Bell Quarry Rehabilitation Project

Volume 2 - Appendix A to C

August 2018

Appendix A

SEARs

Industry Assessments
Contact: Patrick Copas
Phone: (02) 9274 6273
Email: patrick.copas@planning.nsw.gov.au

Mr Karl Rosen
GHD
Level 15, 133 Castlereagh Street
SYDNEY NSW 2000

16/13848
SEAR 1105

Dear Mr Rosen

Waste Management Facility
Bell Quarry, Sandham Road, Newnes Junction (Part Lot 23 in DP 751631)
Secretary's Environmental Assessment Requirements (SEAR) 1105

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.

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 *Water Management Act 2000*.

In preparing the SEARs, the Department has consulted with Water NSW, the Environment Protection Authority and the Department of Primary Industries. A copy of their requirements for the EIS are attached. The Department has also consulted with the Office of Environment and Heritage (OEH). Unfortunately, OEH was unable to respond in time, and you are required to consult with them directly in relation to further requirements for the EIS.

The Department has also consulted with the Roads and Maritime Services as required by Schedule 3 of *State Environmental Planning Policy (Infrastructure) 2007* and attaches its requirements for the EIS.

If other integrated approvals are identified before the Development Application (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, please contact Patrick Copas, Planning Services, at the Department on (02) 9274 6273.

Yours sincerely

C. Ritchie
18/11/16.

Chris Ritchie
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	1105
Proposal	Rehabilitation of the former Bell Quarry through the importation of approximately 1.5 million tonnes of VENM, ENM and other clean fill, with a vehicle haulage rate of up to 140,000 tonnes per annum.
Location	Bell Quarry, Sandham Road, Newnes Junction (part Lot 23 in DP 751631).
Applicant	Bell Quarry Rehabilitation Project 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. • **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 how the proposal would meet the EPAs Excavated Natural Material Order and Exemption 2014 if relevant; - 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*. • **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. • **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. • **soil and water** – including: – a description of local soils, topography, drainage and landscapes; – an assessment of potential impacts on the quality and quantity of surface and groundwater resources; – details of fill material to be imported to the site, including quantity and its waste classification; – details of sediment and erosion controls; – a detailed site water balance; – details of the proposed stormwater and wastewater management systems (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts; and – a description and appraisal of impact 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. • **biodiversity** – including: – accurate predictions of any vegetation clearing on site or for any road upgrades; – a detailed 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. • **visual** – including an impact assessment at private receptors and public vantage points. • **heritage** – including Aboriginal and non-Aboriginal cultural heritage.
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 (Mining, Petroleum Production and Extractive Industries) 2007;* • *State Environmental Planning Policy No. 33 Hazardous and Offensive Development*; • *State Environmental Planning Policy No. 55 Remediation of Land*; • *Lithgow Local Environmental Plan 2014*; 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; • Water NSW; • NSW National Parks and Wildlife Services;

	• Lithgow City Council; • holder of Mining Lease 1654 and Mineral Exploration Licence 7674 (Kaolin Pty Ltd); • holder of Coal Authorisation 307 (Hartley Vale Coal Pty Ltd); • holder of Mining Lease 1583 (Coalex Pty Ltd); 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.

Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Notice Number	1546196
File Number	DOC16/536449-01
Date	08-Nov-2016

Dear Mr Copas

Rehabilitation of former Bell Quarry, Sandham Road, Newnes Junction (SEAR 1105)
Secretary Environmental Assessment Requirements

I refer to your e-mail to the Environment Protection Authority (EPA), dated 24 October 2016, seeking Secretary Environmental Assessment Requirements (SEARs) for an Environmental Impact Statement (EIS) for the proposed rehabilitation of the former Bell Quarry located at Sandham Road Newnes Junction.

The EPA notes that the FORM A Request for Secretary's Requirements attached with the Preliminary Environmental Assessment did 'not' mark the relevant box acknowledging that the project may need approval i.e., licensing under the '*Protection of the Environment Operations Act 1997* (the POEO Act)'. In addition, dot point 1 of Section 3.1 Overview, states that "*where the material is not VENM it would meet the requirements of Part 9 of the POEO (Waste) Regulation 2014 and not be subject to either licensing or the waste levy under the POEO Act*". It therefore appears that proponent does not consider the activity to be a Scheduled Activity and as such will not require an Environment Protection Licence (EPL).

Further, the EPA notes that the activity proposes to "rehabilitate" the site through the importation of virgin excavated natural material (VENM), excavated natural material (ENM), and other clean fill material sourced from major infrastructure projects across Sydney and the local regional area. On this matter, the EPA requires clarification on the material to be classified as "other" and the relevant exemptions to be applied in the proposed context.

While the proposed activity may not be Scheduled Activity and not requiring licensing with the EPA, SEARs are provided below. The EPA will however review the EIS to determine that the activity is not Scheduled Activity and that environmental impacts have been identified and adequately addressed.

The EPA has reviewed the document titled "*Bell Quarry Rehabilitation - Preliminary Environmental Assessment*", October 2016, prepared by GHD and has identified the information that it requires to adequately assess the proposal in Attachment 1.

General Guidance material is provided in Attachment 2. In summary, the EPA's key information requirements for the proposal include an adequate assessment of:

- water and soil management
- air quality impacts;
- waste and resource recovery, and
- noise impacts

Should you have any queries in relation to this matter please contact Mr Nino Di Falco at the Central West (Bathurst) Office of the EPA by telephoning (02) 6332 7609.

Yours sincerely

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DARRYL CLIFT
Head Central West Unit
Environment Protection Authority
(by Delegation)

Enclosures: Attachment 1 - EPA requirements for Rehabilitation of former Bell Quarry
Attachment 2 - General guidance material

NSW EPA

ATTACHMENT 1: EPA REQUIREMENTS FOR REHABILITATION OF FORMER BELL QUARRY

1. Environmental impacts of the project

Environmental Impact Statements (EIS) should address the specific requirements outlined under each heading below and assess impacts in accordance with the relevant guidelines mentioned. A full list of guidelines is provided in **Attachment 2**.

2. Water and soils

2.1 Soils

The EIS should include:

1. An assessment of potential impacts on soil and land resources should be undertaken, being guided by *Soil and Landscape Issues in Environmental Impact Assessment* (DLWC 2000). The nature and extent of any significant impacts should be identified. Particular attention should be given to:

   a. Soil erosion and sediment transport - in accordance with *Managing urban stormwater: soils and construction,* vol. 1 (Landcom 2004) and vol. 2 (A. Installation of services; B. Waste landfills; C. Unsealed roads; D. Main Roads; E. Mines and quarries) (DECC 2008).
   b. Mass movement (landslides) – in accordance with *Landslide risk management* guidelines presented in Australian Geomechanics Society (2007).
   c. Urban and regional salinity – guidance given in the Local Government Salinity Initiative booklets which includes *Site Investigations for Urban Salinity* (DLWC, 2002).

2. A description of the mitigation and management options that will be used to prevent, control, abate or minimise identified soil and land resource impacts associated with the project, in particular soil and surface water management procedures in order to protect downstream rivers and creeks from any impacts resulting from quarry operations. . This should include an assessment of the effectiveness and reliability f the measures and any residual impacts after these measures are implemented.

2.2 Water management

The EIS should:

1. Describe water usage for the proposal including the position of any intakes and discharges, volumes, water quality and frequency of all water discharges.

2. Demonstrate that all practical options to avoid discharge have been implemented and environmental impact minimised where discharge is necessary.

3. Where relevant include a water balance for the development including water requirements (quantity, quality and source(s)) and proposed storm and wastewater disposal, including type, volumes, proposed treatment and management methods and re-use options.

4. Describe existing surface and groundwater quality. An assessment needs to be undertaken for any water resource likely to be affected by the proposal.

5. State the Water Quality Objectives for the receiving waters relevant to the proposal. These refer to the community's agreed environmental values and human uses endorsed by the NSW Government as goals for ambient waters (http://www.environment.nsw.gov.au/ieo/index.htm). Where groundwater may be impacted the assessment should identify appropriate groundwater environmental values.

6. State the indicators and associated trigger values or criteria for the identified environmental values. This information should be sourced from the ANZECC (2000) Guidelines for Fresh and Marine Water Quality(http://www.environment.gov.au/water/quality/publications/australian-and-new-zealandguidelines-fresh-marine-water-quality-volume-1).

7. State any locally specific objectives, criteria or targets which have been endorsed by the NSW Government.

8. Describe the nature and degree of impact that any proposed discharges will have on the receiving environment.

9. Assess impacts against the relevant ambient water quality outcomes. Demonstrate how the proposal will be designed and operated to:

    a. protect the Water Quality Objectives for receiving waters where they are currently being achieved; and

    b.contribute towards achievement of the Water Quality Objectives over time where they are not currently being achieved.

10. Where a discharge is proposed that includes a mixing zone, the proposal should demonstrate how wastewater discharged to waterways will ensure the ANZECC (2000) water quality criteria for relevant chemical and non-chemical parameters are met at the edge of the initial mixing zone of the discharge, and that any impacts in the initial mixing zone are demonstrated to be reversible.

11. Describe how stormwater will be managed both during and after construction.

12. Describe how predicted impacts will be monitored and assessed over time.

3. Air issues

The EIS should include a detailed air quality impact assessment (AQIA). The AQIA should:

1. Identify all potential discharges of fugitive and point source emissions of pollutants including dust for all stages of the proposal and assess the risk associated with those emissions. All processes that could result in air emissions must be identified and described. Sufficient detail to accurately communicate the characteristics and quantity of all emissions must be provided. Assessment of risk relates to environmental harm, risk to human heath and amenity.

2. Justify the level of assessment undertaken on the basis of risk factors, including but not limited to:

    a. proposal location;
    b. characteristics of the receiving environment; and
    c. type and quantity of pollutants emitted.

3. Describe the receiving environment in detail. The proposal must be contextualised within the receiving environment (local, regional and inter-regional as appropriate). The description must include but need not be limited to:

    a. meteorology and climate;
    b. topography;
    c. surrounding land-use; receptors; and
    d. ambient air quality.

4. Include a consideration of 'worst case' emission scenarios and impacts at proposed emission limits.

5. Account for cumulative impacts associated with existing emission sources as well as any currently approved developments linked to the receiving environment.

6. Include air dispersion modelling where there is a risk of adverse air quality impacts, or where there is sufficient uncertainty to warrant a rigorous numerical impact assessment. Air dispersion modelling must be conducted in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (2005) http://www.environment.nsw.gov.au/resources/air/ammodelling05361.pdf.

Demonstrate the proposal's ability to comply with the relevant regulatory framework, specifically the *Protection of the Environment Operations (POEO) Act (1997)* and the *POEO (Clean Air) Regulation (2010)*.

Detail emission control techniques/practices that will be employed by the proposal.

4. Waste and Resource Recovery

The EIS should specify the following:

1. The source of the VENM and ENM that is proposed to be transported to the facility and note that ENM can only be applied to land as engineering fill or for use in earthworks.

2. Specify what "other clean fill material" that is proposed to be imported to the site and why this material would not be classified as waste or specify which Resource Recovery Exemption will be used to permit its use as quarry rehabilitation.

3. Demonstrate why this activity is not considered a waste disposal activity as defined in the POEO Act Schedule 1. and therefore a scheduled activity requiring an environment protection licence.

4. Identify options and strategies for waste minimisation; reuse and recycling across all activities and processes during both construction and operational stages and appropriate avoidance, recycling, reuse and disposal options.

5. Any options or strategies must be in line with current NSW Government legislation/policy/guidance on waste minimisation etc.

5. Noise and vibration

In relation to noise, the following matters should be addressed (where relevant) as part of the Environmental Assessment.

1. Construction noise associated with the proposed development should be assessed using the *Interim Construction Noise Guideline (*DECC, 2009). http://www.epa.nsw.gov.au/resources/noise/09265cng.pdf.

2. Operational noise from all industrial activities (including private haul roads and private railway lines) to be undertaken on the premises should be assessed using the guidelines contained in the *NSW Industrial Noise Policy* (EPA, 2000) and *Industrial Noise Policy Application Notes.* http://www.epa.nsw.gov.au/noise/applicnotesindustnoise.htm

Noise on public roads from increased road traffic generated by land use developments should be assessed using the guidelines contained in the *NSW Road Noise Policy* (DECCW, 2011). http://www.epa.nsw.gov.au/resources/noise/2011236nswroadnoisepolicy.pdf

Noise from new or upgraded public roads should be assessed using the *NSW Road Noise Policy* (DECCW, 2011). http://www.epa.nsw.gov.au/resources/noise/2011236nswroadnoisepolicy.pdf.

NSW EPA

ATTACHMENT 2: GENERAL GUIDANCE MATERIAL

Title	Web address
Relevant Legislation	
Contaminated Land Management Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+140+1997+cd+0+N
Environmentally Hazardous Chemicals Act 1985	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+14+1985+cd+0+N
Environmental Planning and Assessment Act 1979	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+203+1979+cd+0+N
Protection of the Environment Operations Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+156+1997+cd+0+N
Licensing	
EPA Guide to Licensing	http://www.epa.nsw.gov.au/licensing/licenceguide.htm
Air Issues	
Air Quality	
Approved methods for modelling and assessment of air pollutants in NSW (2005)	http://www.environment.nsw.gov.au/resources/air/ammodelling05361.pdf
POEO (Clean Air) Regulation 2002	http://www.legislation.nsw.gov.au/maintop/view/inforce/subordleg+642+2002+cd+0+N
Noise and Vibration	
Interim Construction Noise Guideline (DECC, 2009)	http://www.epa.nsw.gov.au/resources/noise/09265cng.pdf
Assessing Vibration: a technical guideline (DEC, 2006)	http://www.epa.nsw.gov.au/resources/noise/vibrationguide0643.pdf
Australian and New Zealand Environment Council – Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC, 1990)	http://www.epa.nsw.gov.au/resources/noise/ANZECBlasting.pdf
Industrial Noise Policy Application Notes	http://www.epa.nsw.gov.au/noise/applicnotesindustnoise.htm
NSW Road Noise Policy (DECCW, 2011)	http://www.epa.nsw.gov.au/resources/noise/2011236nswroadnoisepolicy.pdf
Rail Infrastructure Noise Guidelines (EPA, 2013)	http://www.epa.nsw.gov.au/resources/noise/20130018eparing.pdf

Environmental assessment requirements for rail traffic-generating developments	http://www.planning.nsw.gov.au/planningsystem/pdf/guide_infra_devtrailroadcorridors_interim.pdf
Waste, Chemicals and Hazardous Materials and Radiation	
Waste	
Environmental Guidelines: Solid Waste Landfills (EPA, 1996)	http://www.environment.nsw.gov.au/resources/waste/envguidlns/solidlandfill.pdf
Draft Environmental Guidelines - Industrial Waste Landfilling (April 1998)	http://www.environment.nsw.gov.au/resources/waste/envguidlns/industrialfill.pdf
Waste Classification Guidelines (EPA, 2014)	http://www.epa.nsw.gov.au/wasteregulation/classify-guidelines.htm
EPA Resource recovery exemptions	http://www.epa.nsw.gov.au/wasteregulation/recoveryexemptions.htm
Water and Soils	
Soils – general	
Soil and Landscape Issues in Environmental Impact Assessment (DLWC 2000)	Available for purchase at - http://www.shop.nsw.gov.au/pubdetails.jsp?publication=839
Managing urban stormwater: soils and construction, vol. 1 (Landcom 2004) and vol. 2 (A. Installation of services; B Waste landfills; C. Unsealed roads; D. Main Roads; E. Mines and quarries) (DECC 2008)	Vol 1 – http://www.environment.nsw.gov.au/resources/water/BlueBookVol1.pdf Vol 2 -http://www.environment.nsw.gov.au/resources/stormwater/08208soilsconststorm2e.pdf
Landslide risk management guidelines	http://www.australiangeomechanics.org/resources/downloads/
Site Investigations for Urban Salinity (DLWC, 2002)	http://www.environment.nsw.gov.au/resources/salinity/booklet3siteinvestigationsforurbansalinity.pdf
Local Government Salinity Initiative Booklets	http://www.environment.nsw.gov.au/salinity/solutions/urban.htm
Water	
Water Quality Objectives	http://www.environment.nsw.gov.au/ieo/index.htm
ANZECC (2000) Guidelines for Fresh and Marine Water Quality	http://www.environment.gov.au/water/quality/publications/australian-and-new-zealand-guidelines-fresh-marine-water-quality-volume-1
Applying Goals for Ambient Water Quality Guidance for Operations Officers – Mixing Zones	http://deccnet/water/resources/AWQGuidance7.pdf
Approved Methods for the Sampling and Analysis of Water Pollutant in NSW (2004)	http://www.environment.nsw.gov.au/resources/legislation/approvedmethods-water.pdf

28 October 2016

SF2016/234040; WST16/00165

The Manager
Industry Assessments
Department of Planning & Environment
GPO Box 39
SYDNEY NSW 2001

Attention: Mr Patrick Copas

Dear Mr Copas

SEAR ID 1105: Lot 23 DP 751631; Sandham Road, Newnes Junction;
Rehabilitation of former Bell Quarry;
Request for input into Secretary's Environmental Assessment Requirements (SEARs)

Thank you for your email on 24 October 2016 requesting input into SEARs from Roads and Maritime Services for the above-mentioned development proposal.

Roads and Maritime has reviewed the submitted documentation and has identified the following key issues to be addressed in the Environmental Impact Statement being prepared in support of the project:

- A traffic impact study prepared in accordance with the methodology set out in Section 2 of the *RTA's Guide to Traffic Generating Developments 2002* and including:
  - Road transport volumes and vehicle types broken down into:
    - origin and destination.
    - travel routes.
    - peak hours.

- The study is to provide details of projected transport operations including:
    - traffic volumes, both proposed and cumulative.
    - materials to be transported and vehicle types used for transport.
    - physical constraints, risks and hazards on the haulage route(s).
    - measures to be employed to ensure a high level of safety for all road users interacting with construction and haulage traffic.
- Any over size and over mass vehicles and loads expected for the project.
- Staff numbers (including employees and contractors) and staff parking arrangements for the duration of the project.
- Measures to be employed to ensure traffic efficiency and safety on the public road network are maintained for the duration of the project. This includes an assessment of the cumulative impacts of existing and proposed quarry rehabilitation related traffic and existing background traffic at the intersection of Sandham Road and Bells Line of Road (MR184) and the intersection of Bells Line of Road and Darling Causeway.
- Local climate conditions that may affect road safety during construction and operation of the project (e.g. fog, wet weather, etc) and appropriate measures to mitigate the impacts of such conditions.

- Details of vehicular access, location and treatment(s) servicing the proposed quarry operations. Vehicular access treatments are to be identified and in accordance with *Austroads Guide to Road Design*, including Safe Intersection Sight Distance (SISD).

Roads and Maritime appreciates the opportunity to contribute to the SEARs and requests that a copy of the SEARs be forwarded to Roads and Maritime at the same time they are sent to the applicant. If you require further information please contact the undersigned on 02 6861 1453.

Yours faithfully

Andrew McIntyre
Manager Land Use Assessment
Western

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 1105
Our ref: V16/7030#2

Via email: patrick.copas@planning.nsw.gov.au

Department of Planning & Environment
Industry Assessments
GPO Box 39
SYDNEY NSW 2001

Attention: Partick Copas

Dear Mr Copas,

Request for Secretary's Environmental Assessment Requirements – SEAR 1105 – Rehabilitation of former Bell Quarry – Sandham Road Newnes Junction (Part Lot 23 DP 751631)

Thank you for your email of 24 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
7 November, 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

NSW GOVERNMENT | Department of Industry
Resources & Energy

7th November 2016

Patrick Copas
Student Planner – Industry Assessments
Department of Planning & Environment
GPO Box 39
Sydney NSW 2001

Your Reference: EARs ID No.1105
Our Reference: OUT16/41967

Emailed: patrick.copas@planning.nsw.gov.au

Dear Mr Copas

Re: Request for Secretary's Environmental Assessment Requirements - Rehabilitation of former Bell Quarry, Newnes Junction - SEARs ID No. 1105

I refer to your letter of 24th October 2016 requesting advice on issues concerning the preparation of Secretary's Environmental Assessment Requirements for the above project. Thank you for the opportunity to provide advice on the above matter. This is a response from the NSW Department of Industry – Geological Survey of NSW (GSNSW). The Department of Primary Industries (incorporating advice from Agriculture and Fisheries) and the Forestry Corporation of NSW may respond separately.

Mineral Resources Requirements

Identification and assessment of impacts on other land users is required as a critical component of the Environmental Assessment (EA) process. Specifically, the EA must consider the potential for the project to impact upon any significant mineral resources, including metallic minerals, industrial and extractive minerals, petroleum, gas and coal resources. A significant aspect of mineral resource evaluation and development in regards to land use planning is that the locations of mineable deposits cannot always be predicted. This makes it imperative that known resources are protected from sterilisation by inappropriate zoning or development, and that access to land for mineral exploration should be maintained over as much of the project area as possible.

