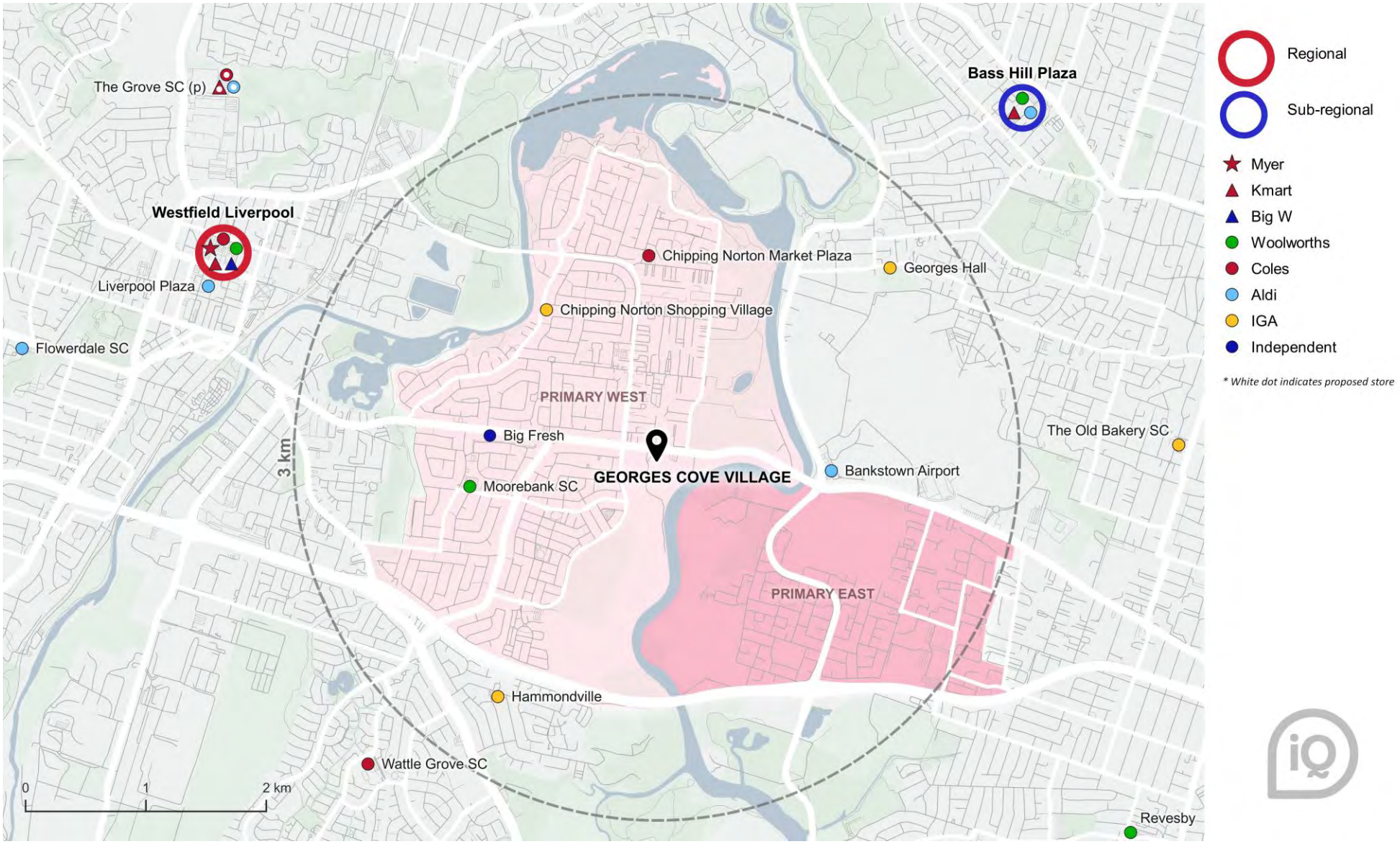
This section of the report provides a summary of the existing and future competitive developments within the region. As shown in Map 3.1 and Table 3.1 retail facilities within the surrounding region

TABLE 3.1. COMPETITIVE CENTRES

Centre	Shopfront GLA (sq.m)	Anchor Tenants	Dist. From Site (km)
Regional Shopping Centres			
Liverpool CBA	111,000		5.1
• Westfield Liverpool	83,100	Myer (11,900), Big W (8,300), Kmart (8,250), Coles (3,900), Woolworths (3,650)	
• Liverpool Plaza SC	7,900	Aldi (1,500)	
• Other	20,000		
Sub-regional Shopping Centres			
Bass Hill Plaza	19,800	Kmart (8,150), Woolworths (3,980), Aldi (1,500)	6.0
Casula Mall	20,200	Kmart (7,800), Coles (5,300), Aldi (1,600)	7.7
Supermarket Based Shopping Centres			
Moorebank	11,900		-
• Moorebank SC	8,900	Woolworths (2,000)	
• Other	3,000	Big Fresh (700)	
Bankstown Airport	2,500	Aldi (1,700)	1.4
Chipping Norton	5,800		2.0
• Chipping Norton Market Plaza	4,400	Coles (2,800)	
• Chipping Norton Shopping Village	1,400	IGA (200)	
Milperra SC	1,300	Friendly Grocer (250)	2.9
Georges Hall	2,300	Supa IGA (1,100)	3.9
Hammondville	1,800	IGA (350)	4.0
Wattle Grove Shopping Village	6,900	Coles (2,150)	4.3
Flowerdale SC	3,600	Aldi (1,700)	5.6
Revesby	10,000		6.5
• Revesby Village Centre	14,500	Coles (4,350)	
• Other	10,000	Woolworths (4,400)	