As such, the GSNSW requires the proponent to conduct an assessment as part of the EA, regarding the potential impacts of the project on any significant mineral resources, including:

- **Any operating mines, extractive industries or known mineral or petroleum resources.**
- **Exploration activities in the vicinity of the proposed development.**
- **Access for future exploration in the area.**

General Information

Please note that identification of the following title holders is to make the consent authority aware that there are other stakeholders with interests in the region.

Mining Lease (ML) 1654 held by Newnes Kaolin Pty Ltd is positioned adjacent to the northern parcel of the rehabilitation area. Additionally, Mineral Exploration License (EL) 7674 also held by Newnes Kaolin Pty Ltd exists over a broad regional area including the entire subject site. The titleholders should be consulted regarding active exploration in the vicinity of the proposed development, with a record of consultation included in the EIS.

The contact details (that GSNSW currently has on record) for the above title holders are as follows:
Contact: Ron Goldbery, Director
P: 0298691627 & 0410692404
E: rongoldbery@optusnet.com.au

GSNSW notes that Coal Authorisation (AUTH) 307, held by Hartley Vale Coal Pty Ltd and Mining Lease (ML) 1583, held by Coalex Pty Ltd (both part of Centennial Coal), overlap the greater subject area (refer to Figure 1). As part of the stakeholder engagement GSNSW would recommend consultation with the operators of AUTH 307 and ML 1583.

The contact details (that GSNSW currently has on record) for the above title holders are as follows:

ML 1583
Contact: Gavin Slade (mine geologist)
P: 0263538042
E: gavin.slade@centennialcoal.com.au

AUTH 307
Contact: David Sullivan (mine geologist)
P: 0263538042
E: david.sullivan@centennialcoal.com.au

Geoscience Information Services

The GSNSW has a range of online data related to mineral exploration, land use and general geoscience topics:
http://www.resources.nsw.gov.au/geological/online-services

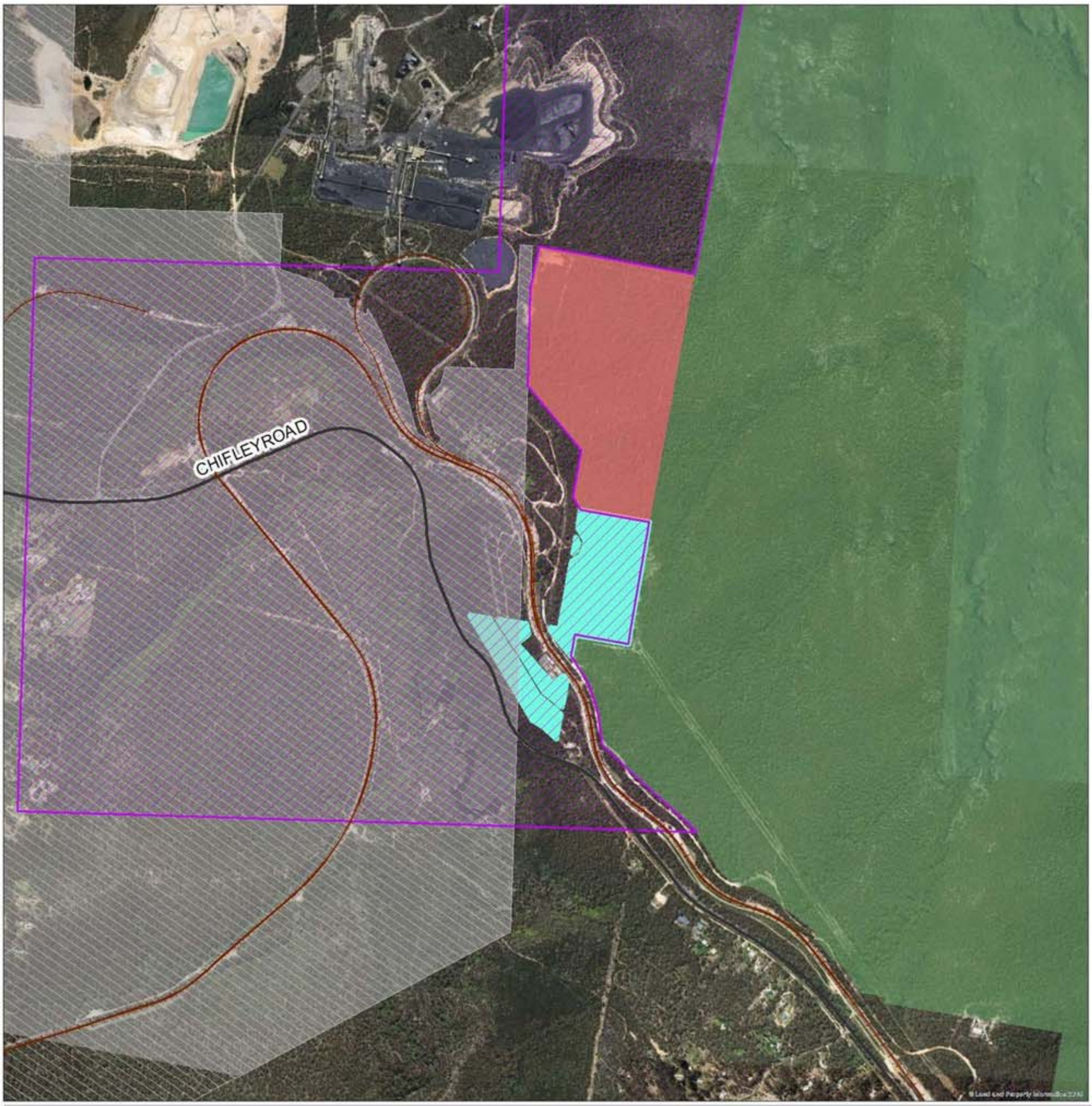
The location of current exploration and mining titles in NSW, explanations of mining and production titles and the roles of community and government in the decision making process for mining/resource projects may be accessed by the general public using the following online utilities:
http://commonground.nsw.gov.au

Queries regarding the above information, and future requests for advice in relation to this matter, should be directed to the GSNSW Land Use team at landuse.minerals@industry.nsw.gov.au.

Yours sincerely

Cressida Gilmore
Manager - Land Use

Figure 1 – Mineral & Coal title stakeholders proximity to the Bell Quarry rehabilitation area.



0 0.75 1.5 Kilometers

Legend

- Railways
- Major Road
- EL 7674
- ML1654
- AUTH 307
- ML1583
- National Parks Reserves
- Bell Quarry Rehabilitation Project

N W E S

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NSW GOVERNMENT | Department of Industry Resources & Energy

Brief

Topic

The Department of Planning and Environment (DPE) has requested DoI – Lands to provide Secretary Environmental Assessment Requirements in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* for the Rehabilitation of the Bell Quarry at Newnes Plateau near Lithgow NSW.

Analysis

Crown land Lots 7031 and 7032 DP 1066257 and Lot 7005 DP1020664 have the potential to be impacted by the rehabilitation of the quarry due to high walls abutting the adjacent Crown land.

Access to the Bell Quarry consists of traversing Clarence Colliery Rd (partial Crown road), Crown Reserves and Sandham Rd (partial Crown road). Legal access issues require addressing with the impacted Crown roads and Crown Reserves being transferred to the relevant authority or easements applied.

Recommendations

1 Respond to the request as follows.

a. Crown land Lots 7031 and 7032 DP 1066257 and Lot 7005 DP1020664 have the potential to be impacted by the rehabilitation of the quarry due to high walls abutting the adjacent Crown land. The sequencing of the backfilling of the quarry and the final surface water management flows would be required to be described in detail to ensure that there is no impact on Crown land.

b. Long term access to the Newnes Plateau area has been by Clarence Colliery Road and Sandham Road which traverses partially on Crown roads and Crown Reserves that are either under tenure with the *Crown Lands Act 1989* or the *Mining Act 1992.* This access issue needs to be addressed, in consultation with tenure holders, to ensure legal access together with the ability to undertake road maintenance to the Bell Quarry and other landholders / commercial operations in the area.

Key reasons

Crown land Lots 7031 and 7032 DP 1066257 and Lot 7005 DP1020664 have the potential to be impacted by the rehabilitation of the quarry due to high walls abutting the adjacent Crown land. Rehabilitation of the high walls may require extensive earth works and change in water flow directions. The Applicant would need to demonstrate that this can be completed without having any impact on Crown land.

There have been several past attempts to resolve the legal access issues within the Newnes Plateau locality without any success. This access issue needs to be addressed to ensure legal access and the negotiation of impacted Crown Reserves and Crown roads be transferred to the relevant authority or easements applied for continuing road maintenance works.

Departmental approvals

Position	Signature	Date
Coordinator officer: Kerry Ede, Coordinator Client Services,	Kerry Ede	4/11/16
Approving officer: Grant Marsden, Area Manager South West		7-Nov-16
Endorsing officer: Daryl Lawrence, Group Leader	D. Lawrence	03/11/2016
Recommending officer: Kay Oxley, Senior Natural Resource Management Officer	Kay Oxley	3 November 2016

Background

The Department of Planning and Environment (DPE) has requested DoI – Lands to provide Secretary Environmental Assessment Requirements in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* for the Rehabilitation of the Bell Quarry at Newnes Plateau near Lithgow NSW (**Attachment A**).

The Project involves the importation, by road at a rate of up to 140,000 tpa, of VENM (Virgin Excavated Natural Material), ENM (Excavated Natural Material) and other clean fill material generated from major infrastructure projects across Sydney and the local regions.

This material will be placed in existing quarry voids, compacted and shaped to closely represent the pre-quarry landform (**Attachment B)**. The Applicant has committed to developing a water management system to control surface water discharges (flow to the east) and also will revegetate the site with locally endemic species.

The Newnes and Clarence locality consists of many Crown reserves and roads with multiple licences. This includes the Clarence Colliery, Hanson's Quarry, the proposed Newnes Kaolin Project, and a licence application for the Wolgan Walking Track (**Attachment C**).

Access to the Bell Quarry consists of traversing Clarence Colliery Rd (partial Crown road) that is utilised by the above mentioned operations. The access for the Bell Quarry deviates to the east along partial Crown Reserve and Crown Road known as Sandham Road (**Attachment D**).

The Crown Reserves surrounding the Bell Quarry mainly consists of Crown reserves for 'village purposes'. This locality was the original settlement supporting the construction of the Zig Zag Railway line in the late 1800s. A number of private freehold houses remain in the locality. **Table 1** lists and **Attachment E** illustrates the relevant Crown Reserves and roads that may be impacted by the proposal.

Table 1 Crown Reserves and Crown Roads

Crown Land	Purpose	Tenure Holder
Lot 7031 DP1066257	Village Purposes	
Lot 7032 DP1066257	Village Purposes	
Lot 7005 DP1020664	Licence for extraction of sand	Kaolin Pty Ltd
Crown Road (partial Sandham Road), Crown Road (partial Clarence Colliery Rd) (see		

Attachment D)		

Crown land Lots 7031 and 7032 DP 1066257 and Lot 7005 DP1020664 have the potential to be impacted by the rehabilitation of the quarry due to high walls abutting the adjacent Crown land. The sequencing of the backfilling of the quarry and the final surface water management flows would be required to be described in detail to ensure that there is no impact on Crown land. The Applicant has provided a preliminary description of final surface water flows to the east of the quarry land. (**Attachment B**).

Additionally, consultation should also be undertaken with Kaolin Pty Ltd, tenure holders of Lot 7005 DP 1020664.

Sensitive Issues

Historical access to the Newnes Plateau Village has been by Clarence Colliery Road which is dissected by privately owned land of Zig Zag Railway Co-operation which has a compensation agreement with Clarence Colliery. The access turns east at Sandham Road which traverses Crown Reserve under tenure to Hansons Quarry through private freehold land and Crown Reserve that is tenured to Clarence Colliery under the *Mining Act 1992* (see Attachment D).

This arrangement has been ongoing for numerous years. It is a complex issue and there have been several attempts to resolve the legal access issues without any success. This access issue needs to be highlighted to ensure there is legal access and the negotiation of impacted Crown Reserves and Crown roads be transferred to the relevant authority or easements applied.

Attachments

Attachment	Title
A	Locality Figure
B	Quarry landform and pre-existing contours figures
C	Newnes Plateau Figure
C	Crown Road Figure
D	Crown Reserve Figure

Attachment A

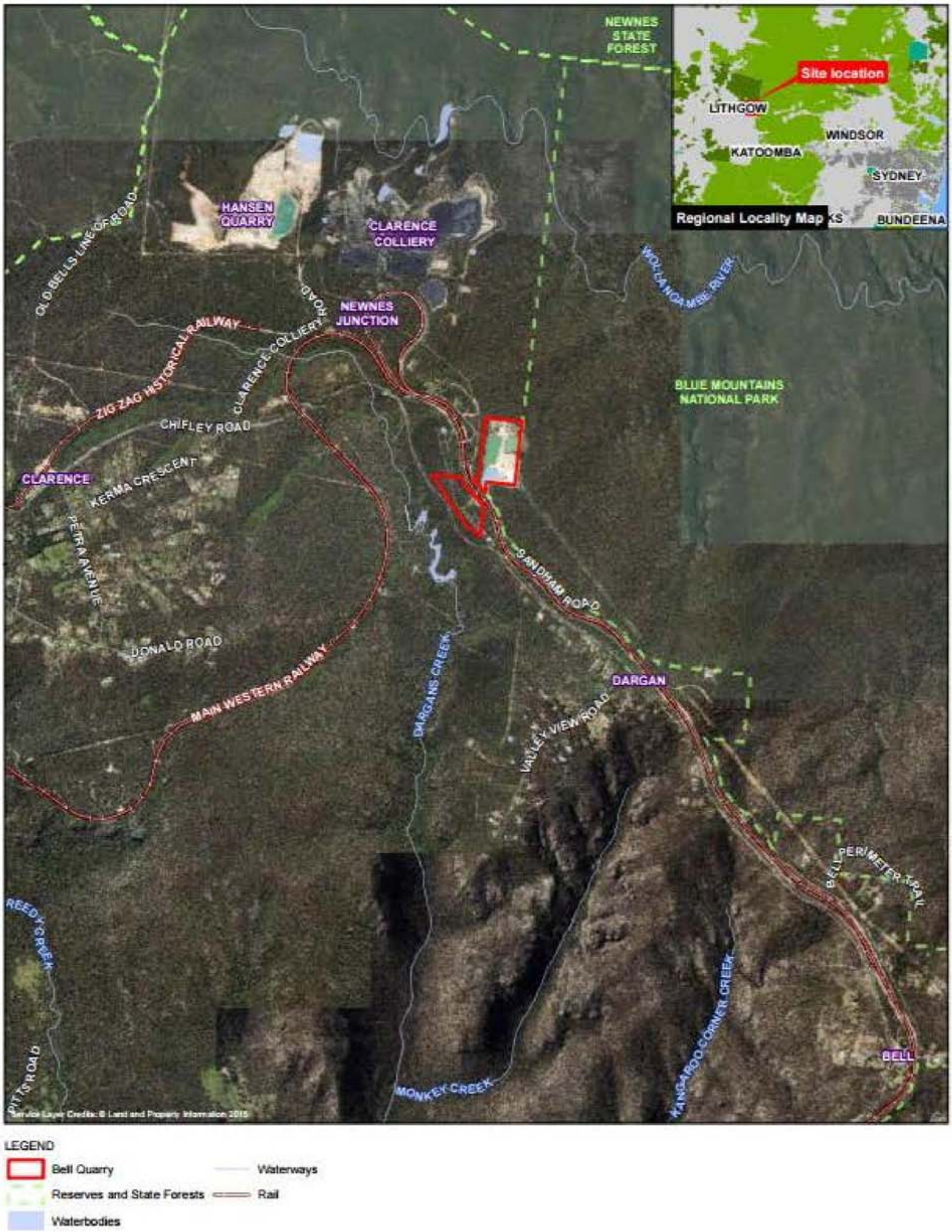


Figure 3-2

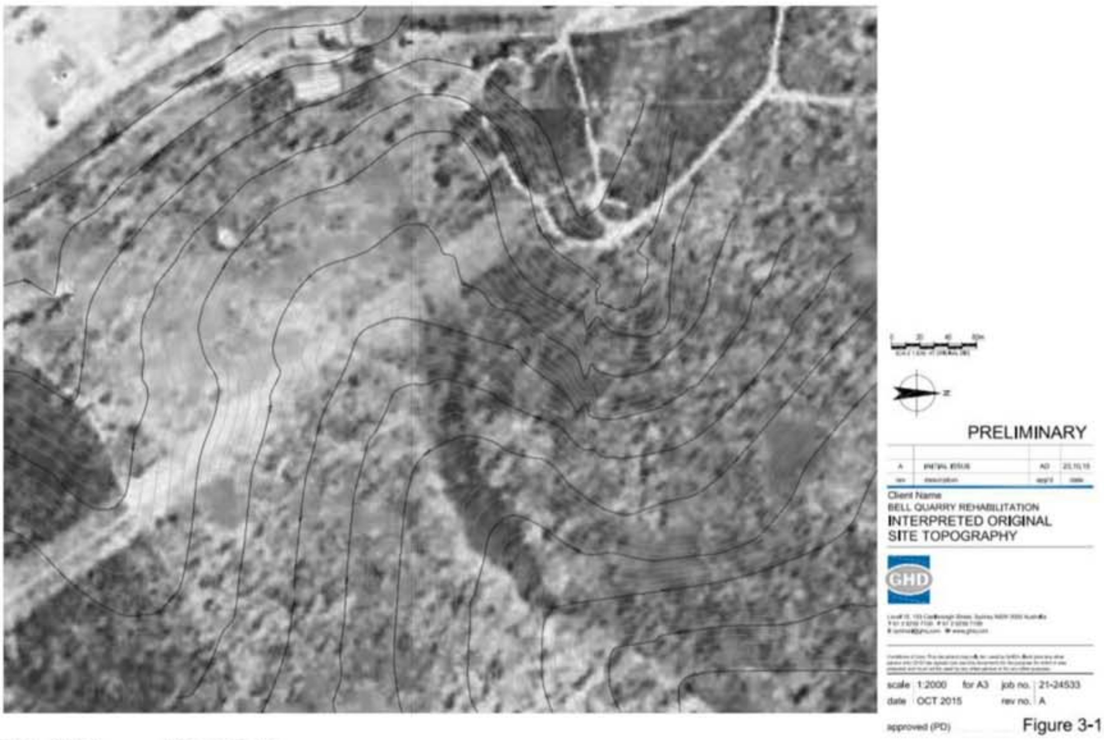
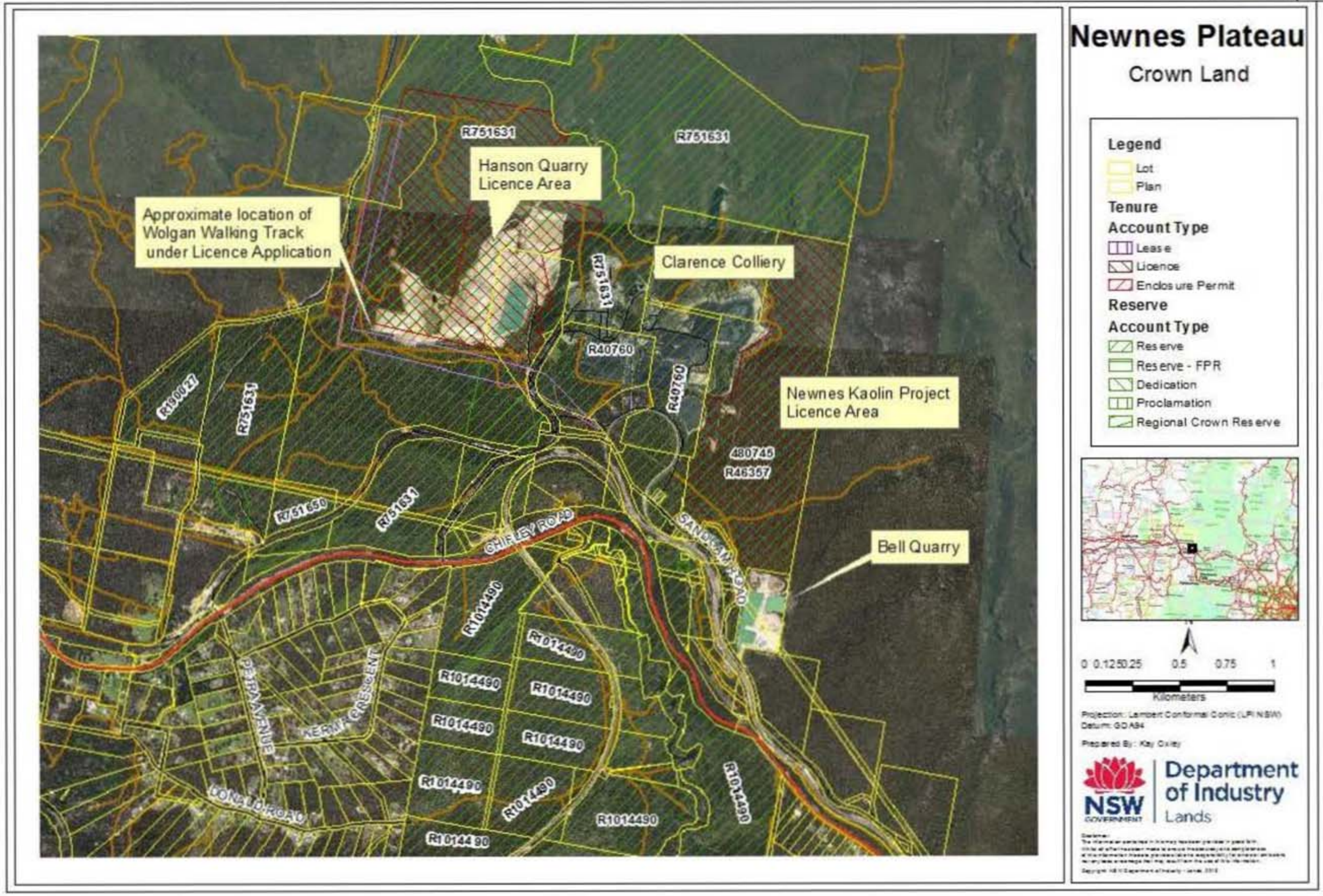
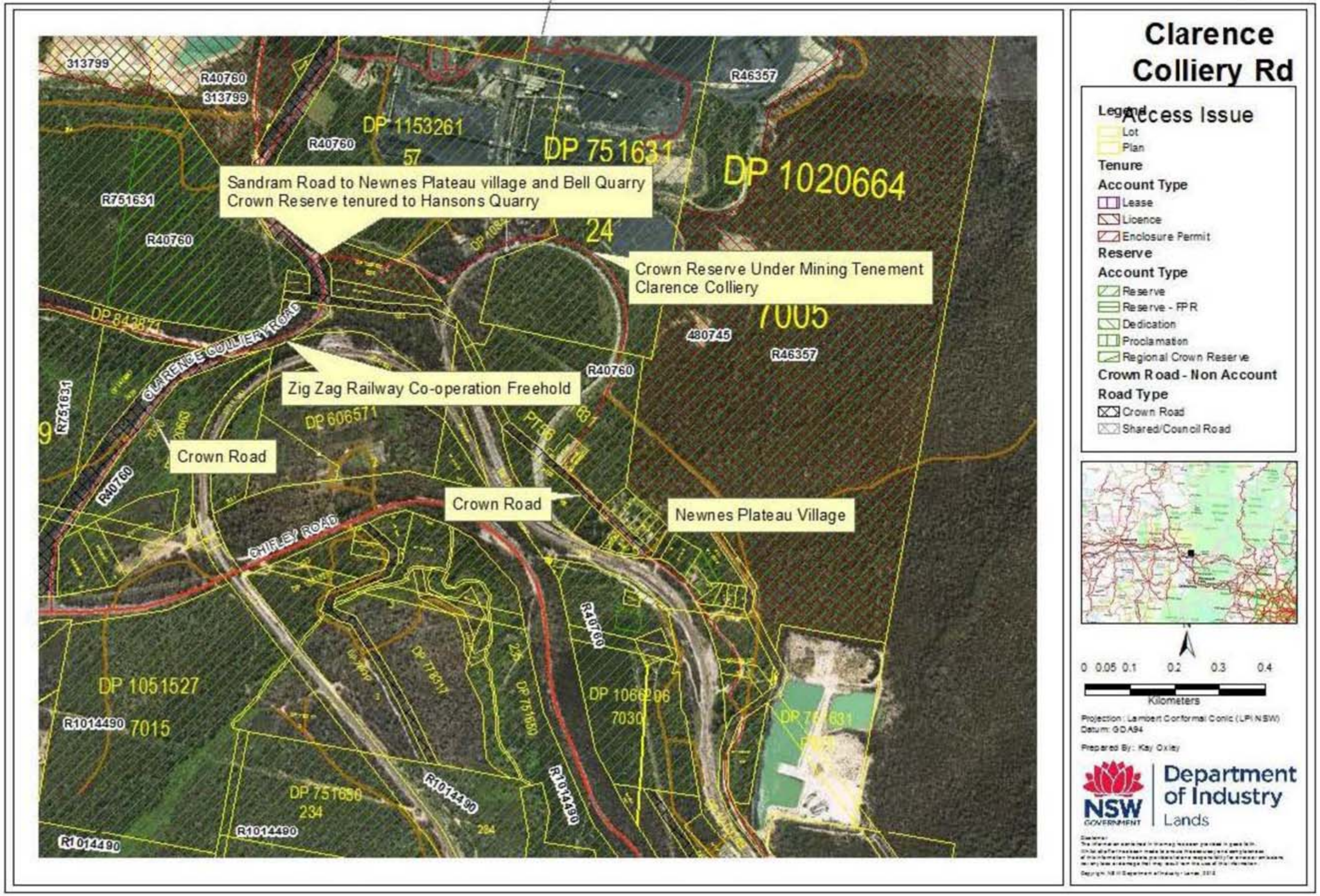


Figure 3-1

Attachment C



Attachment D



Attachment E

Our Ref: DOC17/32171-1
Your Ref: EAR 1105

Ms Aryel Pyliotis
Senior Environmental Scientist
GHD
Level 15 133 Castlereagh St
SYDNEY NSW 2000
Aryel.Pyliotis@ghd.com

Dear Ms Pyliotis,

Bell Quarry Rehabilitation – EAR 1105

I refer to your request seeking Secretary's Environmental Assessment Requirements (SEARs) for the preparation of an Environmental Impact Assessment (EIS) for the Rehabilitation of the former Bell Quarry (EAR 1105).

The background information provided indicates that the proposal intends to rehabilitate the former Bell Quarry site using clean fill and others to create a natural state landform.

OEH Role

OEH has responsibilities under the:

- *National Parks and Wildlife Act 1974* (NP&W Act) - namely the protection and care of Aboriginal objects and places, the protection and care of native flora and fauna and the protection and management of reserves;
- *Threatened Species Conservation Act 1995* (TSC Act) which aims to conserve threatened species of flora and fauna, populations and ecological communities to promote their recovery and manage processes that threaten them; and
- *Native Vegetation Conservation Act 2003* – ensuring compliance with the requirements of this legislation.

OEH understands from the correspondence that the proposed activity is a Part 4 application pursuant to the *Environmental Planning and Assessment Act 1979* (EP&A Act), and has not been classified as State Significant Development. As such OEH only has a statutory role in assessing such an activity if the consent authority determines that:

a) the activity is likely to significantly affect a threatened species, population, ecological community, or its habitat, as listed under the TSC Act; and/or
b) An Aboriginal Heritage Impact Permit is required.

The EP&A Act and *Environmental Planning and Assessment Regulation 2000* require that the EIS should fully describe the proposal, the existing environment and impacts of the proposal. It is the responsibility of the proponent and consent authority to adequately consider the requirements under the EP&A Act and Regulation.

OEH can provide advice on the EIS where the EIS deals with natural and cultural heritage conservation issues. OEH may also comment on the legitimacy of the conclusions reached regarding the significance of impacts by the proposed development to these components of the environment.

This letter directs you primarily to our generic guidance material. However please note that it is up to the proponent (and later the consent/determining authority after appropriate consultation) to determine the detail and comprehensiveness of the surveys and level of assessment required to form legally defensible conclusions regarding the impact of the proposal. The scale and intensity of the proposed development should dictate the level of investigation. It is important that all conclusions are supported by adequate data.

OEH Requirements

In summary, OEH's key information requirements for the proposal include an adequate assessment of:

1. **Impacts on flora, fauna, threatened species, populations, communities and their habitats;**
2. **Impacts to Aboriginal cultural heritage objects.**

This assessment should include consideration of direct and indirect impacts as a result of both construction and operation of the project. Assessment of any cumulative impacts of this and other developments in the area will be essential.

Flora, Fauna and Threatened Species

A copy of our generic Environmental Assessment Guidelines are included in **Attachments A** and **B**. These guidelines address requirements under the EP&A Act and OEH's areas of responsibility relating to flora, fauna and threatened species, populations and ecological communities and their habitats.

OEH is committed to the protection, appropriate management, and where necessary, rehabilitation of native vegetation. For these reasons, OEH considers that careful planning should precede any development that involves further vegetation clearance or other significant impact within areas of remnant vegetation.

Negative impacts to native vegetation (e.g. clearing) should be avoided where possible. Where impacts cannot be avoided, the EIS should detail how a "maintain or improve" outcome for biodiversity will be achieved. BioBanking provides a voluntary mechanism through which this can be achieved. The BioBanking Assessment Methodology allows quantification of impacts and assessment of the value of offset areas and associated management regimes for those areas. The BioBanking scheme provides an alternative path for proponents to the current threatened species assessment of significance process. Information about BioBanking is located on OEH's website at http://www.environment.nsw.gov.au/biobanking/ .

Cultural Heritage

The importance of protecting Aboriginal Cultural Heritage is reflected in the provisions under Part 6 of the NP&W Act, as amended. That Act clearly establishes that Aboriginal objects and places are protected and may not be harmed, disturbed or desecrated without appropriate authorisation. Importantly, approvals under Parts 4 and 5 of the EP&A Act do not absolve the proponent of their obligations under the NP&W Act.

Under the NP&W Act, it is the responsibility of each individual proposing to conduct ground disturbance works to ensure that they have conducted a due diligence assessment to avoid harming Aboriginal objects by the proposed activity. OEH has produced a generic due diligence process, which is not mandatory to follow, however any alternative process followed must be able to demonstrate their process was reasonable and practicable in attempts to avoid harm to Aboriginal objects.

Consultation must also be in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010) as set by OEH if impact to cultural heritage is unavoidable.

Further advice regarding Aboriginal cultural heritage can be found on the OEH web-site at: http://www.environment.nsw.gov.au/licences/achregulation.htm and within guidance documents listed in Attachment B.

If you have any questions regarding this matter further please contact Liz Mazzer on 02 6883 5325 or email Liz.Mazzer@environment.nsw.gov.au.

Yours sincerely,

STEVEN COX
Senior Team Leader Planning
North West Region

Date: 25 January 2017

Contact officer: LIZ MAZZER
6883 5325

Attachment A – Environmental Impact Statement Requirements

Attachment B – Guidance Material

ATTACHMENT A

Environmental Impact Statement Requirements

1. Environmental impacts of the project

Impacts related to the following environmental issues need to be assessed, quantified and reported on:

1. **Cumulative impact**
2. **Aboriginal cultural heritage**
3. **Biodiversity**
4. **OEH Estate - Land reserved or acquired under the NPW Act**

The Environmental Impact Statement (EIS) should address the specific requirements outlined under each heading below and assess impacts in accordance with the relevant guidelines mentioned. A full list of guidelines is at **Attachment B**.

2. Cumulative impact

The cumulative impacts from all clearing activities and operations, associated edge effects and other indirect impacts on cultural heritage, biodiversity and OEH Estate need to be comprehensively assessed in accordance with the EP&A Act.

This should include the cumulative impact of the proponent’s existing and proposed development and associated infrastructure (such as access tracks etc) as well as the cumulative impact of other developments located in the vicinity. This assessment should include consideration of both construction and operational impacts.

3. Aboriginal cultural heritage

The EIS report should contain:

a. A description of the Aboriginal objects and declared Aboriginal places located within the area of the proposed development.
b. A description of the cultural heritage values, including the significance of the Aboriginal objects and declared Aboriginal places, that exist across the whole area that will be affected by the proposed development, and the significance of these values for the Aboriginal people who have a cultural association with the land.
c. A description of how the requirements for consultation with Aboriginal people as specified in clause 80C of the *National Parks and Wildlife Regulation 2009* have been met.
d. The views of those Aboriginal people regarding the likely impact of the proposed development on their cultural heritage. If any submissions have been received as a part of the consultation requirements, then the report must include a copy of each submission and your response.
e. A description of the actual or likely harm posed to the Aboriginal objects or declared Aboriginal places from the proposed activity, with reference to the cultural heritage values identified, and the need apply for an Aboriginal Heritage Impact Permit (AHIP).
f. A description of any practical measures that may be taken to protect and conserve those Aboriginal objects or declared Aboriginal places.
g. A description of any practical measures that may be taken to avoid or mitigate any actual or likely harm, alternatives to harm or, if this is not possible, to manage (minimise) harm.
h. A specific Statement of Commitment that the proponent will complete an Aboriginal Site Impact Recording Form and submit it to the Aboriginal Heritage Information Management System (AHIMS) Registrar, for each AHIMS site that is harmed through the proposed development.

In addressing these requirements, the proponent must refer to the following documents:

- ***Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*** (DECCW, 2010) - http://www.environment.nsw.gov.au/licences/consultation.htm. This document further explains the consultation requirements that are set out in clause 80C of the National Parks and Wildlife Regulation 2009. The process set out in this document must be followed and documented in the Environmental Assessment Report.
- ***Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales*** (DECCW, 2010) http://www.environment.nsw.gov.au/licences/archinvestigations.htm. The process described in this Code should be followed and documented where the assessment of Aboriginal cultural heritage requires an archaeological investigation to be undertaken.

Notes:

i. An *Aboriginal Site Impact Recording Form* (http://www.environment.nsw.gov.au/licences/DECCAHIMSSiteRecordingForm.htm) must be completed and submitted to the Aboriginal Heritage Information Management System (AHIMS) Registrar, for each AHIMS site that is harmed through archaeological investigations required or permitted through these environmental assessment requirements.

ii. Under section 89A of the NP&W Act, it is an offence for a person not to notify OEH of the location of any Aboriginal object the person becomes aware of, not already recorded on the Aboriginal Heritage Information Management System (AHIMS). An AHIMS Site Recording Form should be completed and submitted to the AHIMS Registrar (http://www.environment.nsw.gov.au/contact/AHIMSRegistrar.htm), for each Aboriginal site found during investigations.

4. Biodiversity

Biodiversity impacts can be assessed using **either:**

- The BioBanking Assessment Methodology (scenario 1) **or**
- A detailed biodiversity assessment (scenario 2).

The requirements for each of these approaches are detailed below.

The BioBanking Assessment Methodology can be used either to obtain a BioBanking statement, or to assess impacts of a proposal and to determine required offsets without obtaining a statement. In the latter instances, if the required credits are not available for offsetting, appropriate alternative options may be developed in consultation with OEH officers.

Note:

i. The Shire may be listed in Schedule 1 of ***SEPP No. 44 - Koala Habitat Protection.*** If so, the requirements of the SEPP regarding Koala habitat protection should also be considered by the proponent.

SCENARIO 1 - Where a proposal is assessed using the BioBanking Assessment Methodology (BBAM)

1. Where a BioBanking Statement is being sought under Part 7A of the TSC Act, the assessment must be undertaken by an accredited BioBanking assessor (as specified under Section 142B (1) (c) of the TSC Act) and done in accordance with the *BioBanking Assessment Methodology* (OEH, 2014). To qualify for a BioBanking Statement a proposal must meet the 'improve or maintain' standard.

1a. The EIS should include a specific Statement of Commitments that reflects all requirements of the BioBanking Statement including the number of credits required and any Director General approved variations to impact on Red Flags.

2. Where the BioBanking Assessment Methodology is being used to assess impacts of a proposal and to determine required offsets, and a BioBanking Statement is not being

obtained, the EIS should contain a detailed biodiversity assessment and all components of the assessment must be undertaken in accordance with the *BioBanking Assessment Methodology* (OEH, 2014).

2a. The EIS should include a specific Statement of Commitments which:

a. is informed by the outcomes of the proposed BioBanking assessment offset package;
b. sets out the ecosystem and species credits required by the BioBanking Assessment Methodology and how these ecosystem and/or species credits will be secured and obtained;
c. if the ecosystem or species credits cannot be obtained, provides appropriate alternative options to offset expected impacts, noting that an appropriate alternative option may be developed in consultation with OEH officers and in accordance with OEH policy;
d. demonstrates how all options have been explored to avoid red flag areas; and
e. includes all relevant 'BioBanking files (e.g. *.xml output files), data sheets, underlying assumptions (particularly in the selection of vegetation types from the vegetation types database), and documentation (including maps, aerial photographs, GIS shape files, other remote sensing imagery etc.) to ensure that the OEH can conduct an appropriate review of the assessment.

3. **Where appropriate**, likely impacts (both **direct** and **indirect**) on any adjoining and/or nearby OEH estate reserved under the NP&W Act or any marine and estuarine protected areas under the *Fisheries Management Act 1994* or the *Marine Parks Act 1997* should be considered. Please refer to the *Guidelines for developments adjoining land and water managed by the Department of Environment, Climate Change and Water* (DECCW, 2010).

4. With regard to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the assessment should identify and assess any relevant Matters of National Environmental Significance and whether the proposal has been referred to the Commonwealth or already determined to be a controlled action.

SCENARIO 2 - Where a proposal is assessed outside the BioBanking Assessment Methodology

1. The EIS should include a detailed biodiversity assessment, including assessment of impacts on threatened biodiversity, native vegetation and habitat. This assessment should address the matters included in the following sections.

2. A field survey of the site should be conducted and documented in accordance with relevant guidelines, including:

   - the *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna -Amphibians* (DECCW, 2009);
   - *Guide to Surveying Threatened Plants* (OEH, 2015);
   - *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft* (DEC, 2004); and
   - Threatened species survey and assessment guideline information on www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm.
   - Commonwealth survey requirements (birds, bats, reptiles, frogs, fish and mammals): http://www.environment.gov.au/topics/environment-protection/environment-assessments. These are relevant when species or communities listed under the EPBC Act are present.

   It is preferable for proponents to use the Interim Vegetation Mapping Standard data form to collect the vegetation plot data for the project site, and any offset site associated with the project. This will provide data that is useful for vegetation mapping as well as in the BioBanking Assessment Methodology. This is available at http://www.environment.nsw.gov.au/research/VISplot.htm.

   If a proposed survey methodology is likely to vary significantly from the above methods, the proponent should discuss the proposed methodology with the OEH prior to undertaking the EIS, to determine whether the OEH considers that it is appropriate.

Recent (less than five years old) surveys and assessments may be used. However, previous surveys should not be used if they have:

- been undertaken in seasons, weather conditions or following extensive disturbance events when the subject species are unlikely to be detected or present, or
- utilised methodologies, survey sampling intensities, timeframes or baits that are not the most appropriate for detecting the target subject species,

unless these differences can be clearly demonstrated to have had an insignificant impact upon the outcomes of the surveys. If a previous survey is used, any additional species listed under the TSC Act since the previous survey took place, must be surveyed for.

Determining the list of potential threatened species for the site must be done in accordance with the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft* (DEC, 2004) and *Guide to Surveying Threatened Plants* (OEH, 2015).

The OEH Threatened Species website http://www.environment.nsw.gov.au/threatenedspecies/ and the *Atlas of NSW Wildlife* database must be the primary information sources for the list of threatened species present.

The Vegetation Types database (available via the OEH website at http://www.environment.nsw.gov.au/biobanking/vegtypedatabase.htm, and other data sources (e.g. PlantNET, Online Zoological Collections of Australian Museums (http://ozcam.org.au/), previous or nearby surveys etc.) may also be used to compile the list.

Other reference literature may be available for the subject locality/region. The proponent should explore this possibility thoroughly.

3. The EIS should contain the following information as a minimum:
   a. Description and geo-referenced mapping of study area (**and associated spatial data files**), e.g. overlays on topographic maps, satellite images and /or aerial photos, including details of map datum, projection and zone, all survey locations, vegetation communities (including classification and methodology used to classify), key habitat features and reported locations of threatened species, populations and ecological communities present in the subject site and study area. Separate spatial files (.shp format) to be provided to the OEH should include, at a minimum, shapefiles of the project site, impact footprint, vegetation mapping and classification for both the impact and any offset site(s);
   b. Description of survey methodologies used, including timing, location and weather conditions, and a comparison of survey effort (in tabular form) with that recommended in the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft* (DEC, 2004) and *Guide to Surveying Threatened Plants* (OEH, 2015). Where survey effort is not consistent with those guidelines justification must be provided;
   c. Detailed description of vegetation communities (including classification and methodology used to classify) and including all plot data. Plot data should be supplied to the OEH in electronic format (e.g. MS-Excel) and organised by vegetation community;
   d. Details, including qualifications and experience of all staff undertaking the surveys, mapping and assessment of impacts as part of the EIS;
   e. Identification of national and state listed threatened biota known or likely to occur in the study area and their conservation status;
   f. Description of the likely impacts of the proposal on biodiversity and wildlife corridors, including **direct** and **indirect** and **construction** and **operation** impacts. Wherever possible, quantify these impacts such as the amount of each vegetation community or species habitat to be cleared or impacted, or any fragmentation of a wildlife corridor;
   g. Identification of the **avoidance**, **mitigation** and **management measures** that will be put in place as part of the proposal to avoid or minimise impacts, including details about alternative options considered and how long term management arrangements will be guaranteed;

h. Description of the residual impacts of the proposal. **If the proposal cannot adequately avoid or mitigate impacts on biodiversity, then a biodiversity offset package is expected** (see the requirements for this at point 6 below); and
i. Provision of specific Statement of Commitments relating to biodiversity.