Source: Location IQ Database

MAP 3.1. MAIN TRADE AREA & COMPETITION



3.1. Regional Shopping Centres

i. Regional shopping centres include one or more department stores and are higher order non-food retail facilities that have a wider draw. The Liverpool Central Business Area (CBA) currently includes the major regional shopping facilities for South-west Sydney and is located some 5 km to the west of the subject site.

ii. Westfield Liverpool is the largest component of the Liverpool CBA and is a major regional shopping destination. The centre comprises a total Gross Leasable Area (GLA) of approximately 83,400 sq.m and is anchored by a Myer department store, Big W and Kmart discount department stores, as well as Coles and Woolworths supermarkets. It is understood that Coles and Woolworths supermarkets trade strongly, above the national average of $10,000 - $11,000 per sq.m.

iii. Liverpool Plaza is located to the immediate south of Westfield Liverpool. The centre contains approximately 7,900 sq.m of retail floorspace and is based on an Aldi supermarket.

iv. The balance (around 20,000 sq.m) of retail floorspace within the Liverpool CBA is provided in retail strip format to the south of Westfield Liverpool and is generally limited by Northumberland Street.

3.2. Sub-regional Shopping Centres

i. Sub-regional shopping centres contain at least one discount department store and generally at least one supermarket.

ii. There are currently no sub-regional shopping centres within the main trade area, including:

- Bass Hill Plaza is 6 km to the north-east of the site. The centre encompasses some 19,800 sq.m of lettable floorspace and is anchored by a Kmart department store and Woolworths and Aldi supermarkets.
- Casula Mall comprises a total GLA of around 20,200 sq.m and is based on a Kmart discount department store, along with Coles and Aldi supermarkets. The centre is positioned some 7.7 km to the south-west of the subject site.

3.3. Supermarket Based Shopping Centres

i. Supermarkets are typically defined in court planning documents as:

"Grocery and dry goods stores of at least 500 sq.m, with smaller stores classified as foodstores."

ii. A major full-line supermarket is the largest format of supermarket, generally totalling 3,200 sq.m or larger and catering to the full grocery shopping needs of customers. These large format stores are typically operated by major chains such as Woolworths and Coles

iii. Supermarkets and foodstores of competitive relevance include:

- Big Fresh (650 sq.m) is provided along Newbridge Road as a free-standing supermarket. The supermarket is predominantly fresh food-based offering fresh produce, a butcher and delicatessen, as well as a limited grocery offer.
- Chipping Norton Market Plaza is 1.9 km to the north of the subject site (primary west sector). The centre encompasses a total lettable area of around 4,400 sq.m and is anchored by a medium sized Coles supermarket of 2,800 sq.m. An IGA foodstore of 200 sq.m is also provided nearby, at Chipping Norton Shopping Village.
- Moorebank Shopping Centre (primary west sector) is anchored by a non full-line Woolworths supermarket of 2,000 sq.m across a total GLA of around 8,900 sq.m. The centre occupies and internalised location, some 2.2 km to the west of the site.
- A small Friendly Grocer of around 250 sq.m is provided at Milperra Shopping Centre (primary east sector), some 2.9 km to the south-east of the subject site.

iv. A small collection of food catering operators are also provided along Newbridge Road and includes key national tenants McDonalds, Subway and Red Rooster. Alternate retail facilities within the main trade area are generally limited to free-standing retailers along Newbridge Road, including Salvo's and a pharmacy.

v. Beyond the main trade area, the nearest supermarkets include:

- Aldi at Bankstown Airport, some 1.4 km to the west of the site.
- Supa IGA of around 1,100 sq.m at Georges Hall, some 3.9 km to the north-east.
- Hammondville IGA (350 sq.m), located around 4 km to the south.
- Coles (2,150 sq.m) at Wattle Grove Shopping Village, some 4.3 km south of the subject site.
- Flowerdale Shopping Centre, which is anchored by an Aldi supermarket, some 5.6 km west of the Moorebank site.
- The suburb of Revesby includes a free-standing Woolworths and Coles supermarkets that forms part of Revesby Village Centre.

3.4. Proposed Retail Developments

i. In terms of the most relevant future competitive retail developments currently underway or planned in the area, are as follows:

Within The Main Trade Area

- A planning proposal has been submitted to rezone the existing Flower Power site along Newbridge Road, to the adjacent east of the subject site. The site is planned to include up to 850 sq.m of retail floorspace and 8,250 sq.m of commercial floorspace, as well as residential dwellings. No supermarket anchor tenant is assumed.

- To the immediate south of the subject site the proposed 2,000-dwelling residential estate is also planned to incorporate 1,700 sq.m of retail floorspace. Current plans are not supported by council and therefore not assumed over the forecast period.

Beyond The Main Trade Area

- Council has approved the expansion of Westfield Liverpool to comprise a commercial and leisure precinct. The development is planned to include an eight-storey commercial tower and up to 6,737 sq.m of additional retail floorspace as part of the entertainment and leisure precinct and 7,569 sq.m of commercial floorspace. The additional retail floorspace is to be focused on a new dining, leisure and entertainment offer - including restaurants, tavern/pubs, cafes, indoor recreation facilities and a modified cinema complex.