4. An assessment of the significance of **direct** and **indirect** impacts of the proposal must be undertaken for threatened biodiversity **known or considered likely to occur** in the study area based on the presence of suitable habitat. The Assessment of Significance is a statutory mechanism which allows decision makers to assess whether a proposed development or activity is likely to have a significant effect on threatened species, populations or ecological communities, or their habitats. This assessment must take into account:
   a. the factors identified in s.5A of the EP&A Act[1]; and
   b. the guidance provided by *The Threatened Species Assessment Guideline – The Assessment of Significance* (DECCW, 2007). This guideline is available on the OEH website: http://www.environment.nsw.gov.au/resources/threatenedspecies/tsaguide07393.pdf
5. Where an offsets package is proposed by a proponent for impacts to biodiversity (and a BioBanking Statement has not been sought) this package should:
   a. Meet the OEH's *Principles for the use of biodiversity offsets in NSW*[2], which are available at: http://www.environment.nsw.gov.au/biodivoffsets/oehoffsetprincip.htm
   b. Identify the conservation mechanisms to be used to ensure the long term protection and management of the offset sites; and
   c. Include an appropriate Management Plan (such as vegetation or habitat) that has been developed as a key amelioration measure to ensure any proposed compensatory offsets, retained habitat enhancement features within the

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[1] Following threatened species assessment via the Assessment of Significance, it may be necessary to prepare a **Species Impact Statement** (SIS). The proponent will need to prepare a SIS in the following circumstances:

- If (after having addressed Section 5A) the flora/fauna assessment concludes that there is likely to be a significant impact to threatened species, or
- The proposed development is likely to affect critical habitat declared under the TSC Act.

If a SIS is required, the proponent (not the consultant) must write to OEH for any formal requirements for the SIS that may be deemed appropriate. The SIS must then be prepared in accordance with these requirements and provided to the OEH. In some instances the Minister for the Environment will also need to be consulted for approval.

Methods to reduce the impact on the protected and threatened species should be considered fully, and are considered an integral requirement within any SIS document.

Conducting an Assessment of Significance or an SIS according to the provisions of the *EP&A Act* and the *TSC Act* is a complex task and should be undertaken by suitably qualified person(s).

[2] **Please note** that the OEH's *Principles for the use of biodiversity offsets in NSW* ('the Principles') require offsets to be based on a **quantitative assessment** of the loss in biodiversity from the proposal and the gain in biodiversity from the offset. The methodology must be based on the best available science, be reliable, and used for calculating both the impact and offset sites. Even where a proponent does not intend to use the BioBanking Assessment Methodology and Credit Calculator (Scenario 1), use of a **suitable alternative metric**, justified in the EA, is necessary to demonstrate that the proposal is consistent with the Principles. Ultimately the proponent is expected to demonstrate quantitatively that the biodiversity losses associated with the project will be adequately compensated for by the improvement in vegetation condition and security expected from the offset site. This cannot be properly determined by a hectare comparison alone.

development footprint and/or impact mitigation measures (including proposed rehabilitation and/or monitoring programs) are appropriately managed and funded.

6. **Where appropriate**, likely impacts (both **direct** and **indirect**) on any adjoining and/or nearby OEH estate reserved under the NP&W Act or any marine and estuarine protected areas under the *Fisheries Management Act 1994* or the *Marine Parks Act 1997* should be considered. Refer to the *Guidelines for developments adjoining land and water managed by the Department of Environment, Climate Change and Water* (DECC, 2010).
7. With regard to the Commonwealth EPBC Act, the assessment should identify any relevant Matters of National Environmental Significance and whether the proposal has been referred to the Commonwealth or already determined to be a controlled action.

ATTACHMENT B

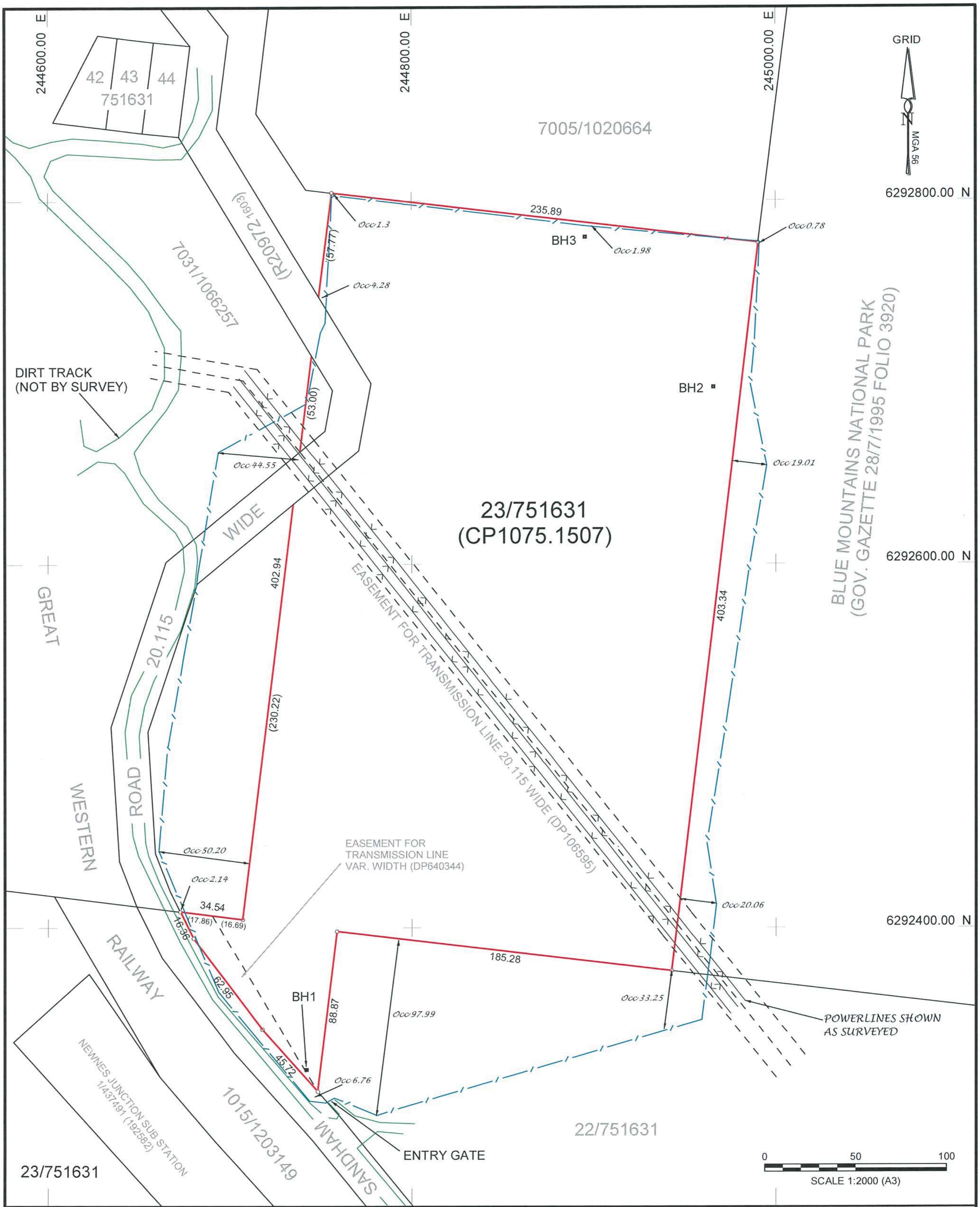
Guidance Material

Title	Web Address
Commonwealth Environment Protection & Biodiversity Conservation Act 1999	http://www.austlii.edu.au/au/legis/cth/consol_act/epabca1999588/
Environmental Planning and Assessment Act 1979	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+203+1979+cd+0+N
Fisheries Management Act 1994	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+38+1994+cd+0+N
National Parks and Wildlife Act 1974	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+80+1974+cd+0+N
Threatened Species Conservation Act 1995	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+101+1995+cd+0+N
Water Management Act 2000	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+92+2000+cd+0+N
Aboriginal Cultural Heritage	
Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (2005)	Available from DoPI.
Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010)	http://www.environment.nsw.gov.au/licences/consultation.htm
Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW, 2010)	http://www.environment.nsw.gov.au/licences/archinvestigations.htm
Due Diligence Code for the Protection of Aboriginal Objects in NSW (DECCW 2010)	http://www.environment.nsw.gov.au/resources/cultureheritage/ddcop/10798ddcop.pdf
Aboriginal Site Impact Recording Form	http://www.environment.nsw.gov.au/licences/DECCAHIMSSiteRecordingForm.htm
Aboriginal Heritage Information Management System (AHIMS) Registrar	http://www.environment.nsw.gov.au/contact/AHIMSRegistrar.htm
Biodiversity	
BioBanking Assessment Methodology (OEH, 2014)	http://www.environment.nsw.gov.au/resources/biobanking/140661BBAM.pdf
BioBanking Assessment Methodology and Credit Calculator Operational Manual (DECCW, 2008)	http://www.environment.nsw.gov.au/biobanking/calculator.htm
Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna –Amphibians (DECCW, 2009)	http://www.environment.nsw.gov.au/resources/threatenedspecies/09213amphibians.pdf
Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DEC, 2004)	http://www.environment.nsw.gov.au/resources/nature/TBSAGuidelinesDraft.pdf
Survey requirements (birds, bats, reptiles, frogs, fish and mammals) for species listed under the EPBC Act	http://www.environment.gov.au/topics/environment-protection/environment-assessments.

Guide to Surveying Threatened Plants (OEH, 2015)	http://www.environment.nsw.gov.au/resources/threatenedspecies/160129-threatened-plants-survey-guide.pdf
OEH Threatened Species website	http://www.environment.nsw.gov.au/threatenedspecies/
Atlas of NSW Wildlife	http://www.environment.nsw.gov.au/wildlifeatlas/about.htm
Vegetation Types databases	http://www.environment.nsw.gov.au/biobanking/vegtypedatabase.htm
PlantNET	http://plantnet.rbgsyd.nsw.gov.au/
Online Zoological Collections of Australian Museums	http://www.ozcam.org.au/
Threatened Species Assessment Guideline - The Assessment of Significance (DECCW, 2007)	http://www.environment.nsw.gov.au/resources/threatenedspecies/tsaguide07393.pdf
Principles for the use of biodiversity offsets in NSW	http://www.environment.nsw.gov.au/biodivoffsets/oehoffsetprincip.htm

Appendix B

Survey and Staging Plans



REMEDIAL CIVIL SOLUTIONS PTY. LTD.
BELL QUARRY REHABILITATION
LOT 23 DP 751631

SCALE -1:2000 DATUM: AHD (BELL TRIG)

NOTES:
1) COPYRIGHT OF THIS PLAN & ASSOCIATED ELECTRONIC FILES VESTS WITH CEH SURVEY.
2) THE PLAN & ASSOCIATED ELECTRONIC FILES SHALL ONLY BE USED BY THE ADDRESSED CLIENT FOR THE PURPOSE OF THE SURVEY.
3) THIS SURVEY AND PLAN IS FOR PLANNING / INFORMATION PURPOSES ONLY.
4) THE BOUNDARIES, AREAS & DIMENSIONS OF THE LAND, AS SHOWN, ARE BASED ON ORIGINAL DATA.
5) LOCATIONS OF FENCES AND POWERLINE ARE AS SURVEYED. OCCUPATIONS (Occ) ARE CONNECTIONS/OFFSETS SHOWN PERPENDICULAR TO THE NEAREST POINT ON THE BOUNDARY .
6) POWERLINE POSITION IS AS SURVEYED OTHER SURFACE AND/OR UNDERGROUND SERVICES MAY NOT BE SHOWN. CEH SURVEY ACCEPTS NO RESPONSIBILITY FOR SERVICES NOT SHOWN. RING 1100: "DIAL BEFORE YOU DIG" CABLE LOCATION, CONTACT RELEVANT AUTHORITIES AND LOCAL COUNCIL FOR OTHER SERVICE LOCATIONS.

CEH SURVEY
CONSULTING LAND, ENGINEERING AND MINING SURVEYORS
"Astrolabe" 1 Rutherford Lane,
LITHGOW 2790
ABN: 68 056 544 551 Office: (02) 6351 2281
Email: survey@ceh.com.au Website: www.ceh.com.au

DATE	19/01/2018
AMENDED	02/02/2018
SURVEYOR	GM/BN
DRAWN	GM
CHECKED	PS

DRAWING No:
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POR. 23 DP751631
JOB:
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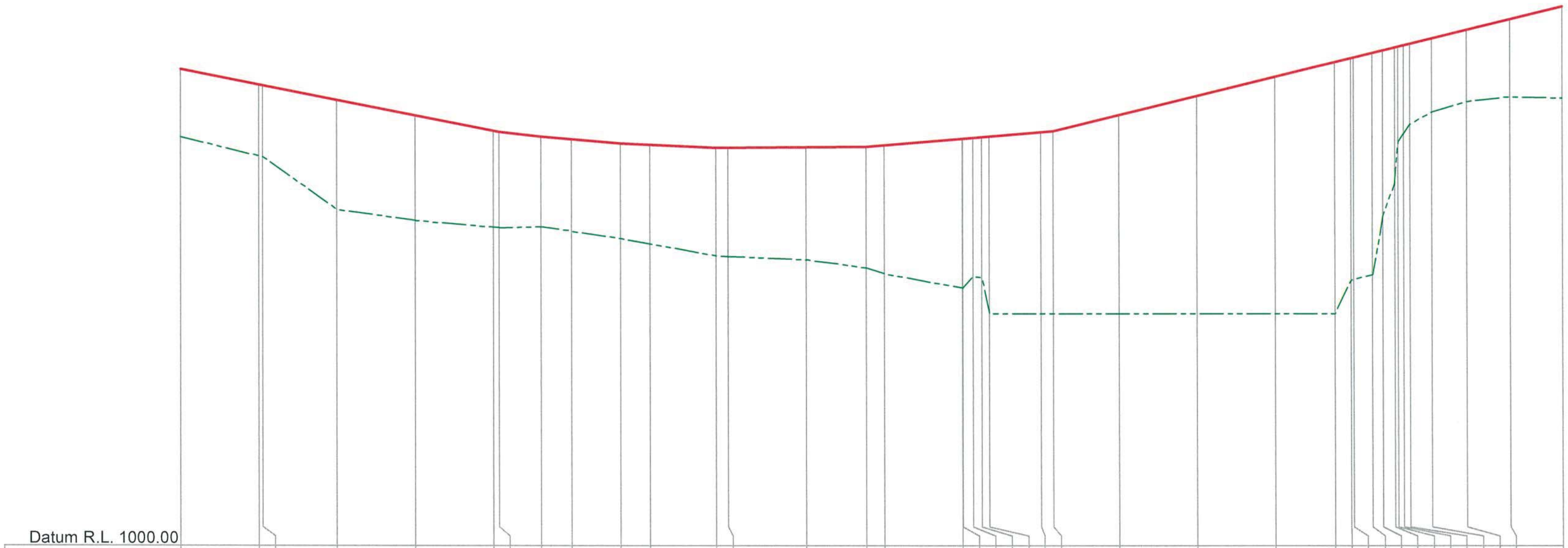

Datum R.L. 1000.00

Chainage	CLEARANCE	POWERLINE	NATURAL
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25.00			1062.10
26.29	11.37	1073.32	1061.96
50.00			1053.55
75.00	16.74	1068.55	1051.81
100.00			1050.70
101.82	15.29	1065.92	1050.63
115.22	14.37	1065.16	1050.79
125.00			1050.10
140.63	15.12	1064.06	1048.94
150.00			1048.07
171.19	17.21	1063.36	1046.15
175.00			1046.05
200.00			1045.55
219.25	19.29	1063.55	1044.26
225.00			1043.34
249.93	23.81	1064.84	1041.03
250.00			1041.08
253.38	22.07	1064.98	1042.91
256.15	22.40	1065.10	1042.70
258.55	28.25	1065.20	1036.95
275.00			1036.95
279.02	29.11	1066.06	1036.95
300.00			1036.95
325.00			1036.95
350.00			1036.95
369.02	40.09	1077.04	1036.95
374.13	35.34	1077.66	1042.32
375.00			1042.43
381.04	35.32	1078.51	1043.18
384.34	26.28	1078.91	1052.63
388.16	21.54	1079.37	1057.84
389.23	15.15	1079.50	1064.35
391.06	14.01	1079.73	1065.72
393.00	12.82	1079.96	1067.14
400.00			1069.09
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425.00			1071.53
441.75	14.62	1085.91	1071.30

Scale Horizontal 1:1500 Vertical 1:750

CEH SURVEY
CONSULTING LAND, ENGINEERING AND MINING SURVEYORS
"Astrolabe" 1 Rutherford Lane,
LITHGOW 2790
ABN: 68 056 544 551 Office: (02) 6351 2281
Email: survey@ceh.com.au Website: www.ceh.com.au

DATE	02/02/2018
AMENDED	
SURVEYOR	GM/BN/LB
DRAWN	PS/GM
CHECKED	PS

SANDHAM ROAD QUARRY
POWERLINE CLEARANCES
REMEDIAL CIVIL SOLUTIONS PTY. LTD.

SCALE - AS SPECIFIED

DRAWING No:
SANDHAM ROAD BELL QUARRY POWERLINE CLEARANCES

CCAD6 JOB & DWG:
Bell Quarry powerline section - PL LS1U

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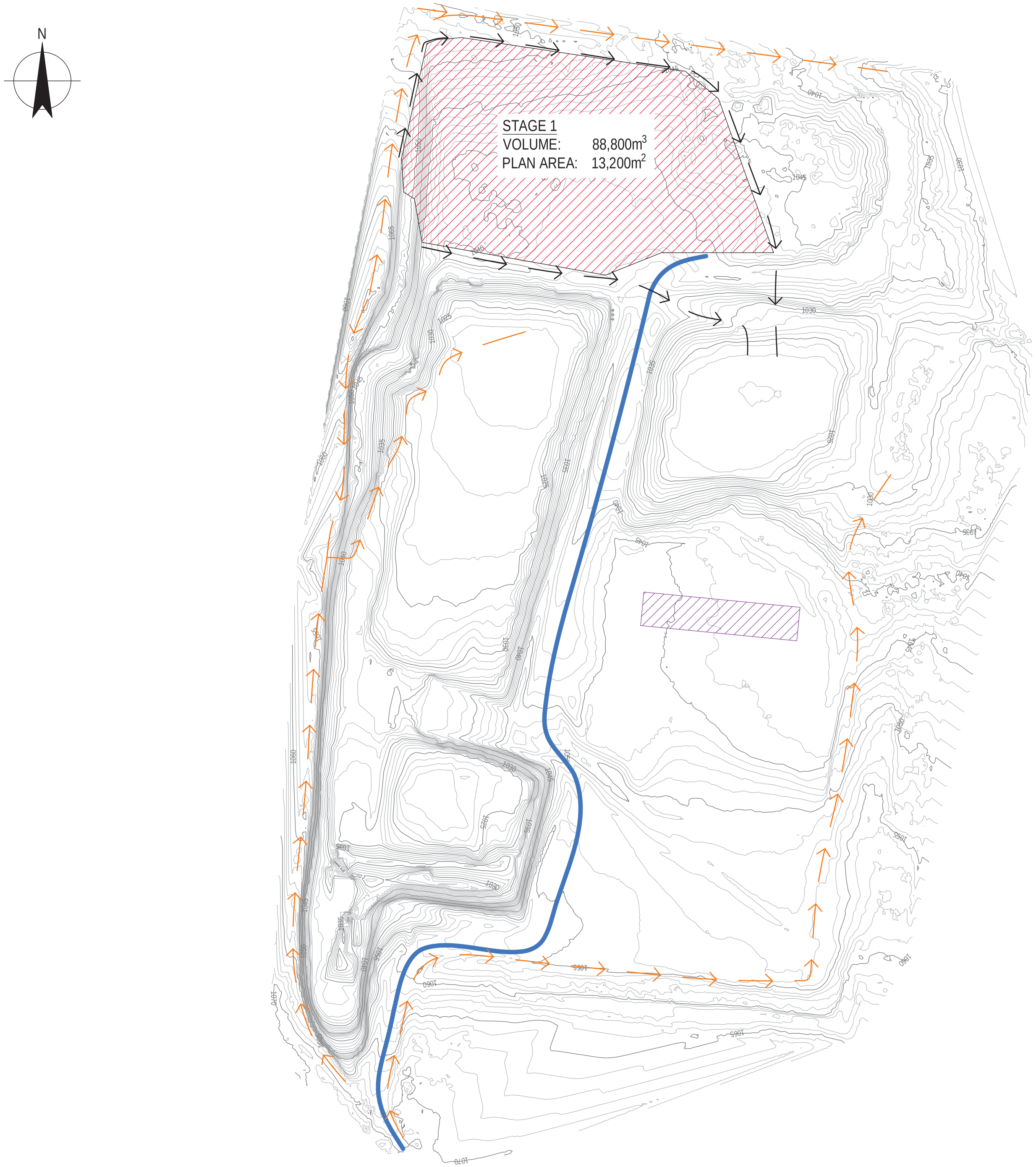

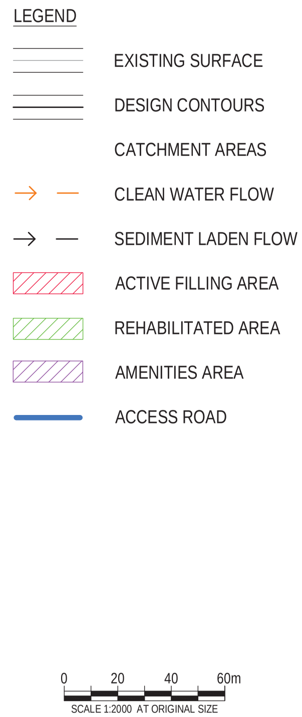

PRELIMINARY

rev	description	app'd	date

CHAULOUHI CONSTRUCTIONS
BELL QUARRY REHABILITATION
STAGING PLANS
STAGE 1

GHD
Level 15, 133 Castlereagh Street, Sydney NSW 2000 Australia
T 61 2 9239 7100 **F** 61 2 9239 7199
E sydmail@ghd.com **W** www.ghd.com

scale	1:2000	for A3	job no.	21-25774
date	MAR 2017		rev no.	B

approved (PD) SK003

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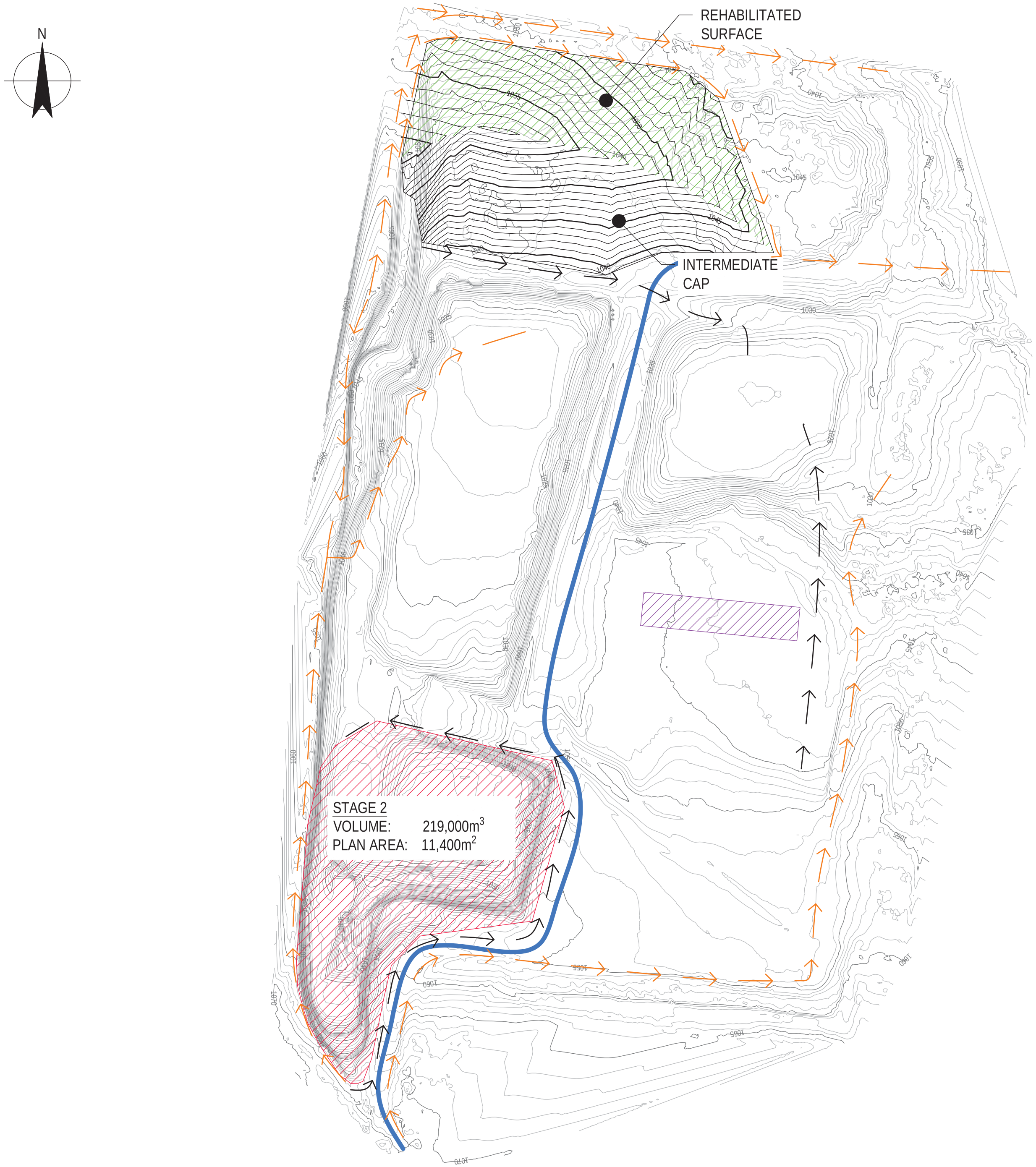

LEGEND

- EXISTING SURFACE
- DESIGN CONTOURS
- CATCHMENT AREAS
- CLEAN WATER FLOW
- SEDIMENT LADEN FLOW
- ACTIVE FILLING AREA
- REHABILITATED AREA
- AMENITIES AREA
- ACCESS ROAD

0 20 40 60m
SCALE 1:2000 AT ORIGINAL SIZE

PRELIMINARY

rev	description	app'd	date

CHAULOUHI CONSTRUCTIONS
BELL QUARRY REHABILITATION

STAGING PLANS
STAGE 2

GHD
Level 15, 133 Castlereagh Street, Sydney NSW 2000 Australia
T 61 2 9239 7100 **F** 61 2 9239 7199
E sydmail@ghd.com **W** www.ghd.com

scale	1:2000 for A3	job no.	21-25774
date	MAR 2017	rev no.	B

approved (PD) SK004

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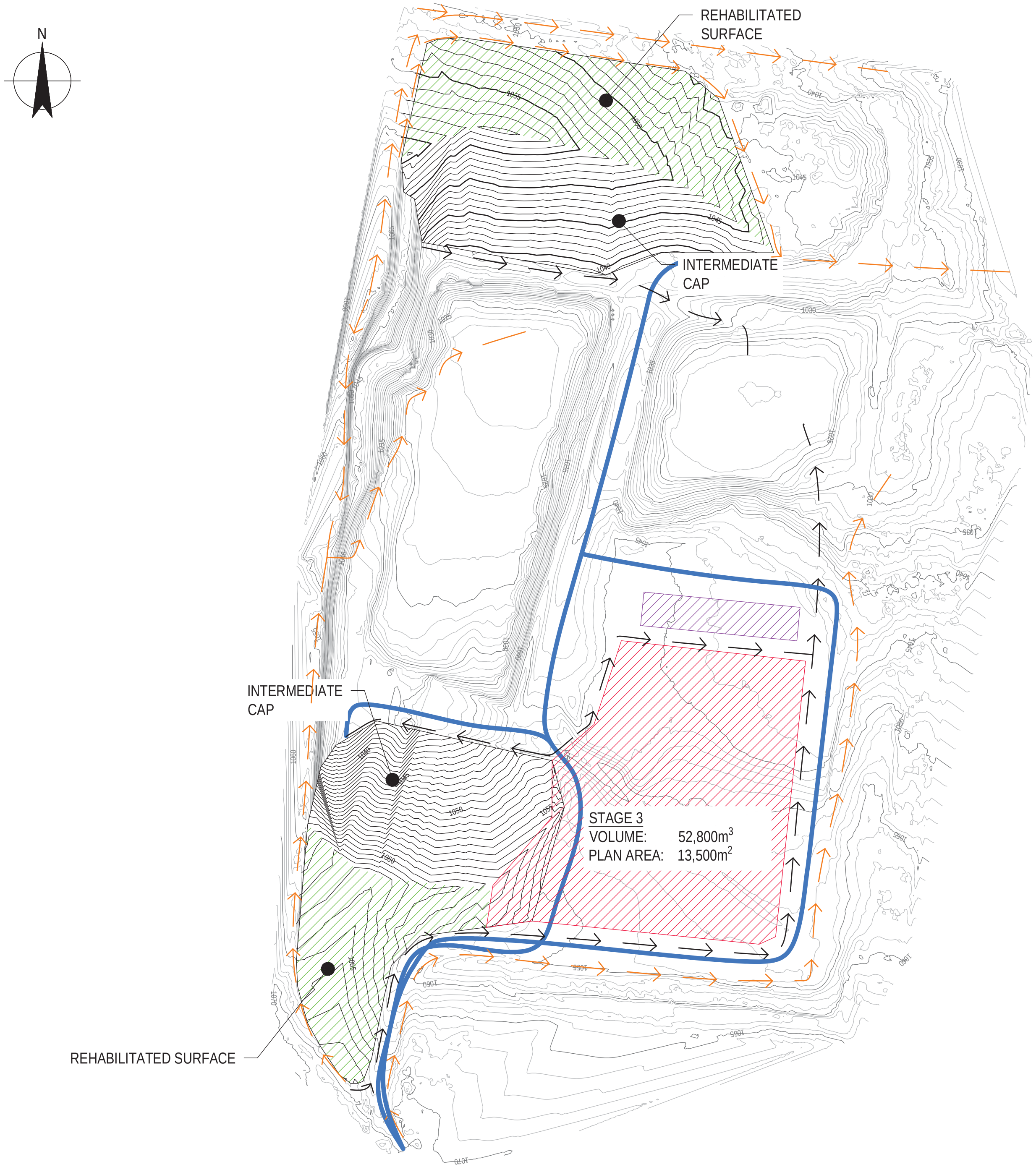

LEGEND

- EXISTING SURFACE
- DESIGN CONTOURS
- CATCHMENT AREAS
- CLEAN WATER FLOW
- SEDIMENT LADEN FLOW
- ACTIVE FILLING AREA
- REHABILITATED AREA
- AMENITIES AREA
- ACCESS ROAD

0 20 40 60m
SCALE 1:2000 AT ORIGINAL SIZE

PRELIMINARY

rev	description	app'd	date

CHAULOUHI CONSTRUCTIONS
BELL QUARRY REHABILITATION

STAGING PLANS
STAGE 3

GHD

Level 15, 133 Castlereagh Street, Sydney NSW 2000 Australia
T 61 2 9239 7100 **F** 61 2 9239 7199
E sydmail@ghd.com **W** www.ghd.com

scale	1:2000 for A3	job no.	21-25774
date	MAR 2017	rev no.	B

approved (PD) SK005

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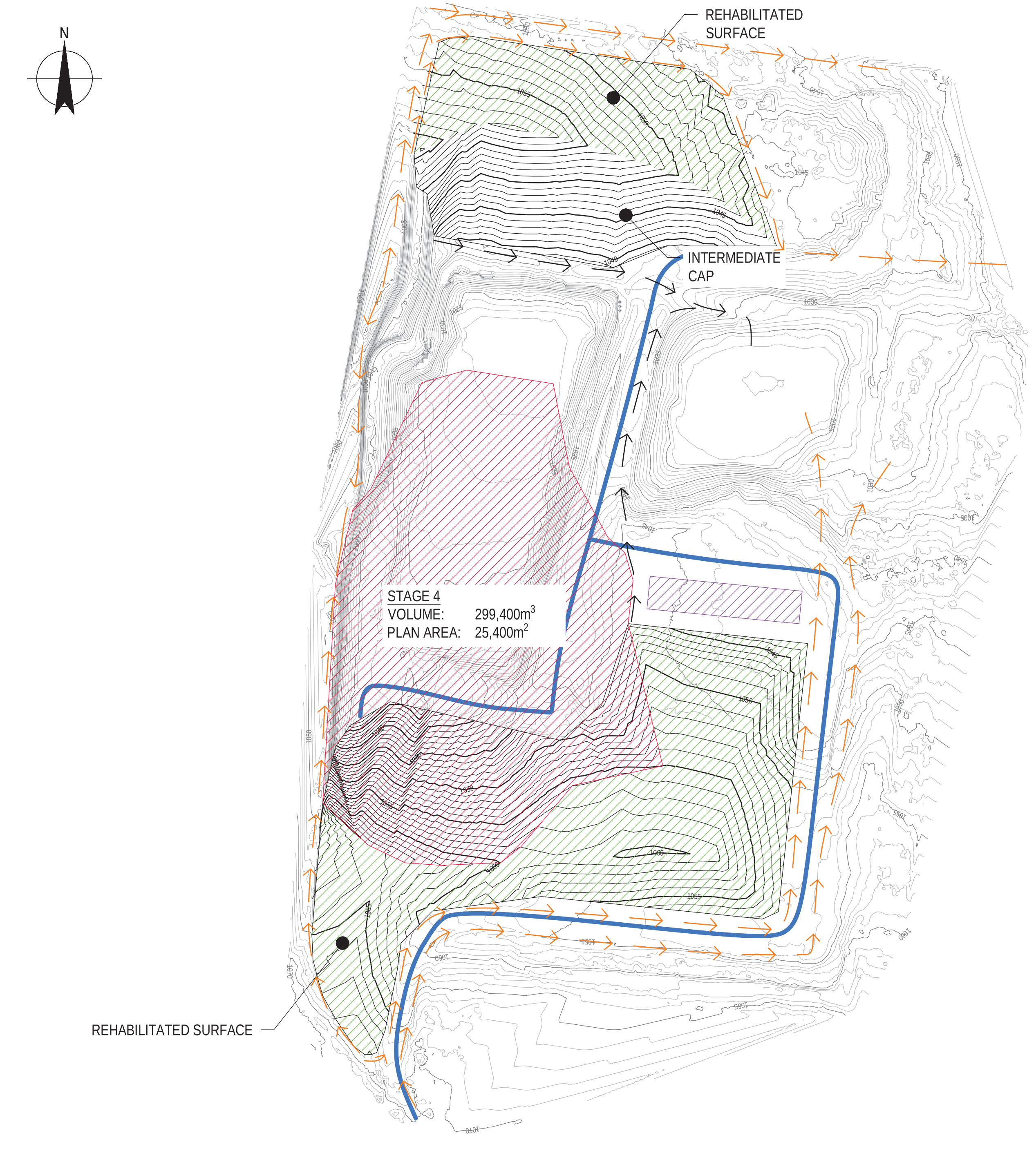

LEGEND

- EXISTING SURFACE
- DESIGN CONTOURS
- CATCHMENT AREAS
- CLEAN WATER FLOW
- SEDIMENT LADEN FLOW
- ACTIVE FILLING AREA
- REHABILITATED AREA
- AMENITIES AREA
- ACCESS ROAD

0 20 40 60m
SCALE 1:2000 AT ORIGINAL SIZE

PRELIMINARY

rev	description	app'd	date

CHAULOUHI CONSTRUCTIONS
BELL QUARRY REHABILITATION

STAGING PLANS
STAGE 4

Level 15, 133 Castlereagh Street, Sydney NSW 2000 Australia
T 61 2 9239 7100 **F** 61 2 9239 7199
E sydmail@ghd.com **W** www.ghd.com

scale	1:2000 for A3	job no.	21-25774
date	MAR 2017	rev no.	B

approved (PD) SK006

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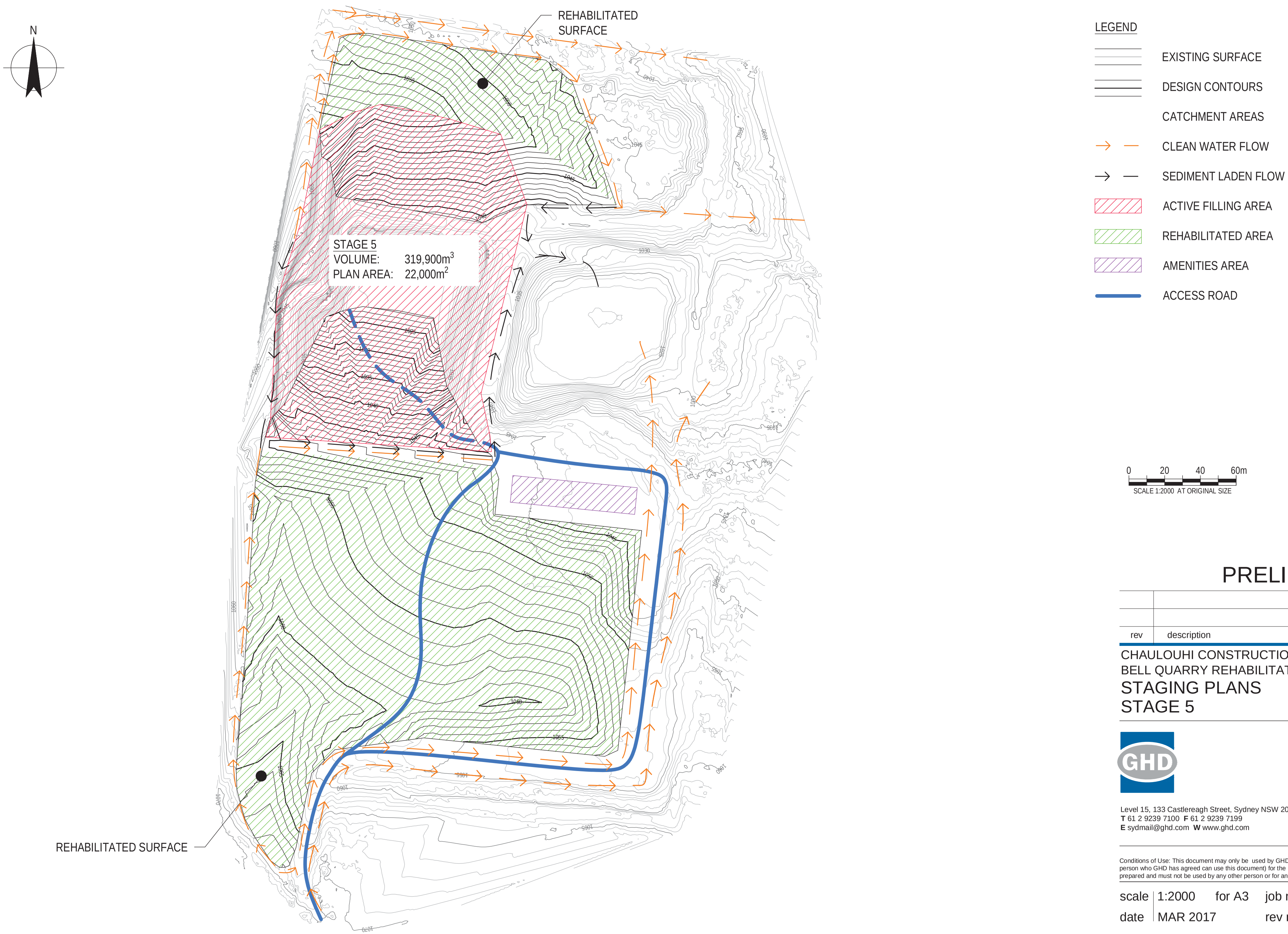

PRELIMINARY

rev	description	app'd	date

CHAULOUHI CONSTRUCTIONS
BELL QUARRY REHABILITATION

STAGING PLANS
STAGE 5

GHD
Level 15, 133 Castlereagh Street, Sydney NSW 2000 Australia
T 61 2 9239 7100 **F** 61 2 9239 7199
E sydmail@ghd.com **W** www.ghd.com

scale	1:2000	for A3	job no.	21-25774
date	MAR 2017		rev no.	B

approved (PD) SK007

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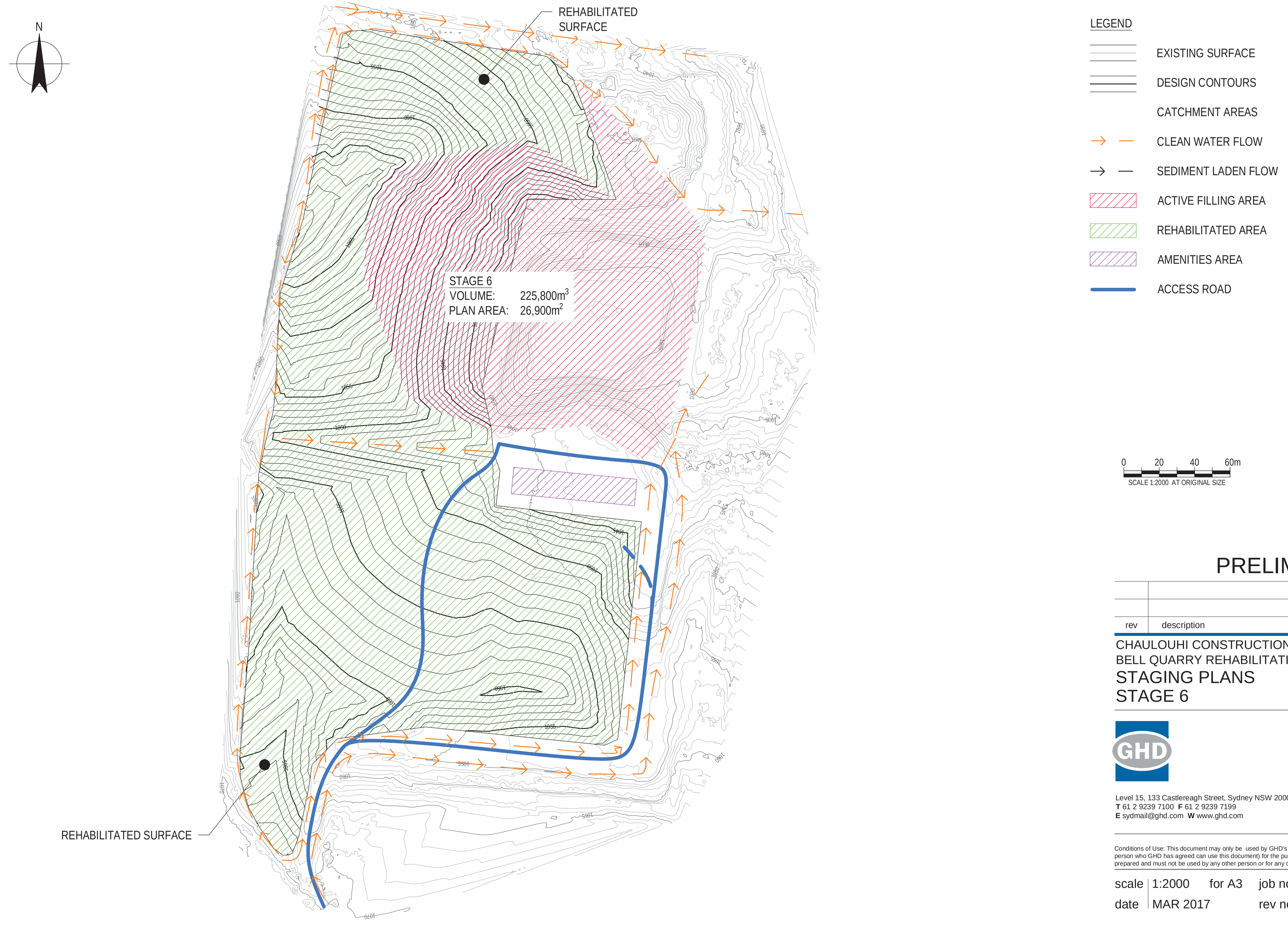