3.5. Supermarket Floorspace Provision

i. Table 3.2 provides a summary of the current provision of supermarket floorspace across the defined main trade area, as compared with the Greater Sydney and Australian benchmark.

ii. As shown, across the main trade area, the provision of supermarket floorspace is currently 223 sq.m per 1,000 persons, significantly lower than the Greater Sydney (272 sq.m per 1,000 persons) and Australian (356 sq.m per 1,000 persons) averages.

iii. If no additional supermarket floorspace is provided across the main trade area by 2040/41, the supermarket floorspace provision is projected to decrease to 173 sq.m per 1,000 persons. Even assuming a supermarket of 3,809 sq.m at the subject site over this period, the level of supermarket floorspace provision is projected to reach 293 sq.m by 2040/41, still below national benchmark levels.

iv. It should be noted that the supermarkets within the main trade area are typically smaller in size and would provide a limited offer compared to a major full-line supermarket. In addition, Big Fresh at Moorebank provides a niche fresh food offer that would have wider draw than a typical supermarket.

v. The preferred store size for Woolworths and Coles has increased in recent years, with both chains now typically seeking stores of around 3,400 sq.m and larger. The major supermarket chains target a population of 8,000 – 10,000 persons in order to support one full-line supermarket and will locate across a wide variety of centres including neighbourhood, sub-regional and regional centres, as well as free-standing locations.

vi. The main trade area population, of almost 25,000 persons, could support up to three full-line supermarkets of around 3,500 sq.m, with only smaller format stores currently provided. Further, the main trade area projected population of 31,812 persons by 2041, would indicatively demand up to four full-line supermarkets.

TABLE 3.2. MAIN TRADE AREA SUPERMARKET PROVISION, 2022/23

Trade Area Sector	No. of Supermarkets*	GLA (sq.m)	2023 Population	GLA per 1,000 persons
Primary Sectors				
• East	0	0	4,182	0
• West	3	5,500	20,530	268
Main Trade Area	**3**	**5,500**	**24,712**	**223**
Greater Sydney Average				*272*
Australian Average				*356*

** Defined as 500 sq.m or larger*

3.6. Summary

i. There are currently no full-line supermarkets within the main trade area. Reflecting this, existing supermarkets within the main trade area and surrounds (upon inspection) trade strongly, at levels above the Australian average of $10,000 - $11,000 per sq.m.

ii. Residents of the region should be provided with a wider range of food and grocery items within proximity to their homes, with the proposed development planned to include a full-line supermarket. Supermarkets within the main trade area are quite small by modern supermarket standards, with the nearest full-line supermarket to the subject site at Westfield Liverpool, more than 5 km away.

iii. The major supermarket chains target a population of 8,000 – 10,000 persons to support one full-line supermarket. The main trade area population at more than 24,500 persons could support almost three full-line supermarkets, and up to four by 2040/41.

4 Assessment of Potential

This section of the report considers the sales potential for the proposed George Cove Village as well as the likely trading and other impacts that can be anticipated following the construction of the proposed development.

4.1. Sales Overview and Methodology

i. To assess the potential economic benefits and impacts that may arise from the proposed Georges Cove Village, and the sales level which the development is projected to achieve are outlined.

ii. The sales performance of any retail facility, be it an individual store, a collection of stores provided in a shopping centre or precinct, is determined by a combination of the following critical factors:

- The composition and quality of the facility, including the major trader or traders; the specialty mix; centre layout and configuration; ease of accessibility and parking; and the overall feel of the centre.
- The size of the available catchment which the facility serves.
- The location and strength of competitive retail facilities.

iii. Assessing a proposed retail development fundamentally requires an understanding of a variety of factors and methodologies, including:

- Retail turnover;
- Market shares;
- Retail supply, demand, and impacts.

iv. Location IQ adopt an evidence-based model that has been tested and refined over more than 10 years and across a range of clients. The model uses all available data, including the Location IQ proprietary database of supermarket and shopping centre tenant size and sales figures.

v. Location IQ has undertaken more than 100 retail needs assessments/economic impact assessments in Australia over the last decade, adopting a similar methodology as presented in this report for the high-level overview of retail demand. A range of other property consulting firms also adopt the approach outlined by Location IQ.

vi. The sales potential for the retail component of the planned Georges Cove Village is now considered accounting for these factors.

4.2. Supermarket Sales Potential

i. Table 4.1 details the potential sales for the proposed full-line supermarket at the Georges Cove Village site. The calculations in this table go through a series of steps, commencing with the available expenditure that is of relevance to supermarkets, assessing the share of expenditure which all supermarkets are likely to achieve; and then concluding with the likely sales which main trade area supermarkets can expect to generate.

ii. Forecast sales are detailed for the proposed full-line supermarket of 3,809 sq.m, noting that supermarkets are defined as grocery and dry goods stores of at least 500 sq.m. Smaller foodstores less than 500 sq.m are excluded from this analysis, with these facilities typically offering a more convenience-based offer and as such do not act as direct competitors to larger full-line supermarkets.

iii. The assessment detailed in Table 4.1 is based on the experience of many comparable analyses in locations throughout Australia, as follows:

- The current retention of main trade area supermarket spending is estimated at 60.9% (i.e. Coles at Chipping Norton Market Plaza, Woolworths at Moorebank Shopping Village, and Big Fresh). This means some 39.1% or $41.5 million of supermarket spending is directed to supermarkets outside the main trade area.
- With the addition of a full-line supermarket at the subject site, the level of retained spending is projected to increase to 73.4% in 2025/26.
- Additionally, an estimated 15% of total supermarket sales are likely to be attracted from beyond the defined main trade area.