PRELIMINARY

rev	description	app'd	date

CHAULOUHI CONSTRUCTIONS
BELL QUARRY REHABILITATION

STAGING PLANS
STAGE 6

GHD

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scale	1:2000	for A3	job no.	21-25774
date	MAR 2017		rev no.	B

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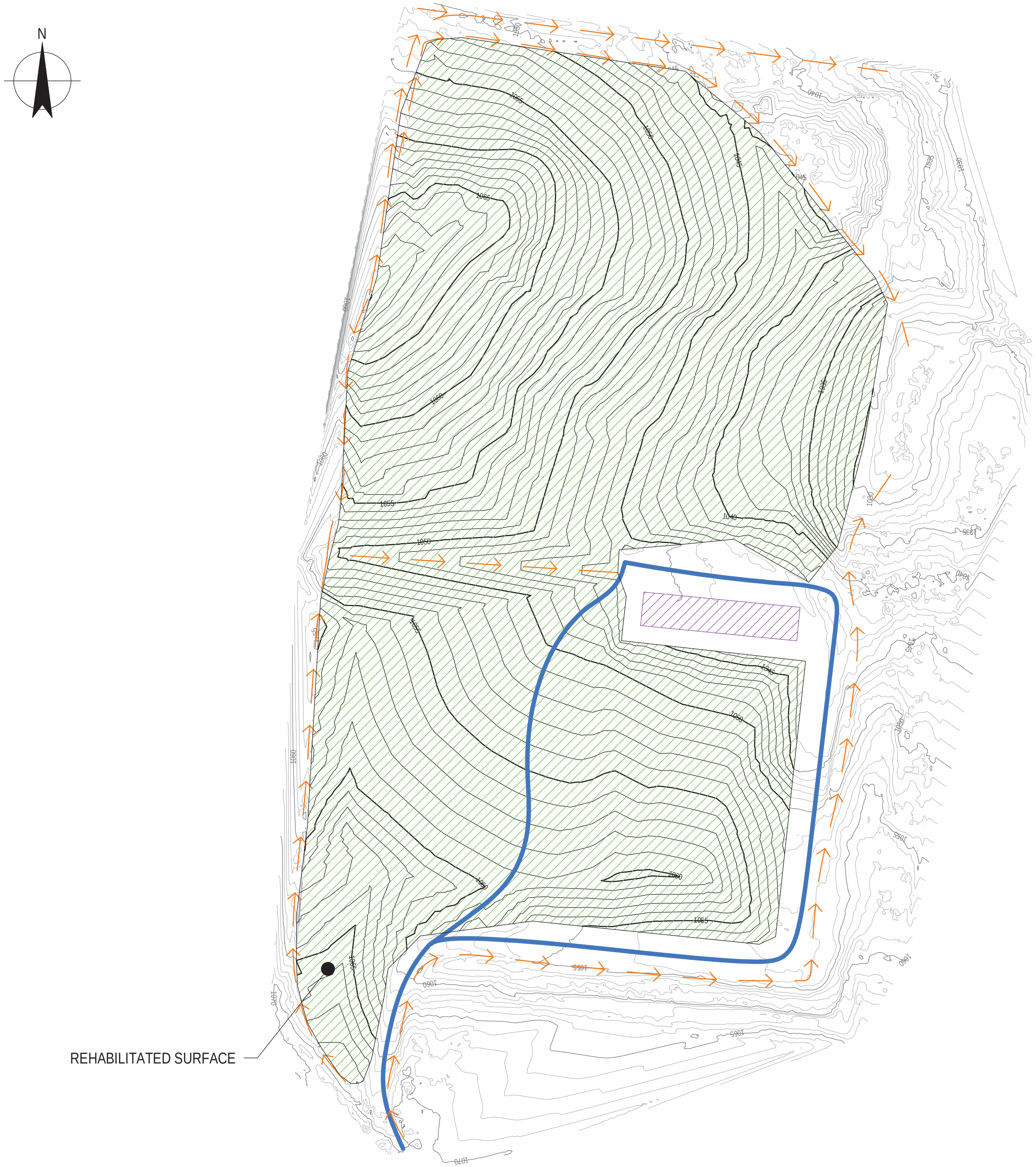

LEGEND

EXISTING SURFACE
DESIGN CONTOURS
CATCHMENT AREAS
CLEAN WATER FLOW
SEDIMENT LADEN FLOW
ACTIVE FILLING AREA
REHABILITATED AREA
AMENITIES AREA
ACCESS ROAD

PRELIMINARY

rev	description	app'd	date
A	INITIAL ISSUE		

CHAULOUHI CONSTRUCTIONS
BELL QUARRY REHABILITATION

STAGING PLANS
REHABILITATED SURFACE

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scale 1:2000 for A3 job no. 21-25774
date MAR 2017 rev no. B
approved (PD) SK009

LEGEND

- EXISTING SURFACE
- PROPOSED REHABILITATION SURFACE
- PROPOSED REHABILITAITON BOUNDARY
- PROPERTY BOUNDARY
- REHABILITATION WITHIN PROPERTY BOUNDARY
- REHABILITATION OUTSIDE PROPERTY BOUNDARY

PRELIMINARY

rev	description	app'd	date
A	INITIAL ISSUE		

BELL QUARRY REHABILITATION PROJECT

REHABILITATION BOUNDARY SHEET 1 OF 2

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date	MAR 2018		rev no.	A

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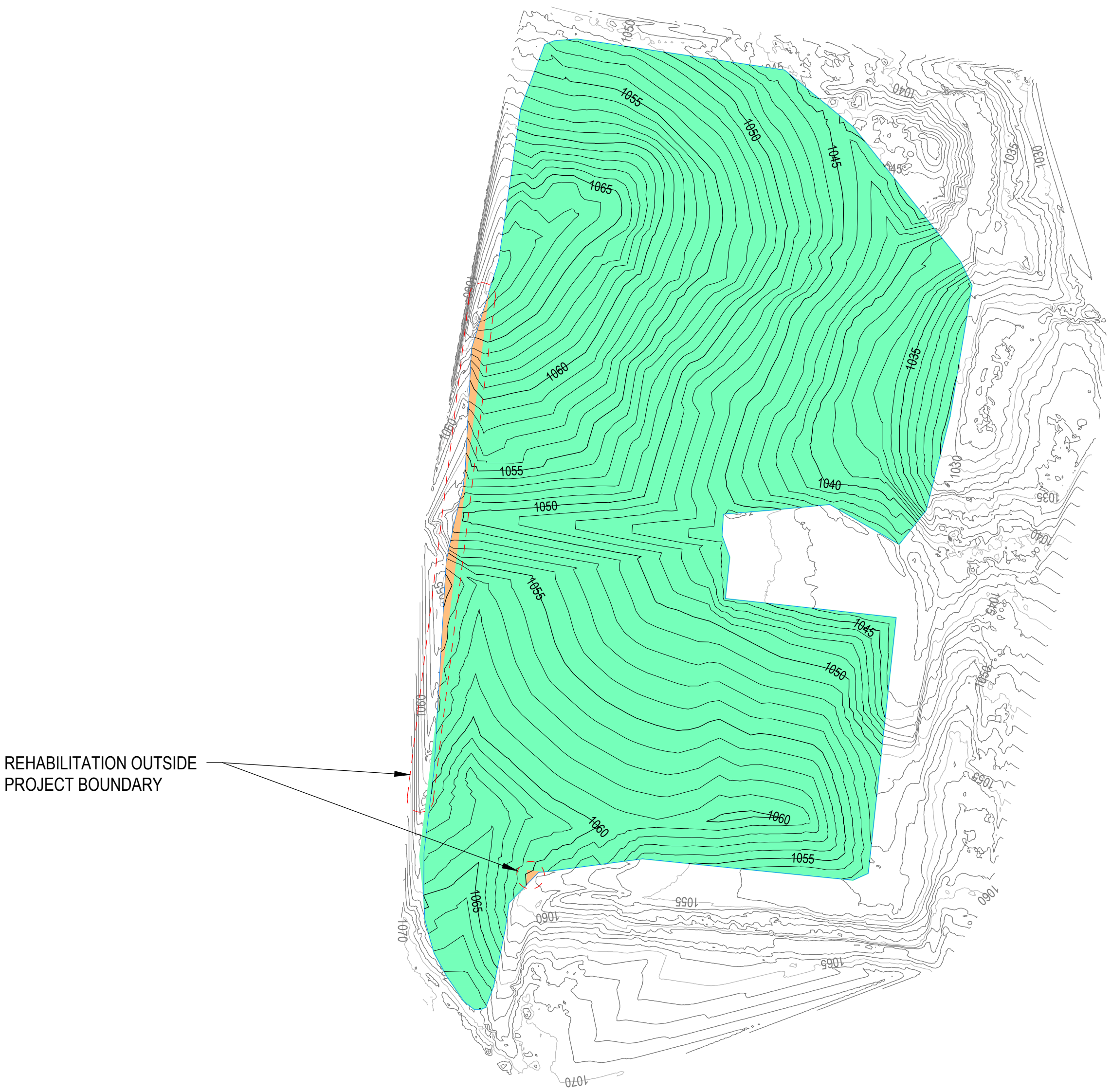
SK020

Plot Date: 8 March 2018 - 4:53 PM Plotted by: Tom Darley Cad File No: G:\21\25774\CADD\Drawings\21-25774-SK020.dwg



LEGEND

- EXISTING SURFACE
- PROPOSED REHABILITATION SURFACE
- PROPOSED REHABILITAITON BOUNDARY
- REHABILITATION WITHIN PROPERTY BOUNDARY
- REHABILITATION OUTSIDE PROPERTY BOUNDARY

PRELIMINARY

rev	description	app'd	date
A	INITIAL ISSUE		

BELL QUARRY REHABILITATION PROJECT

REHABILITATION BOUNDARY SHEET 2 OF 2

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scale	1:2500	for A3	job no.	21-25774
date	MAR 2018		rev no.	A

approved (PD) SK021

Appendix C

Water Resources
Assessment

Bell Quarry Rehabilitation Project Pty Ltd

Bell Quarry Rehabilitation Project
Water Resources Assessment

August 2018

Executive summary

Bell quarry is a now inactive quarry on Sandham Road in Newnes Junction, approximately 10 kilometres east of Lithgow, NSW. Bell Quarry Rehabilitation Project Pty Ltd are seeking to rehabilitate the quarry through the importation of virgin excavated natural material (VENM), excavated natural material (ENM) and other clean fill material (which is under a resource recovery order and exemption) sourced from earthworks projects across Sydney and the local regional area (the Project). GHD has been engaged by Bell Quarry Rehabilitation Project Pty Ltd to prepare the environmental impact assessment for the Project, which includes an assessment of the potential for impacts to the surface water and groundwater environments at and downstream of the site (this report).

The USEPA (1996) soil-water partition equation was used to estimate the quality of runoff from ENM with the maximum average acceptable concentrations as per the ENM Order. This indicated that the substances of potential concern in the ENM water were limited to metals, naphthalene and xylene. Analysis of representative VENM and ENM samples from the Sydney region indicated that the latter organic substances were not of concern.

The results from the flow proportions assessment were used along with the results from the USEPA (1996) soil-water partition equation, and leachate results for the representative VENM and ENM samples. No exceedances of the Guidelines Values (GVs) were predicted at the site boundary, with the exceptions of pH when using the partition equation results, and pH and zinc when using the leachate from Australian Standard Leaching Potential (ASLP) tests. The low pH values predicted were similar to those observed at the site and in the downstream tributary of the Wollangambe River.

The zinc exceedances predicted when using the leachate results were minor and not anticipated to be reflective of the quality of run-off from the site as a result of the conservative nature of the ASLP tests. They also did not exceed the zinc concentrations in natural background water quality in the Wollangambe River upstream of the Clarence Colliery and are not predicted to be observed above the GV approximately 200 metres downstream of the site boundary.

A conservative assessment of groundwater geochemistry and solute fate and transport has been undertaken to assess potential impacts of the project to the beneficial use of groundwater. The project satisfies the Level 1 minimal impact criterion under the NSW Aquifer Interference Policy and is not anticipated to result in a noticeable alteration to the quality of water at the nearest sensitive environmental receiver comprising a swamp approximately 200 metres down gradient from the site.

The assessment has concluded that due to the different times of emergence of ENM affects, the groundwater and surface impacts assessments have been treated as separate impacts that do not overlap. This conclusion will be proactively confirmed during site operations via monitoring of water quality and quantity and a review of the modelled predictions for the future stages of the project, to identify if additional adaptive management controls need to be implemented to meet the GVs for the rehabilitation of the site.

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Appendices

1. Introduction

1.1 Background

Bell Quarry (the site) is located on Sandham Road in Newnes Junction, approximately 10 kilometres east of Lithgow, NSW. Sand and sandstone extraction activities commenced at the site in 1967. The quarry operated under a development consent issued by Lithgow City Council in 1994 and an Environment Protection Licence (EPL) issued by the NSW Environment Protection Authority. The extraction activities have now ceased and the EPL was surrendered in October 2014.

Bell Quarry Rehabilitation Project Pty Ltd (BQRP) are seeking to rehabilitate the site (the portion east of the railway line) through the importation of virgin excavated natural material (VENM), excavated natural material (ENM) and other clean fill material sourced from earthworks projects across Sydney and the local regional area (the Project). The aim of the Project will be to emplace clean fill (which is either VENM or approved under a resource recovery order and exemption under the Protection of the Environment Operations Act 1997) within the existing footprint to enable the site to be returned to a condition more closely representing the original landform and that of the adjoining Blue Mountains National Park.

The excavated natural material order 2014 imposes the requirements that must be met by suppliers of ENM to which ‘the excavated natural material exemption 2014’ applies. The conditions set out in the order are designed to minimise the risk of potential harm to the environment, human health or agriculture by the reused and emplacement of material.

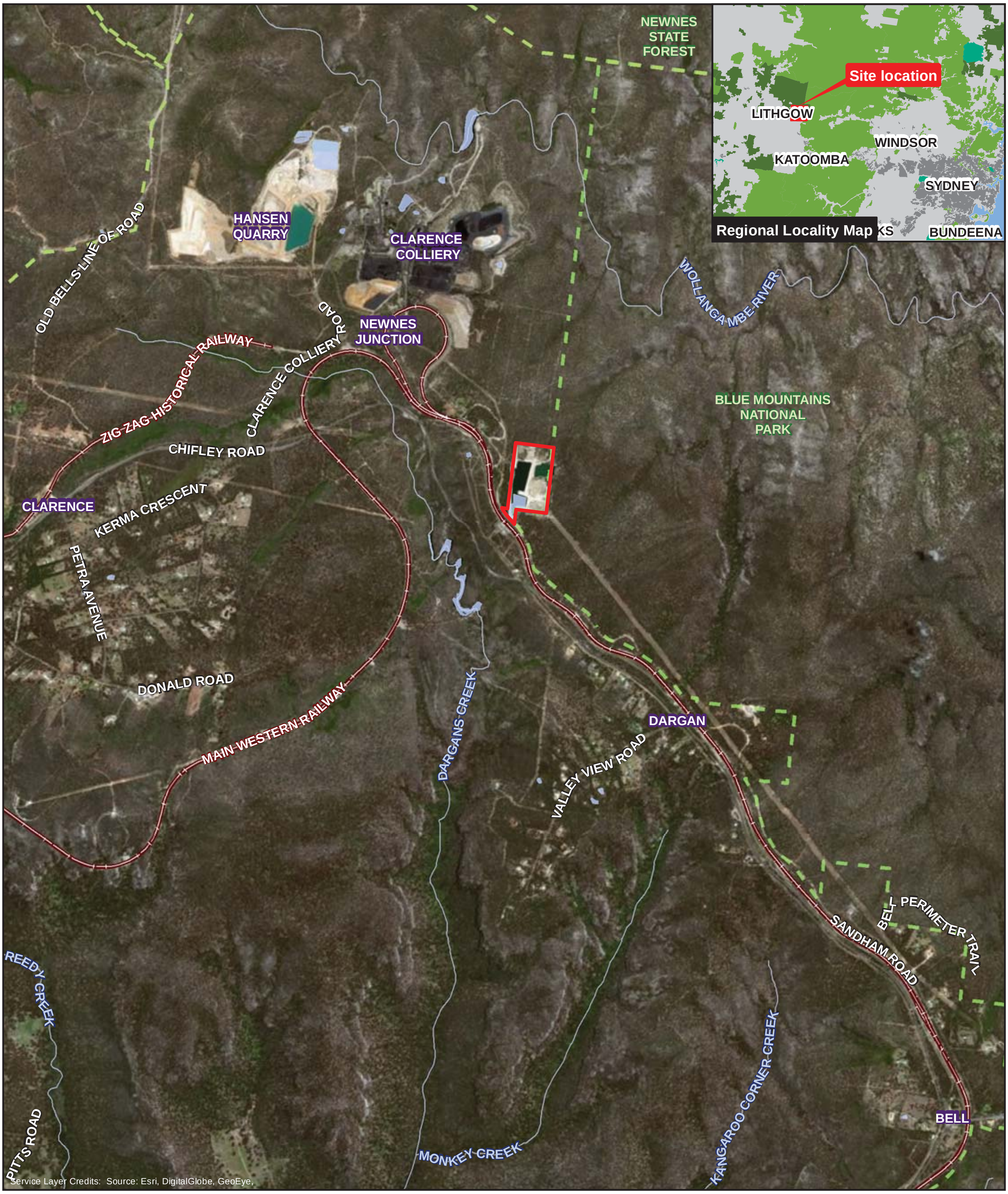
This report has been prepared by GHD as part of the environmental assessment of the Project. The potential for impacts to the surface water and groundwater receiving environment.

1.2 Study area

The site location is shown in Figure 1-1. The quarry was developed in a series of eight cells of between 0.8 ha and 1.5 ha each isolated from adjacent cells by in-situ sandstone barriers as shown in Figure 1-2.

Active quarry operations at the site have now ceased and the site consists of three voids, referred to herein as the south and north voids (which are currently linked by water), and the east void, which lie to the southwest, northwest and northeast of the site as shown on Figure 1-2. Surface water flows from the northeast corner of the north void into the east void, from where it discharges from the site into a small sediment basin prior to being discharged into an ephemeral tributary of the Wollangambe River in the Blue Mountains National Park.

The surface water and groundwater monitoring sites used in this assessment are shown in Figure 1-3.