iv. The steps detailed above generate the annual estimates the expenditure available to supermarkets within the main trade area. On this basis, after the opening of the Georges Cove Village, this figure is projected at $97.0 million by 2025/26. This figure does not include retail inflation, thus the increase shown reflects real growth. By 2040/41, available supermarket spending within the main trade area is projected to increase to $127.2 million, expressed in constant 2023 dollar terms.

v. The existing supermarkets within the main trade area are estimated to currently record sales of around $13,452 per sq.m, which is also above the typical sales levels recorded by supermarkets throughout Australia.

vi. The Georges Cove Village supermarket is projected to achieve sales of $38.7 million in 2025/26, at an average of $10,157 per sq.m, as compared with the Australian average of $10,000 - $11,000 per sq.m. This shows strong demand for the proposed supermarket.

vii. Post the addition of the Georges Cove Village supermarket, the existing supermarkets in the main trade area are projected to achieve an average sales volume of around $10,302 per sq.m, in line with the national average. All supermarkets within the main trade area would still be viable, and by 2040/41 (allowing for population growth) are projected to achieve average sales of $13,516 per sq.m in combination by this time.

viii. Taking the above into account, there is clearly demand for an additional supermarket within the main trade area. The addition of a full-line supermarket at the subject site will provide a convenient supermarket offer that will allow residents to undertake a full weekly shop locally.

ix. The addition of the supermarket would also result in the retention of spending currently being directed to other large supermarket facilities at major shopping centres situated beyond the trade area, which can become quite congested during peak periods.

x. Projected impacts as a result of the proposed supermarket would likely fall upon a range of supermarkets in the surrounding area, both within and beyond the main trade area and are detailed subsequently in Section 4.4 of this report. The impacts would be spread across a number of supermarkets, which would mean the impact on any one supermarket would not detrimentally affect the performance of any stores.

TABLE 4.1. SUPERMARKET FORECAST SALES, FY2026

	Financial Year				
	2023	**2026**	**2031**	**2036**	**2041**
Spending to Smkts ($M)					
Primary Sectors					
• East	17.8	18.5	23.2	25.0	26.9
• West	88.4	93.8	111.0	116.1	121.8
Main Trade Area	**106.1**	**112.3**	**134.3**	**141.1**	**148.7**
Supermarket Spending Retained by TA Smkts					
Primary Sectors					
• East (@ 25% incr. to 40% in 25/26)	4.4	7.4	9.3	10.0	10.8
• West (@ 68.2% incr. to 80% in 25/26)	60.2	75.0	88.8	92.9	97.4
Main Trade Area	**64.7**	**82.4**	**98.1**	**102.9**	**108.1**
Supermarket Sales from Beyond TA (@ 15%)	11.4	14.5	17.3	18.2	19.1
Total Supermarket Sales for TA Smkts	**76.1**	**97.0**	**115.4**	**121.0**	**127.2**
Smkt Floorspace in TA (sq.m)**	5,657	9,466	9,466	9,466	9,466
Average Trading Level ($/sq.m)	13,452	10,244	12,190	12,785	13,441
Distribution of TA Smkt Sales					
Georges Cove Village Smkt	0.0	38.7	46.0	48.3	50.8
Other Main Trade Area Smkts**	76.1	58.3	69.4	72.8	76.5
Total TA Smkt Sales	**76.1**	**97.0**	**115.4**	**121.0**	**127.2**

**Constant 2022/23 dollars & including GST*

***Existing supermarket in TA as at July 2023*

4.3. Total Retail Sales Potential

i. Table 4.2 shows retail forecast sales for the proposed Georges Cove Village. Supermarket forecast sales were outlined previously, with retail specialty sales shown based on a provision of around 873 sq.m. The balance of planned retail and commercial floorspace at the centre is assumed to be made up of commercial and light industrial uses.

ii. Based on a review of Shopping Centre News – Mini Guns 2020 and Big Guns 2023, the closest reporting shopping centres currently achieve sales productivity levels (Moving Annual Turnover per sq.m) as follows:

- Westfield Liverpool: $8,332 per sq.m.
- Bass Hill Plaza: $9,078 per sq.m
- Bankstown Central: $6,229 per sq.m

iii. A productivity level of around $6,500 per sq.m is projected for the Georges Cove Village. At this level, total retail specialty forecast sales would be $5.7 million in 2025/26 (constant 2023 dollars).

iv. This is a realistic representation of the likely projected sales for the planned retail component assuming a full-line supermarket of 3,809 sq.m and retail specialty floorspace of 873 sq.m. As shown, total forecast sales are $44.4 million in 2025/26 (constant 2023 dollars), with the supermarket accounting for 87.2% of total sales.

v. The retail specialty offer planned at the proposed development will complement the supermarket in serving the convenience shopping needs of local residents and providing additional choice. The *Urbis Retail Averages (2021/22)* for single supermarket based shopping centres indicate retail specialty floorspace of 1,346 sq.m across 14 shops. The provision of retail specialty floorspace at the planned Georges Cove Village at 873 sq.m is 473 sq.m smaller than the benchmark level. As such, the retail component of the development will provide a destinational convenience offer only, rather than a full range offer.

TABLE 4.2. TOTAL CENTRE FORECAST SALES, 2025/26

Tenant/ Category	GLA (sq.m)	Forecast Sales 2025/26* ($'000)	Forecast Sales 2025/26* ($/sq.m)
Retail and Commerical Floorspace			
Supermarket	3,809	38,687	10,156
Retail Specialty Shops	873	5,672	6,500
Total Retail	**4,682**	**44,359**	**9,475**
Office/Industrial	4,903	n.a.	n.a.
Total Centre	**9,585**	**n.a.**	**n.a.**

**Constant 2022/23 dollars & including GST*

4.4. Impacts

i. This sub-section of the report outlines the likely sales impacts on competitive retail facilities because of the opening of the retail component of the proposed Georges Cove Village.

ii. It is important to note that impacts outlined in this report are indicative as it is difficult to precisely project the sales impact of the opening of a new store/centre on existing retail facilities. Several factors can influence the impact on individual centres/retailers, including but not limited to:

- Refurbishment/improvements to existing centres.
- Expansions to existing centres.
- Loyalty programs of existing retailers.
- The existing centre mix and how it competes with the proposed development.

iii. For all these reasons and other similar factors, sales impacts outlined in this report should be used as a broad indication.

iv. The following factors are typically considered when assessing the potential impacts of a new supermarket-based development on each existing facility or centre:

- The distance of the (impacted) centre, by road, from the proposed development.
- The size of the centre, in terms of total retail floorspace.
- The amount of supermarket floorspace, and brands of these supermarkets.
- The quality of offer and unique attributes including 24 hour trade etc.
- The role and function of the centre.
- Relative accessibility and convenience compared with the proposed retail development.
- The estimated performance of the centre (in current sales) and future performance (in the impact year), accounting for any future developments in the region that may also impact on the future sales of existing centres.
- The share of available expenditure which the centre attracts from the identified main trade area of the proposed development. A centre may not be situated in the identified main trade area of the proposed development, but its main trade area may extend to include parts, or all, of the main trade area. For example, the main trade area for large regional shopping centres typically includes circa 250,000 persons. Such a trade area is likely to include (partially or completely) trade areas for surrounding smaller convenience-based centres, sub-regional centres, retail strips and stand-alone supermarkets.

v. Table 4.3 outlines projected sales impacts from the proposed Georges Cove Village. The steps involved in assessing the sales and impacts on competitive centres are presented as follows:

- **Step 1**: Estimate sales levels for existing centres in the 2022/23 financial year.
- **Step 2:** Forecast sales are presented for existing and proposed developments in 2025/26, the first full year of trading for the proposed Georges Cove Village, allowing for other proposed developments, including the expansion of Westfield Liverpool. These projections also allow for retail market growth and are presented in constant 2023 dollars (i.e. excluding inflation).
- **Step 3**: Outline the change in sales at each centre in 2025/26 as a result of the opening of the proposed development.
- **Step 4:** Show the impact on sales in 2025/26, both in dollar terms and as a percentage of sales.

vi. Generally, retail trading impacts between -10% to -15% are considered by the industry to be high but acceptable, with impacts less than -10% considered relatively moderate, and impacts less than -5% generally considered minor/negligible. Other factors such as trading performance; expansions/refurbishments of centres; potential loss of services to the community; expected growth; and overall net community benefit should be considered.

vii. The key information outlined in Table 4.3 is summarised as follows:

- Overall, forecast sales for the retail component of the proposed Georges Cove Village development are $44.4 million 2025/26 (i.e. constant 2023-dollar terms).
- Of this total, $14.2 million is projected as result of a redirection of spending from competitive facilities within the main trade area in 2025/26, with $26.3 million being a reduction in spending from represented facilities beyond the main trade area.
- Around $3.7 million is likely to be made up of small impacts on a range of other retail facilities within and (primarily) beyond the main trade area that are not currently represented in this analysis.

Within the Main Trade Area

- The largest impact in dollar terms would be on Moorebank Shopping Centre, at some -$7.1 million or around -17.5%. Most of this impact is expected to fall on the Woolworths supermarket at the centre. Other retail facilities within Moorebank (primarily along Newbridge Road), including Big Fresh are projected to be impacted by some -$0.4 million or approximately -5%. These levels of impacts would not affect the viability of any retail facilities.
- The next highest impact (at around -$5.8 million) is expected to occur on Chipping Norton Market Plaza, with most of this impact to fall on the Coles supermarket at the centre. In percentage terms this equates to an impact of around -12.5%, within the normal competitive range. A small impact of -$0.4 million or some -5% is projected to occur on the Chipping Norton Shopping Village. Again, these impacts would not influence the viability of any of the retail facilities.
- An impact of around -$0.8 million (or -10%) is expected on Milperra Shopping Centre, anchored by a Friendly Grocer foodstore.

- Post the development of the proposed supermarket at the subject site, other supermarkets within the main trade area will remain viable and continue to trade at levels above the Australian average.

Beyond the Main Trade Area

- With no full-line supermarkets currently provided within the main trade area, the proposed full-line supermarket at the subject site would retain a significant proportion of expenditure that is currently escaping the area. It is currently estimated that more than -$1 in every -$4 of main trade area food and grocery spending is currently escaping the main trade area.

- The largest impact beyond the main trade area is projected to be on the Liverpool CBA, at a total of -$13.4 million, or some -1.7%. The various components of the CBA, including Westfield Liverpool (post development), Liverpool Plaza Shopping Centre and the balance or retail shopfront within the precinct are projected to be impacted by between -0.5% and -1% each.

- The next largest impact beyond the main trade area is likely to fall on Aldi at Bankstown Airport, at around -10% or some -$2.4 million dollars in 2025/26.