LEGEND

- Bell Quarry
- Reserves and State Forests
- Waterbodies
- Waterways
- Rail

Paper Size A4

0 250 500 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Bell Quarry Rehabilitation Project
Water Resources Assessment

Job Number	21-25774
Revision	0
Date	16 Mar 2018

Site location

Figure 1-1

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com **W** www.ghd.com.au

Data source: Aerial imagery - sixmaps 2016, Inset map - Geoscience Australia, General topo - NSW LPI DTDB 2012, Landuse zoning - SILEP LZN. Created by: jrichardson, tmorton, gmcdiarmid

LEGEND

- Bell Quarry
- Discharge point
- Culverts
- Diversion Bank
- Flow Line
- Rail

Paper Size A4

0 15 30 60

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Bell Quarry Rehabilitation Project
Water Resources Assessment

Job Number	21-25774
Revision	0
Date	16 Mar 2018

Existing site layout

Figure 1-2

\\ghdnet\ghd\AU\Sydney\Projects\21\25774\GIS\Maps\Deliverables\WaterResAssess\21_25774_WRA005_ExistingSiteLayout

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com **W** www.ghd.com.au

Data source: Aerial imagery - AStute 2015 & sixmaps 2016, Inset map - Geoscience Australia, General topo - NSW LPI DTDB 2012, Landuse zoning - SILEP LZN. Created by: jrichardson, tmorton, gmcdiarmid

LEGEND

- Bell Quarry site
- Rail
- Waterways
- Groundwater monitoring
- Surface water monitoring
- Cross Section

Paper Size A4

0 20 40 80 120 160 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Bell Quarry Rehabilitation Project
Water Resources Assessment

Job Number	21-25774
Revision	0
Date	16 Mar 2018

Monitoring locations

Figure 1-3

G:\21\25774\GIS\Maps\Deliverables\WaterResAssess\21_25774_WRA001_MonitoringLocations_0.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

Data source: LPI: Aerial imagery, 2015. Commonwealth of Australia (Geoscience Australia): 250K Topographic Data Series 3, 2006. LPI: DTDB, 2015. Created by: tmorton, gmcdiarmid

1.3 Project description

The Project proposes to rehabilitate the site through the importation of VENM, ENM and other clean fill (which is under a resource recovery order and exemption) generated from earthworks projects in Sydney and surrounding regional areas. This rehabilitation will involve:

- Importation of approximately 1.2 million cubic metres of VENM, ENM and other clean fill material
- Vehicle haulage at a rate of up to 140,000 tonnes per annum (tpa)
- Emplacement and compaction of soil and rock material within the existing quarry voids
- Shaping of fill to closely represent the pre-quarry landform and to allow surface water drainage across the final landform
- Development of a water management system to control surface water discharges throughout the rehabilitation program and from the final landform
- Revegetation of the site with locally endemic species to provide effective integration with the surrounding landscape.

All clean fill material will meet the definition of either VENM, ENM or material permitted under a specific resource recovery order and associated exemption. The Protection of the Environment Operations Act 1997 defines virgin excavated natural material (VENM) as ‘natural’ material (such as clay, gravel, sand, soil or rock fines):

a. *that has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial, mining or agricultural activities, and*

b. *that does not contain any sulfidic ores or soils or any other waste.*

ENM refers naturally occurring rock and soil (including but not limited to materials such as sandstone, shale, clay and soil) that has:

a. *been excavated from the ground, and*

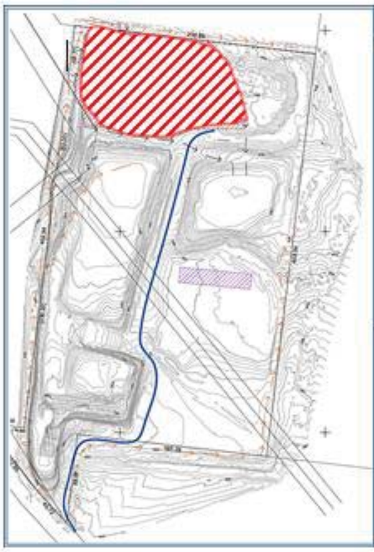
b. *contains at least 98% (by weight) natural material, and*

c. *does not meet the definition of Virgin Excavated Natural Material in the Act.*

Excavated natural material does not include material located in a hotspot; that has been processed; or that contains asbestos, Acid Sulfate Soils (ASS), Potential Acid Sulfate soils (PASS) or sulfidic ores.

The rehabilitation works will be located entirely within the existing footprint of the former quarry and the proposed staging of the Project is outlined below in Table **1-1**.

Table 1-1 Staging of the project



Stage One

Volume: 88,800 m^3

- Filling works over the north western corner of the site to achieve the rehabilitation landform. The completed fill surface would generally grade to the north and east.
- The southern fill batter will be graded at 1 (vertical) to 3 (horizontal) and an intermediate cap placed.
- In preparation for Stage 2, dewatering of the existing voids will occur. The main void will need to be dewatered and the water level maintained below RL 1032m to allow the south void to be completely dewatered in preparation for filling.
- No revegetation to occur in this stage.

EXISTING SURFACE
DESIGN CONTOURS
CATCHMENT AREAS
CLEAN WATER FLOW
SEDIMENT LADEN FLOW
ACTIVE FILLING AREA
REHABILITATED AREA
AMENITIES AREA
ACCESS ROAD

Stage Two

Volume: 271,700 m^3

- Filling works in the south void to the south of the access ramp. Once above the surrounding ground level, surface water runoff will be directed to the main void. The completed fill surface will have a central ridgeline, allowing water to drain to the east and west. The northern batter of filling in Stage 2 is shaped at 1 (vertical) to 3 (horizontal) and will be capped.
- Areas of Stage 1 at final levels revegetated.
- Development access road and extension of the stormwater drainage system to divert around the south eastern corner of the site, in preparation for Stage 3

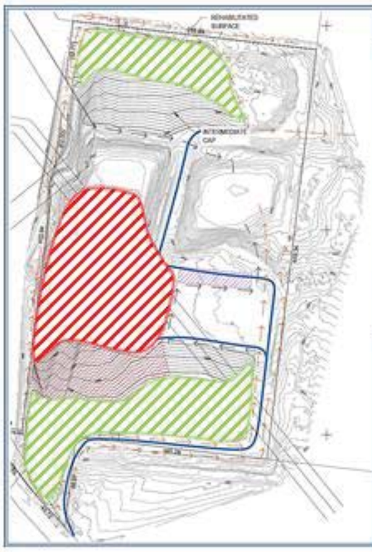
EXISTING SURFACE
DESIGN CONTOURS
CATCHMENT AREAS
CLEAN WATER FLOW
SEDIMENT LADEN FLOW
ACTIVE FILLING AREA
REHABILITATED AREA
AMENITIES AREA
ACCESS ROAD

Stage Three

Volume: 52,000 m^3

- Filling undertaken in the south eastern corner of the site, to the south of the east void. The filled surface will have a ridgeline near the southern extent, such that the southern portion falls to the south and the northern area will flow to the north. The western batter of filling in Stage 3 would be shaped at 1 (vertical) to 3 (horizontal) and an intermediate cap placed.
- Areas filled in Stage 2 at final levels will be revegetated.
- The main void will be dewatered in preparation for filling. A temporary sump installed in the north east corner of the main void will manage stormwater.

EXISTING SURFACE
DESIGN CONTOURS
CATCHMENT AREAS
CLEAN WATER FLOW
SEDIMENT LADEN FLOW
ACTIVE FILLING AREA
REHABILITATED AREA
AMENITIES AREA
ACCESS ROAD



Stage Four

Volume: 357,600 m^2

- Stage 4 filling is anticipated to be in the southern portion of the main void. The filled area would fall to the north and east. The northern batter of filling in Stage 4 would be shaped at 1 (vertical) to 3 (horizontal) and an intermediate cap placed.
- Stage 4 fill works will allow the surface water running onto the site from the west to flow over the fill area. Appropriate erosion and sediment controls will be installed along this drainage line.
- During the filling of Stage 4, areas of Stage 3 which have reached final levels would be revegetated.

EXISTING SURFACE
DESIGN CONTOURS
CATCHMENT AREAS
CLEAN WATER FLOW
SEDIMENT LADEN FLOW
ACTIVE FILLING AREA
REHABILITATED AREA
AMENITIES AREA
ACCESS ROAD

Stage Five

Volume: 293,800 m^3

- The northern portion of the main void will be filled in Stage 5. The final fill surface in this area will generally fall to the east. The eastern batter of filling in Stage 5 would be shaped at 1 (vertical) to 3 (horizontal) and an intermediate cap placed.
- During the filling of Stage 5, areas of Stage 4 which have reached final levels would be revegetated.
- To prepare Stage 6 for filling, the east void will require dewatering and desilting.

EXISTING SURFACE
DESIGN CONTOURS
CATCHMENT AREAS
CLEAN WATER FLOW
SEDIMENT LADEN FLOW
ACTIVE FILLING AREA
REHABILITATED AREA
AMENITIES AREA
ACCESS ROAD

Stage Six

Volume: 140,500 m^3

- The final area of filling would be the east void to create a surface which generally falls to the east. Throughout the filling of this stage, temporary sumps will need to be maintained in the fill area to allow for the collection and treatment of sediment laden surface water
- During the filling of Stage 6, areas of Stage 5 which have reached final levels would be revegetated. Upon completion of filling of Stage 6, the remaining areas will be revegetated.

EXISTING SURFACE
DESIGN CONTOURS
CATCHMENT AREAS
CLEAN WATER FLOW
SEDIMENT LADEN FLOW
ACTIVE FILLING AREA
REHABILITATED AREA
AMENITIES AREA
ACCESS ROAD

1.4 Environmental assessment requirements

The project is both designated and integrated development under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Secretary's Environmental Assessment Requirements (SEARs) for the preparation of an Environmental Impact Statement (EIS) for the project were provided on 18 November 2016. The requirements that relate to water resources are provided in Table 1-2.

Table 1-2 Secretary's environmental assessment requirements – soil and water

Secretary's environmental assessment requirements	Where addressed
• A description of local soils, topography, drainage and landscapes	Section 4.1
• An assessment of potential impacts on the quality and quantity of surface and groundwater resources	Section 5
• Details of fill material to be imported to the site, including quantity and its waste classification	
• Details of sediment and erosion controls	Section 6.1.1
• A detailed site water balance	Sections 4.2 and 5.2
• Details of the proposed stormwater and wastewater management systems (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts	Section 6
• A description and appraisal of impact mitigation and monitoring measures.	Section 6

1.5 Purpose of this report

This report has been prepared to support the EIS for the project and addresses the soil and water requirements of the SEARs. The aims and scope of this report are to:

- Outline the methods used for the water resources assessment
- Describe the existing environments of the study area, including the local soils, topography, drainage, landscapes, surface water environment and groundwater environment
- Assess the potential impacts of the Project on surface water and groundwater environments
- Recommend mitigation and management measures to avoid or minimise adverse impacts on the surface water and groundwater environments.

2. Relevant legislation, policies and guidelines

2.1 Legislation

2.1.1 Environmental Planning and Assessment Act 1979

The EP&A Act, administered by the NSW Department of Planning and Environment, is the core legislation relating to planning and development activities in NSW and provides the statutory framework under which development proposals are assessed. The EP&A Act aims to encourage the proper management, development and conservation of resources, environmental protection and ecologically sustainable development.

2.1.2 NSW National Parks and Wildlife Act 1974

The NPW Act, administered by the Office of Environment and Heritage, covers a range of areas including reserving lands, management of reserved lands, the protection of aboriginal objects and places, and the protection of native flora and fauna. The NPW Act is relevant to the Project due to the eastern boundary of the site sharing the boundary with the Blue Mountains National Park. Additionally, the reach of the Wollangambe River between the confluences with Bungleboori Creek and the Colo River is a declared wild river under the NPW Act, which aims to protect wild rivers and maintain their high conservation values.

2.1.3 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) is administered by the EPA, which is an independent statutory authority and the primary environmental regulator for NSW. The objectives of the POEO Act are to protect, restore and enhance the quality of the environment. Some of the mechanisms that can be applied under the POEO Act to achieve these objectives include programs to reduce pollution at the source and monitoring and reporting on environmental quality. The POEO Act regulates and requires licensing for environmental protection, including in some cases for waste generation and disposal and for water, air, land and noise pollution.

The material proposed to be received and utilised at the site to rehabilitate it is such that it would not trigger licensing under the POEO Act.

Protection of the Environment Operations (Waste) Regulation 2014

The excavated natural material order 2014 (ENM order) was issued by the EPA under clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014. The ENM order imposes the requirements that must be met by suppliers of ENM to which party applying the ENM to land must meet the requirements of ‘the excavated natural material exemption 2014’. The conditions set out in the order are designed to minimise the risk of potential harm to the environment, human health or agriculture. Specific resource recovery exemptions and resource recovery orders can be sought and obtained on a case-by-case basis where other material is fit for purpose.

2.1.4 Water Management Act 2000

Water Management Act

The Water Management Act 2000 (WM Act) is intended to ensure that water resources are conserved and properly managed for sustainable use benefitting both present and future generations. It is also intended to provide a formal means for the protection and enhancement of the environmental qualities of waterways and their catchments.

The WM Act controls the extraction and use of water, the construction of works such as dams and weirs, and the carrying out of activities in or near water sources in NSW. 'Water sources' are defined very broadly to include any river, lake, estuary or place where water occurs naturally on or below the surface of the ground and NSW coastal waters.

Part 2 of the WM Act applies to the requirement to obtain a licence for the "taking of water" from a water source. An access licence entitles its holder to specified shares in the available water within a specified water management area or from a specified water source. It enables the licence holder to take water from the environment in accordance with specified rates and conditions under the terms of the licence.

The licensing provision apply to areas of New South Wales that have a water sharing plan (WSP). Provisions within WSPs provide water to support the ecological processes and environmental needs of groundwater dependent ecosystems (GDEs) and waterways. WSPs also provide how the water available for extraction is shared between the environment, basic landholder rights, town water supplies and commercial uses.

The following two WSPs made under Section 50 of the WM Act are relevant to the Project:

- Greater Metropolitan Region Unregulated River Water Sources WSP (GMRU WSP).
- Greater Metropolitan Region Groundwater Sources WSP (GMR WSP).

Greater Metropolitan Region Unregulated River Water Sources Water Sharing Plan

For surface water, the site is located within the GMRU WSP, which became operational in July 2011. This WSP covers six water sources which are made up of a total of 87 management zones. The Project is located within the Colo River Management Zone.

Greater Metropolitan Region Groundwater Sources Water Sharing Plan

For groundwater, the site is located within the GMR WSP, which became operational in July 2011. This WSP covers 13 groundwater sources on the east coast of NSW. The Project is located within the Sydney Basin Richmond Groundwater Source.

Part 3 of the WM Act specifies approval requirements for water use, water management works approvals and activity approvals. There are two kinds of activity approvals including controlled activity approvals and aquifer interference approvals.

Controlled activity approvals confer a right for the holder to carry out a specified controlled activity on waterfront land which is defined as land within 40 metres of a river, lake, estuary or shoreline. The definition of controlled activities include the deposition of material (whether or not extractive material) on land and the definition of a river includes 'any watercourse, whether perennial or intermittent and whether comprising a natural channel or a natural channel artificially improved'.

The project involves emplacing clean fill material within 40 metres of an intermittent drainage channel to enable filling of the land to represent the pre quarried landform and drainage path and therefore triggers the need for a controlled activity approval under Section 91(2) of the WM Act to enable these rehabilitation works to be undertaken.

An aquifer interference approval confers a right on its holder to carry out one or more specified aquifer interference activities at a specified location, or in a specified area, in the course of carrying out specified activities. An aquifer interference activity includes any works that involve:

a. the penetration of an aquifer;

b. the interference with water in an aquifer;

c. the obstruction of the flow of water in an aquifer;

d. the taking of water from an aquifer in the course of carrying out mining, or any other activity prescribed by the regulations;

e. the disposal of water from an aquifer as referred to in paragraph (d).

The historical quarry operations have previously extended below the groundwater levels and therefore involved penetration of an aquifer. The Project involves filling the existing voids to return the aquifer to be representative of conditions prior to extraction. However, dewatering of voids will be required during active emplacement operations and will result in the temporary taking of water from the aquifer. The project would therefore be considered and an aquifer interference activity A water licence is required (unless an exemption applies or water is being taken under basic landholder right) where an aquifer interference activity causes the removal of water from a water source of the transfer of water from one water source to another. A water licence will need to be obtained for water take under Section 56 of the WM Act. Detailed water balance investigations have been undertaken as part of this assessment to outline the anticipated water take for the Project.

2.2 Policies

2.2.1 NSW Aquifer Interference Policy

The NSW Aquifer Interference Policy requires that potential impacts on groundwater sources, including their users and GDEs, be assessed against minimal impact considerations, outlined in Table 1 of the Policy. If the predicted impacts are less than the Level 1 minimal impact considerations, then these impacts will be considered as acceptable.

The Level 1 minimal impact considerations for less productive groundwater sources are relevant to the groundwater at the site and are as follows:

- Water table: less than or equal to 10% cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, 40 m from any high priority GDE or high priority culturally significant site listed in the schedule of the relevant WSP. A maximum of a 2 m decline cumulatively at any water supply work unless make good provisions should apply.
- Water pressure: a cumulative pressure head decline of not more than 40% of the 'post-water sharing plan' pressure head above the base of the water source to a maximum of a 2 m decline at any water supply work.
- Water quality: any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity. For alluvial water sources, there should be no increase of more than 1% per activity in the long-term average salinity in a highly connected surface water source at the nearest point to the activity. It is considered that the beneficial use category of groundwater at the Site is environmental protection.

2.3 Guidelines

2.3.1 Australian and New Zealand Guidelines for Fresh and Marine Water Quality

The National Water Quality Management Strategy (NWQMS) provides a national framework for improving water quality in Australia’s waterways. The main policy objective of the NWQMS is to achieve sustainable use of the nation’s water resources, protecting and enhancing their quality, while maintaining economic and social development.

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000) is a benchmark document of the NWQMS which provides a guide for assessing and managing ambient water quality in a wide range of water resource types and according to specified environmental values, such as aquatic ecosystems, primary industries, recreation and drinking water. ANZECC (2000) provide a framework for determining appropriate guideline values or performance criteria to evaluate the results of water quality monitoring programs.

The ANZECC Guidelines present numerical guidelines which can be used as a basis to assess the impact of the rehabilitation of Bell Quarry against defined objectives or values for the receiving waters.

The core concept of the ANZECC Guidelines relates to managing water quality for environmental values. For each environmental value, the guidelines identify particular water quality characteristics or ‘indicators’ that are used to assess whether the condition of the water supports that value. The environmental values expressed as water quality objectives provide goals to assist in the selection of the most appropriate management options within a catchment. The guiding principles include that:

- where the environmental values are being achieved in a waterway they should be protected; and
- where the environmental values are not being achieved in a waterway, all activities should work towards their achievement over time.

The environmental values expressed as water quality objectives provide goals to assist in the selection of the most appropriate management options within a catchment. The ANZECC Guidelines also advocate an ‘issues-based’ approach to assessing ambient water quality, rather than the application of rigid numerical criteria without an appreciation of the context. This means that the guidelines focus on:

- the environmental values we are seeking to achieve or maintain;
- the outcomes being sought; and
- the ecological and environmental processes that drive any water quality issue.

It should also be noted that the environmental values and respective numerical indicator values apply to ambient background water quality and are not intended to be applied to stormwater discharges or mixing zones associated with a release from a sediment basin. Discharges from the Bell Quarry site therefore need to be considered in recognition of other land uses within the catchment which also influence water quality.

The existing surface water quality in the Wollangambe River upstream of the Site was established using water quality data reported in OEH (2015). Data for two sampling locations upstream of the Site has been tabulated in this report, and compared to the following ANZECC (2000) GVs:

- The default GVs for physical and chemical stressors for upland rivers in south east NSW.
- The default GVs for conductivity and turbidity in upland rivers in south east Australia
- The GVs for toxicants in fresh water at the 99 percent protection level (applicable due to the high conservation value of the receiving environment).

Default ANZECC GVs for physical and chemical stressors applicable to the Bell Quarry site and adopted in this assessment are shown in Table 2-1. It is emphasised that these default GVs are water quality objectives only, and are not compliance standards.

ANZECC Guidelines states that site specific guideline values (SSGVs) are preferred and should be established and adopted, and that the default GVs should only be used where site specific values are not available. According to ANZECC Guidelines, SSGVs should be based on a minimum of two years of contiguous monthly data at the site, with the SSGVs computed as the 80th percentile values. As two years of contiguous monthly data is not available for the Bell Quarry site, the default GVs are applicable.

Table 2-1 ANZECC (2000) GVs applicable to the Bell Quarry site.

Parameter	Units	ANZECC (2000) GV
Default GVs for physical and chemical stressors		
Total phosphorous	mg/L	0.020
Reactive phosphorous	mg/L	0.015
Total nitrogen	mg/L	0.250
Nitrite and Nitrate	mg/L	0.015
Ammonia	mg/L	0.013
Dissolved Oxygen	% saturation	90 - 110
pH	pH unit	6.5 – 8.0
Default GVs for conductivity and turbidity		
EC	µS/cm	30 - 350
Turbidity	NTU	25
GVs for substances at the 99% protection level.		
Aluminium	mg/L	0.027
Arsenic	mg/L	0.0008
Cadmium	mg/L	0.00006
Chromium	mg/L	0.00001
Copper	mg/L	0.001
Lead	mg/L	0.001
Manganese	mg/L	1.2
Nickel	mg/L	0.008
Zinc	mg/L	0.0024
Mercury	mg/L	0.00006
Ammonia	mg/L	0.32
Naphthalene	mg/L	0.0025
Benzene	mg/L	0.600
Meta- & para-Xylene	mg/L	0.140
Ortho-Xylene	mg/L	0.200

The ANZECC (2000) guidelines adopt a risk-based approach to assessing ambient water quality by providing the framework to tailor water quality guidelines to local environmental conditions. Guideline values (GVs) provided by ANZECC (2000) can be modified into regional, local or site-specific guideline values (SSGVs) by taking into account factors such as the variability of the particular ecosystem, soil types, rainfall and level of exposure to contaminants. It should be noted that guideline values are applied to the receiving environment at the edge of the mixing zone and do not apply to the point of discharges.