- Other major regional and sub-regional shopping centres throughout the area, including Bass Hill Plaza and Casula Mall are each projected to absorb impacts less than -$2 million each, or less than 1%.

- Less than $4 million (i.e. less that 10% of forecast sales) would be spread across a wider range of retail floorspace not outlined in Table 4.3.

viii. Overall, the proposed Georges Cove Village would not impact on the viability or continued operation of any existing in the surrounding region, with most of the impacts within the normal competitive range. The highest impacts are on strong trading, full-line supermarkets that would continue to trade area sales levels above the national benchmark.

ix. In addition, the proposed development would have less than 1,000 sq.m of retail specialty floorspace. Residents will continue to frequent other centres/shops in the surrounding area for a variety of tenants that are not likely to be provided as part of the proposed development.

x. In summary, most sales impacts across the identified centres are within an acceptable range, and when considered in the context of the size, performance and role and function of surrounding centres, would be highly unlikely to result in a material reduction of retail service provision. The proposed development would add to the range of services in the region.

TABLE 4.3. GEORGES COVE VILLAGE SUPERMARKET PROJECTED IMPACTS, 2026

	Unit	Estimated 2023	Projected 2026 Pre Dev.	Projected 2026 Post Dev.	Impact 2026 $M	Impact 2026 %
Moorebank Site	***$M***	***n.a.***	***n.a.***	***44.4***	***n.a.***	***n.a.***
Regional Centres						
Liverpool CBA	$M	691.3	768.6	755.2	-13.4	-1.7%
• Westfield Liverpool	$M	552.0	620.8	608.4	-12.4	-2.0%
• Liverpool Plaza SC	$M	49.3	52.3	51.8	-0.5	-1.0%
• Other	$M	90.0	95.5	95.0	-0.5	-0.5%
Sub-regional Shopping Centres						
Bass Hill Plaza	$M	151.0	160.2	158.6	-1.6	-1.0%
Casula Mall	$M	193.0	204.8	203.8	-1.0	-0.5%
Supermarket Based Shopping Centres						
Moorebank	$M	45.2	48.2	40.7	-7.5	-15.5%
• Moorebank SC	$M	38.0	40.5	33.4	-7.1	-17.5%
• Other	$M	7.2	7.7	7.3	-0.4	-5.0%
Bankstown Airport	$M	22.3	23.7	21.3	-2.4	-10.0%
Chipping Norton	$M	50.7	54.0	47.8	-6.2	-11.5%
• Chipping Norton Market Plaza	$M	43.7	46.5	40.7	-5.8	-12.5%
• Chipping Norton Shopping Village	$M	7.0	7.5	7.1	-0.4	-5.0%
Milperra SC	$M	7.2	7.5	6.8	-0.8	-10.0%
Georges Hall	$M	11.0	11.7	11.3	-0.3	-3.0%
Hammondville	$M	5.5	5.8	5.7	-0.1	-2.5%
Wattle Grove Shopping Village	$M	45.3	48.0	45.6	-2.4	-5.0%
Flowerdale SC	$M	19.0	20.2	19.2	-1.0	-5.0%
Revesby	$M	172.5	183.0	179.1	-4.0	-2.2%
• Revesby Village Centre	$M	57.5	61.0	58.9	-2.1	-3.5%
• Other	$M	115.0	122.0	120.2	-1.8	-1.5%
Total Impacts					**-40.7**	

**Constant 2022/23 dollars & including GST*

[1] Proposed centres and expansions assumed to be trading for a full year by FY2021

4.5. Employment and Consumer Impacts

i. The development of the proposed Georges Cove Village site would result in a range of important economic benefits which will be of direct benefit to the local community. These key positive employment and consumer impacts include:

- The provision of a wider range of food and grocery shopping facilities (including a full-line supermarket), which would increase convenience and price competition for residents.
- Improved customer amenity, design and aesthetic for the local residents by way of a new and modern development.
- Better integration with the surrounding arterial traffic routes such as Newbridge Road.

Ongoing Employment Generation

- The retail component of the development is projected to employ 243 persons as summarised in Table 4.4. Taking a conservative view and allowing for an estimated 10% of the total increase to be because of reduced employment at existing retail facilities, net additional jobs are estimated at 219. An additional 123 jobs are estimated to be generated by the commercial uses as part of the Georges Cove Village.
- The additional 219 permanent retail employees would earn an average annual wage of around $64,982.40 (assuming 48 working weeks), based on employee earnings data for the retail trade industry released by the ABS in November 2022. This represents an additional $14.2 million in salary/wages for the local economy, as a direct result of the retail component of the proposed development.

Construction

- Construction of the proposed Georges Cove Village is estimated to incur total capital costs around $40 million, generating significant employment within the construction and associated industries during the development of the project.
- By using the appropriate ABS Input/Output Multipliers that were last proposed in 1996/97 and a deflated estimated total capital cost of construction of $18.0 million (i.e., in 1996/97 dollars), it is estimated that the construction period of the proposed retail and non-retail component would directly generate some 126 full-time, part-time, and temporary jobs (refer Table 4.5).

Multiplier Effect

- Overall, it is estimated that the retail and non-retail component of the proposed development will directly generate 470 jobs (refer Table 4.6) including:

– **Ongoing Employment from Planned Floorspace**: 344 jobs

– **Construction Phase:** 126 jobs

- In addition to this direct employment, multiplier effects will flow through the local economy and indirectly generate additional employment opportunities through ancillary businesses/suppliers that support the

development and services, as well as additional consumption expenditure by workers employed within the precinct (spending wages).

- Again, by using the appropriate ABS Input/Output Multipliers that were last produced in 1996/97 and adjusting for inflationary and other changes to present, it is estimated that an additional 529 jobs will be created indirectly.

ii. Overall, some 999 jobs are likely to be created both directly and indirectly as a result of the subject development.

TABLE 4.4. NET ADDITIONAL PERMANENT EMPLOYMENT

Component	Total Floorspace (sq.m)	Employment Potential		
		Employm. per 1,000 sq.m	Indic. Total Jobs	Net Increase[1]
Retail				
Supermarket	3,809	50.0	190	171
Retail Specialty Shops	873	60.0	52	47
Total Retail	**4,682**		**243**	**219**
Commercial				
Offices	1,253	50.0	63	56
Light Industrial	3,859	20.0	77	69
Total Commercial	**5,112**		**140**	**126**
Total	**9,794**		**383**	**344**

1. Indicates the estimated number of net additional ongoing jobs as a result of the proposed development
Source : Australian National Accounts: Input-Output Tables 1996-97

TABLE 4.5. ESTIMATED CONSTRUCTION COST

Metric	Retail Floorspace	Commercial & Other Floorspace	Total
Estimated Capital Costs of Construction			
Estimated Capital Costs 2022/23 ($M)*	$30.0	$10.0	$40.0
Estimated Capital Costs 1996/97 ($M)	$13.49	$4.5	$18.0
Direct Employment Generation			
Construction Jobs per $1 million (2021/22)	3.15	3.15	3.15
Total Construction Jobs[1]	**94**	**31**	**126**

Source : Australian National Accounts: Input-Output Tables 1996-97
Employment totals include both full-time and part-time work. Indicates the estimated number of jobs over the life of the construction project plus ongoing multiplier effects, for the equivalent of one year

TABLE 4.6. EMPLOYMENT SUMMARY

Metric / Category	Est. Net Employment Increase[1]	Employment Multiplier Effects	Total Employment
Ongoing Employment from Planned Floorspace			
Retail	219	207	426
Commercial	126	119	245
Total	**344**	**327**	**671**
Construction Phase			
Direct Employment Generation	126	202	328
Net Additional Employment	**470**	**529**	**999**

1. Net increase includes an allowance for reduced employment levels at impacted centres estimated at 10% of the total increase

5 Needs Analysis

The final section of this report summarises the key conclusions of the impact analysis for the proposed Georges Cove Village.

'Need' or 'Community Need' in a planning sense is a relative concept that relates to the overall wellbeing of a community. A use is needed, for example, if it would, on balance, improve the services and facilities available in a locality. The reasonable demands and expectations of a community are important, therefore, in assessing need.

Several important factors that relate to need, and particularly economic need, include:

- Population and supermarket demand.
- Consumer trends.
- Location.
- Impacts on existing retail facilities.
- Impacts on retail hierarchy.
- Net community benefits.

5.1. Population and Supermarket Demand

i. The main trade area population is currently 24,712 and is projected to increase to 31,812 persons by 2041, representing strong average annual growth of 1.4%.

ii. In Australia, one major full-line supermarket is typically supportable for every 8,000 – 10,000 persons. On this basis, the main trade population could currently support up to three full-line supermarkets, with none currently provided. Overs the period to 2041, with population growth, the main trade could support an additional full-line supermarket, or up to four in total.

iii. It should be noted that the supermarkets within the main trade area are typically smaller in size and would provide a limited offer compared to a major full-line supermarket. In addition, Big Fresh Moorebank provides a niche/boutique fresh food offer that would have a wider draw than a typical supermarket.

iv. This simple analysis highlights the need for an additional full-line supermarket to serve the daily and weekly needs of surrounding residents. The proposed development would therefore result in an increased level of facilities and services available to the local community.

v. Based on inspection and industry information, all full-line supermarkets in the surrounding area are understood to trade strongly, highlighting the under supply of floorspace. Trading levels will increase in the future with population growth.

5.2. Consumer Trends

i. Retail facilities in Australia, such as the proposed development, play fundamental roles in the economies of metropolitan areas, having developed around the need to meet consumer demand. The nature of consumer demand continues to develop and evolve, reflecting social changes within society, such as:

- Increasing time pressures on working families.
- Population and income growth.
- The evolution of new retail formats and traders.
- Competitive retail developments and precincts.

ii. The demands of retailers, as well as consumers, combine to add pressure for additional retail floorspace in existing retail precincts.

iii. There is a strong need for supermarket facilities within close proximity to the homes of main trade area residents, with consumers visiting supermarkets two to three times a week on average.

iv. Over the past decade, there has been an increasing trend towards convenience shopping. This trend has been largely driven by broader social trends that have resulted in consumers becoming more time poor, such as longer working hours and an increase in the number of women in the labour force.

v. Time pressures are ranked at the top of the list of issues that consumers face when undertaking their regular food and grocery shopping. As a result, there is growing demand for convenience shopping facilities to meet the needs of local residents.

vi. The design of proposed development, including an easily accessible provision of car parking and arterial location, would be highly convenient for local families who would visit on a regular basis. The site is on the left hand side for home bound traffic and is to the south of a larger employment area.

5.3. Location

i. The proposed development enjoys a high-profile location along Newbridge Road in Moorebank. Newbridge Road is a major east-west arterial route through the region, connecting Liverpool with a range of suburbs throughout the south-west and inner-west.

ii. Based on a review of the most recent traffic counts provided by the Roads and Maritime Services New South Wales, 40,006 vehicles travel along Newbridge Street (west of Henry Lawson Drive) on an average weekday, this equates to an annual traffic volume of some 14.1 million vehicles.

iii. The subject is also served by the M90 bus route which runs between Liverpool Station and Westfield Burwood.

iv. The planned development is a plan for now and the future. Retail planning is typically lumpy in nature given the large size and cost involved in construction. The proposed site would offer a high level of convenience and limited retail specialty floorspace.

v. There is a large and growing population around the site, and limited retail floorspace.

5.4. Impact on Existing Retailers

i. The retail component of the Georges Cove Village would not impact on the viability or continued operation of any existing or proposed retail centre within the main trade area or the surrounding region. The Georges Cove Village development is projected to record retail sales of $44.4 million in 2025/26.

ii. The largest impact within the main trade area would be on Moorebank Shopping Village, at some -$7.1 million or around -17.5%. Most of this impact is expected to fall on the Woolworths supermarket at the centre. Other retail facilities within Moorebank (primarily along Newbridge Road) including Big Fresh are projected to be impacted by some -$0.4 million or approximately -5%.

iii. The next highest impact within the main trade area is projected to fall on Chipping Norton Market Plaza, at around -$5.8 million or some -12.5%. Again, most of this impact would fall on the Coles supermarket at the centre. These levels of impact would not affect the viability of any retail facilities.

iv. With no full-line supermarkets currently provided within the main trade area, the proposed full-line supermarket at the subject site would retain a significant proportion of expenditure that is currently escaping the area. The largest impact beyond the main trade area is projected to be on the Liverpool CBA, at a total of -$13.4 million, or some -1.7%.

v. Overall, the proposed development would not impact on the viability or continued operation of any existing or proposed centre within the main trade area or the surrounding region.

5.5. Impacts on Retail Hierarchy

i. Beyond the main trade area, the Liverpool CBA represents the major food and non-food retail destination within the region. As a regional centre, the Liverpool CBA serves a different role in the retail hierarchy than the proposed Georges Cove Village development, which would be a convenience-based retail offer for the local population.

ii. Post the development of Georges Cove Village, Liverpool would continue to act as the major retail destination, particularly for non-food retail. Westfield Liverpool is also proposed for a major expansion that would reinforce this regional centre as a major precinct with a wide regional draw.

iii. The *Urbis Retail Averages (2021/22)* for single supermarket based shopping centres indicate retail specialty floorspace of 1,346 sq.m across 14 shops. The provision of retail specialty floorspace at the planned Georges Cove Village at 873 sq.m is 473 sq.m smaller than the benchmark level. As such, the retail component of the development will provide a destinational convenience offer only, rather than a full range offer.

iv. The proposal would not provide a significant number of specialty shops and, as such, residents will continue to frequent other centres/shops in the surrounding area and the projected impacts on these businesses, that would not compete directly with a supermarket, would be limited.

v. Further, the proposed development will provide residents with a full-line supermarket alternative that is not currently offered within the main trade area. This will create additional choice and competition for convenience-based retail, within the region.

vi. Increased competition between supermarkets is beneficial to consumers and will not adversely affect the balance of the centre hierarchy. The analysis of impacts provided in the previous section of this report shows that projected impacts on other retailers throughout the area from the proposed development would not threaten the viability or continued operation of any centre/precinct.

vii. Overall, the proposed Georges Cove Village would not impact on the viability or continued operation of any existing in the surrounding region, with most of the impacts within the normal competitive range. The highest impacts are on strong trading, full-line supermarkets that would continue to trade area sales levels above the national benchmark.

viii. In summary, most sales impacts across the identified centres are within an acceptable range, and when considered in the context of the size, performance and role and function of surrounding centres, would be highly unlikely to result in a material reduction of retail service provision. The proposed development would add to the range of services in the region.

5.6. Net Community Benefits

i. It is the conclusion of this report that a substantial net community benefit would result from the proposed Georges Cove Village. Offsetting the trading impacts on some existing retailers, there are very substantial positive impacts including the following:

- Significant improvement in the range of retail facilities that would be available to residents, particularly in terms of convenient supermarket retailing.
- The proposed supermarket would improve choice of location and allow for price competition. The inclusion of a full-line supermarket would represent the only such offer within the defined main trade area.
- The addition of a supermarket at the subject site would also result in the retention of spending currently being directed to other large supermarket facilities at major shopping centres situated beyond the trade area, thereby reducing the need for local residents to travel further afield for their supermarket and convenience-based shopping needs.
- The retail offer will enable the development to serve the growing population and the associated demand for additional retail floorspace.
- The creation of additional employment which would result from the project, both during the construction period, and more importantly, on an ongoing basis once the development is complete and operational. In total, some 999 jobs are likely to be created both directly and indirectly as a result of the retail component of the proposed Georges Cove Village. This includes a number of youth employment opportunities with retail developments generally employing a large number of younger staff.

ii. It is concluded that the combination of the substantial positive economic impacts serve to more than offset the trading impacts that could be anticipated for a small number of existing retail stores, particularly supermarkets, in the region. Further, the impacts would not threaten the viability of any retail facilities.

LocationIQ

Contact Us
(02) 8248 0100
Level 27 | 25 Martin Place
Sydney NSW 2000
locationiq.com.au