2.3.2 Approved Methods for the Sampling and Analysis of Water Pollutants in NSW

The document Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (EPA 2004) lists the sampling and analysis methods to be used when acquiring water samples for compliance with environmental protection legislation, a relevant licence or relevant notice.

3. Assessment methodology

3.1 Overview

The objective of this Water Resources Assessment (WRA) is to determine the potential impact of the Project on surface water and groundwater environments. The identification of conceptual pathways that have potential to result in impacts to water resources has enabled the development of a targeted assessment methodology, measures to avoid or mitigate impacts, and the monitoring programs required for the Project.

The following potential impacts to surface water and groundwater systems were identified:

- Impacts to surface water and groundwater quality downstream of the site associated with rainfall and run-off coming into contact with emplaced material prior to discharging from the site or infiltration to groundwater.
- Impacts to the quantity of surface and groundwater downstream of the site associated with altered runoff and discharge patterns from the site.
- Impacts to the stability and geomorphology of the tributary of the Wollangambe River located downstream of the Site through alteration of flow regimes.

Based on these potential impacts a tailored assessment methodology was developed and described in detail in the following sections. The methodology involved development of the following:

- A detailed water balance to estimate water transfer volumes throughout the site under a number of rainfall scenarios
- A flow duration assessment to assess the change in flow regimes downstream of the site during all stages of the rehabilitation program
- A flow proportion assessment to assess the proportions of flows that have come into contact with emplaced material.
- A review of background water quality based upon sampling at the site and review of records from the locality
- Geochemical modelling to predict the quality of water discharging from the site and at key locations downstream from the site.
- Installation of groundwater monitoring wells to determine existing groundwater levels and quality at the site
- Geochemical and fate and transport modelling to determine potential impacts upon the nearest groundwater sensitive receiver identified as a swamp located approximately 200 metres downstream from the site discharge.

3.2 Water balance

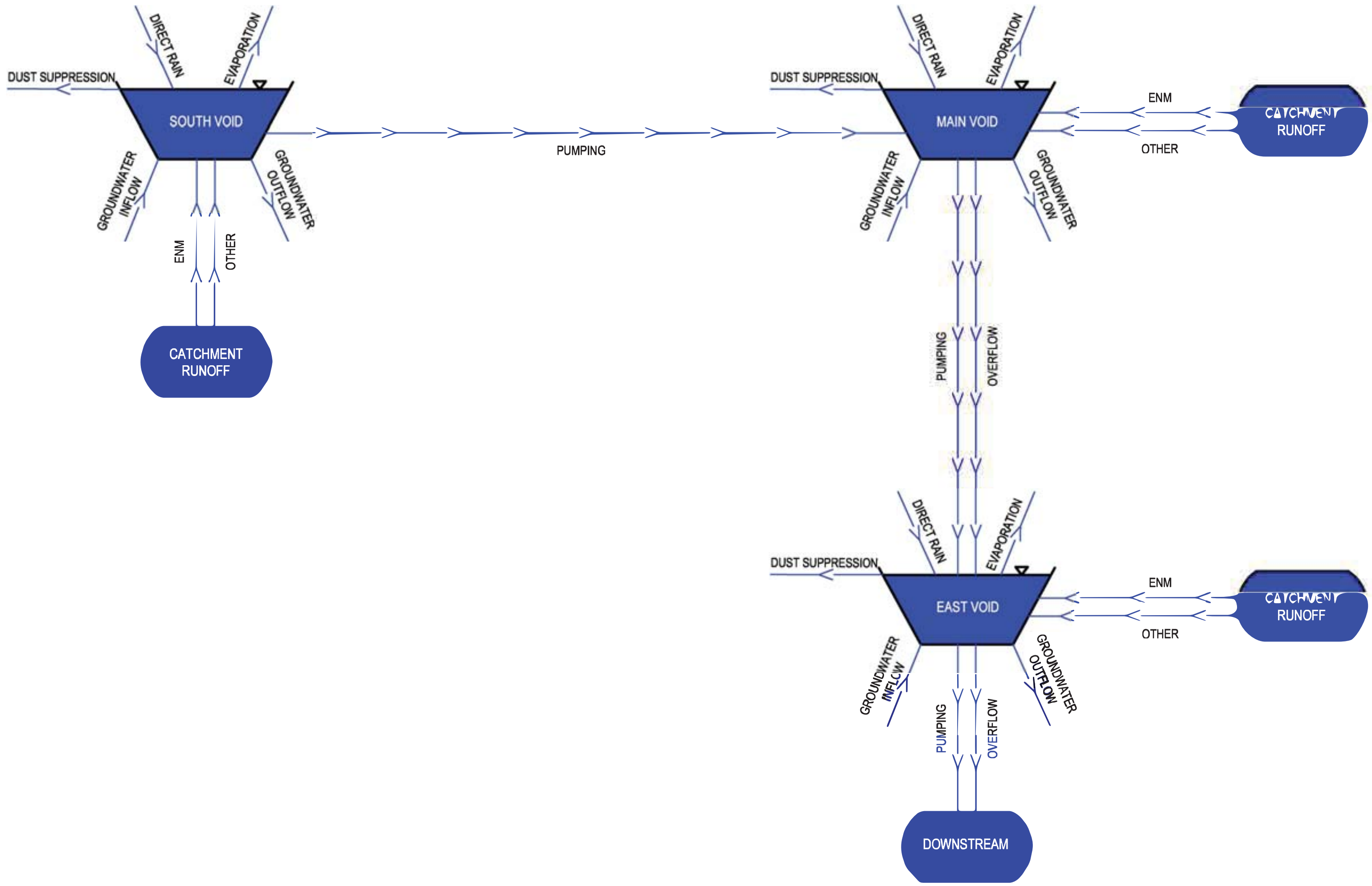
A detailed site water balance was developed for the site. This allowed estimation of total volumes of water transfers for different elements of the site such as runoff, evaporation, reuse, groundwater inflow/outflow and discharge for different phases of the project. It also allowed estimation of the proportion of total water in the system that would come into contact with emplaced material. Understanding of the total volumes and proportions in turn allows assessment of the following:

- Total inflow/outflow volumes for the purpose of water licensing review
- Total discharge volume, frequency and rate to inform the flow duration assessment
- Proportion of total discharge flows that have come into contact with emplaced material to inform estimation of the surface water quality of discharges

3.2.1 Water Balance Representation

The water balance model was developed using the GoldSIM software package as a daily time-step model on the basis of historical meteorological data. That is, on each day of the time series the model estimated the inflows, outflows and storage levels in each of the three voids. The water cycle schematic represented in the model is shown on Figure 3-1. Each of the transfers in the water cycle schematic were represented on a daily basis in the model. The transfers are governed by a number of rules or processes established in the model. For example, pumping rates are established based on assumed operational procedures and pump rates, runoff is based on representation of a rainfall:runoff model and evaporation is estimated based on observed evaporation and the wetted surface area of the voids at each time step. Table 3-1 summarises the basis for the representation of key transfers.

The time series represented in the model corresponded to the predicted life of the project which allowed representation of the proposed filing pattern and staging plan of the project. However, in order to represent the potential range of climatic conditions that could be experienced over the project life the period was simulated a number of times for each iteration, representing a different rainfall time series for each simulation until all of the modelled rainfall time series was represented. Each simulation of the model for a different climate time series is referred to as a ‘realisation’.



BELL QUARRY REHABILITATION PROJECT

WATER CYCLE SCHEMATIC

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Figure 3-1

Table 3-1 Water Balance Representation

Element	Representation
Rainfall	A daily rainfall dataset from 1900 to 2015 was represented from the SILO database managed by the Queensland Government. The database works by selecting a Bureau of Meteorology Rainfall Station to centre the data extraction on with the SILO database interpolating data from nearby stations where not available at the selected station. The selected station was the Lithgow station 063224. Although this station is located at a significantly different elevation to the site it was selected based on review of data available at the closest station to the site at Newnes Junction (063139). Whilst this station does not have enough rainfall data to select it for the data extraction, review of the data at this location indicates a much closer match in rainfall conditions to the Lithgow Station than other potential stations with significant data such as Mt Wilson (063057). The average annual rainfall for the extracted data based on the Lithgow Station was 855 mm.
Runoff	Runoff was represented based on simulation of the Australian Water Balance Model (AWBM) framework within the model. This framework is widely used in studies throughout Australia and literature is available to guide in selecting model parameters where calibration data is not available in the catchment in question. Catchment areas were estimated for each stage based upon the developed staging plans, with catchments separated into natural areas, quarry areas and quarry areas with emplaced material on them at that stage. For undisturbed natural catchments AWBM parameters were selected based on *Boughton and Chiew, 2003* parameters for data collected at the Coxs River stream flow gauging station 212045. For disturbed quarry catchments and catchments of emplaced material rainfall storage parameters in the model were reduced to represent the loss of storage from removal of vegetation and runoff response time was decreased to represent the lower proportion of baseflow than would be expected for a natural catchment.
Evaporation	Evaporation data was sourced from the SILO data extraction undertaken for the rainfall data. Pan evaporation was converted to field evaporation based on factors provided in *McMahon et. al. 2012.*. This field evaporation was then applied to the wetted surface areas in each of the voids to estimate the daily evaporation rate.

Element	Representation
Groundwater Inflow/Outflow	A relationship was developed for the groundwater inflow/outflow into each void based on the current water level in the void. The Dupuit-Forcheimer equation (Marinelli and Niccoli, 2000), applicable for the evaluation of dewatering rates in a pit excavation, was used in this analysis. A low and a high inflow scenario was calculated. The low inflow scenario is based on the following parameters: • Rainfall recharge of 51 mm/yr (approximately 6 % annual average rainfall as per the Water Sharing Plan) • Horizontal hydraulic conductivity of 3 x 10^{-8} m/s (based on typical values for Banks Walls Sandstone in the region). • Regional groundwater head of 1050 m AHD and base of pits at 1021.6 m AHD[1]. The high inflow scenario is based on the following parameters: • Rainfall recharge of 51 mm/yr (approximately 6 % annual average rainfall as per the Water Sharing Plan) • Horizontal hydraulic conductivity of 6 x 10^{-7} m/s (based on field testing). • Regional groundwater head of 1050 m AHD and base of pits at 1021.6 m AHD.
Dust Suppression	Dust suppression was represented as being applied over the quarry and emplacement areas. The depth of application was represented as storage depth available in the AWBM soil moisture storage on the basis that this represents saturation of the soil without generation of runoff. This dust suppression was applied as an input to the AWBM model so the affect of saturation of the soil on subsequent runoff was represented.
Project Stages	Project stages were represented based on the required filling times as well as dewatering requirements. Triggers were introduced into the model to step the stage up to the subsequent stage if the required filling time and dewatering requirements are satisfied. This allowed for analysis of model results based on respective stages of the project. Furthermore, some voids were deactivated in the model and converted to being a catchment area for another void during later stages of the project when those voids are completely filled.
Pumping/Dewatering	Pumping and dewatering were represented based on operational rules dependent on the current stage of the project. For example, pumping from one void to another is represented when that stage involves dewatering of the void for the next stage. When a void is being filled for the current stage water is assumed to be immediately pumped out of that void after rainfall.

[1] A bathymetric survey was undertaken at the site to determine the depth of the water filled voids.

3.2.2 Flow Duration Assessment

A flow duration assessment was undertaken based on the results of the water balance to assess the change in flow regimes downstream of the site during the project both with respect to existing and natural conditions. This in turn allowed assessment of waterway stability and aquatic ecological impacts downstream.

This was undertaken based on statistical analysis of the daily time series of flows at the site discharge predicted by the water balance. This involved a percentile analysis to provide an indication of the predicted low flows, moderate flows and higher flows and how they may change due to the implementation of the project. This was undertaken for the modelled project as well as for existing conditions, rehabilitated conditions and natural conditions.

This analysis was also undertaken at a point further downstream to assess the extent of any impacts and the impact of attenuation of the impacts based on mixing with flows from downstream catchment areas. The location of the two analysed points is indicated on Figure 3-2.

LEGEND

- Bell Quarry site
- Rail
- Waterways
- Flow Duration and Flow Proportion Assessment Locations
- Flow Proportion Assessment Locations

Paper Size A4

0 40 80 160 240 320 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Bell Quarry Rehabilitation Project
Water Resource Assessment

Job Number	21-25774
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Date	16 Mar 2018

Assessment locations

Figure 3-2

G:\21\25774\GIS\Maps\Deliverables\WaterResAssess\21_25774_WRA003_Assessment_Locations_0.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

Data source: LPI: Aerial imagery, 2015. Commonwealth of Australia (Geoscience Australia): 250K Topographic Data Series 3, 2006. LPI: DTDB, 2015. Created by: tmorton, gmcdiarmid

3.2.3 Flow Proportions Assessment

The water balance was extended to allow an assessment of the proportions of flows that have come into contact with emplaced material. This was undertaken by applying a factor of one to flows generated from emplaced area runoff and a factor of zero to other flows. These inputs were then traced through the model to the point of discharge from the site to estimate the corresponding volumetric proportion. This result was analysed for each of the stages and the different rainfall simulations to provide a range of potential proportions which were then adopted in the subsequent water quality assessment.

The median proportion predicted over each stage was then extracted for the water quality assessment. This is on the basis of the relatively large extent and volume of the receiving system compared to the daily discharge volumes from the site, meaning that receiving environment water quality conditions are most sensitive to longer term accumulation and trends rather than daily peak ratios, with these trends most accurately represented by the median proportion.

To assist in developing mitigation measures the flow proportion of water that has come into contact with emplaced material was also reviewed at a downstream location and in the Wollangambe River as indicated on Figure 3-2. This was undertaken by delineating external catchment areas draining to these locations. This catchment was then represented (as a natural vegetated catchment) in the runoff model within the water balance model. The proportions were then calculated in the water balance model as described above for these locations, including the external catchment runoff.

3.3 Surface water quality

3.3.1 Existing conditions

The existing surface water quality in the Wollangambe River upstream of the site was established using water quality data reported in OEH (2015). Data for two sampling locations upstream of the site (one upstream of the Clarence Colliery discharge and one downstream of the discharge) has been tabulated in this report, and compared to the following ANZECC (2000) GVs:

- The default GVs for physical and chemical stressors for upland rivers in south east NSW (table 3.3.2 in ANZECC (2000)).
- The default GVs for conductivity and turbidity in upland rivers in south east Australia (table 3.3.3 in ANZECC (2000)
- The GVs for substances in fresh water at the 99 percent protection level (applicable due to the high conservation value of the receiving environment) (table 3.4.1 in ANZECC (2000)). For arsenic and chromium, for which the potential toxicity is dependent on the oxidation state, the GVs for the more toxic oxidation state were adopted.

The existing surface water quality at the site and in the receiving environment was established based on sampling performed during a site visit on 9 March 2017. The following sites were sampled:

- North void – grab samples were collected at the northeast corner of the north void, where it discharges to the east void.
- East void – grab samples were collected at the southeast corner of the east void, where it discharges to the sediment basin.
- Site discharge – grab samples were collected at the northeast corner of the sediment basin where water is discharged from the site into the tributary of the Wollangambe River.

- Tributary – grab samples were collected from the tributary approximately 100 m downstream of the site discharge, upstream of the swamp
- Tributary DS – grab samples were collected for the tributary downstream of its confluence with a similar tributary which has headwaters to the north of the site.

These samples were sent to a NATA accredited laboratory for testing for the parameters listed in Table 3-2.

Table 3-2 Analytical schedule - water quality samples, 9 March 2017.

Analyte group	Analytes
Physicochemical parameters	Electrical conductivity (EC), pH, total suspended solids (TSS)
Major cations and anions	Calcium, magnesium, sodium, potassium, Total alkalinity, sulfate, chloride
Dissolved metals	Aluminium, arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel, zinc, mercury
Nutrients	Ammonia, nitrite and nitrate, total Kjeldahl nitrogen (TKN), total nitrogen (TN), total phosphorous (TP), reactive phosphorous (RP)
Hydrocarbons	Polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH), total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylene, naphthalene (BTEXN)
Other	Dissolved organic carbon (DOC)

To assess the existing condition of the surface water environment at the site, the results of the analyses detailed above were compared against the ANZECC (2000) GVs as detailed above (refer Section 4.4). The certificate of analysis for these analyses is provided as Appendix A.

3.3.2 Impact assessment

For the assessment of the potential impacts of the project on the surface water environment, the results from the flow proportions assessment were used (refer Section 3.2.3). The assessment involved two key steps: predicting the quality of water interfacing with emplaced ENM, and predicting the water quality of the site discharge following natural substance concentration reduction by water which has not interfaced with ENM.

The potential discharge water quality from the site during the construction stages was estimated using the USEPA soil-water partition equation (USEPA 1996), which is an industry standard equation for estimating the potential transfer of inorganic and organic substances in soils into the liquid state. The soil-water partition equations for inorganic and organic substances as reported in USEPA (1996) are presented below as Equation 3-1 and Equation 3-2 along with the parameter definitions and their default values (where applicable). These equations were solved for C_w ("the target soil leachate concentration") using the maximum average substance concentrations (or the absolute maximum concentrations, where no maximum average concentration exists) from Table 4 of the NSW ENM order (EPA 2014), which has been reproduced as Table 3-3 below. It is noted that, under the ENM order, substance concentrations in a single ENM sample may exceed the maximum average concentrations presented in Table 3-3, but the average concentrations in the imported materials must not. Therefore the maximum average concentrations were the most applicable to use when solving the partition equation for C_w. The default parameter values presented in Equation 3-1 and Equation 3-2 were used with the following exceptions:

- Dry soil bulk density was set at 1.8 kg/L to align with the assumptions of the project staging (Section 1.3)

- The dilution attenuation factor (DAF) was conservatively reduced to 10, which more accurately reflects the site area than the default DAF of 20, which is based on a 0.5-acre source.

Soil-water partition coefficients (K_d) for metals were sourced from Allison and Allison (2005), which is a USEPA document that presents median K_d values based on a literature review. Soil organic carbon-water coefficients (K_{oc}) were and dimensionless Henrys law constants (H) were sourced from USEPA (2016).

The soil-water partition equation results were compared to the ANZECC (2000) GVs as outlined in Section 3.3.1.

As there is no relevant GV for total PAHs, the soil water concentration of naphthalene (the only PAH for which ANZECC (2000) presents a GV) was estimated assuming a naphthalene concentration of 0.1 mg/kg in ENM. This concentration was based on the results reported in Nguyen *et al.* (2014) for naphthalene in contaminated road-deposited sediments in Kogarah, Sydney. Road-deposited sediments had the highest naphthalene concentrations of the soil types studied by Nguyen *et al.* (2014), with an average of approximately 0.05 mg/kg. As such, the adopted concentration of 0.1 mg/kg is conservatively representative of that which may be observed in ENM sourced from the greater Sydney region.

As there is no relevant ANZECC (2000) GV for total xylene, noting that xylene exists as a mixture of three isomers, the assumed concentrations of these isomers in ENM were based on the normal distribution of these isomers as reported in Kandayla *et al*. (2010), which are: 20% ortho-xylene, 60% meta-xylene, and 20% para xylene. As such, the assumed concentrations of these isomers in ENM corresponded to these percentages of the ENM order absolute maximum concentration for xylene (15 mg/kg), i.e. 3, 9 and 3 mg/kg respectively.

Equation 3-1 Soil-water partition equation for inorganic substances.

$$C_t = C_w \left(K_d + \frac{\theta_w + \theta_a H'}{\rho_b} \right)$$

Parameter/Definition (units)	Default	Source
C_t/screening level in soil (mg/kg)	–	–
C_w/target soil leachate concentration (mg/L)	(nonzero MCLG, MCL, or HBL) × 20 DAF	Table 1 (nonzero MCLG, MCL); Section 2.5.6 (DAF for 0.5-acre source)
K_d/soil-water partition coefficient (L/kg)	chemical-specific	see Part 5
θ_w/water-filled soil porosity (L_{water}/L_{soil})	0.3 (30%)	U.S. EPA/ORD
θ_a/air-filled soil porosity (L_{air}/L_{soil})	0.13	$n - \theta_w$
n/total soil porosity (L_{pore}/L_{soil})	0.43	$1 - \rho_b/\rho_s$
ρ_b/dry soil bulk density (kg/L)	1.5	U.S. EPA, 1991b
ρ_s/soil particle density (kg/L)	2.65	U.S. EPA, 1991b
H′/dimensionless Henry's law constant	H × 41, where 41 is a conversion factor	U.S. EPA, 1991b
H/Henry's law constant (atm-m^3/mol)	chemical-specific	see Part 5

Equation 3-2 Soil-water partition equation for organic substances.

$$C_t = C_w \left((K_{oc}\, f_{oc}) + \frac{\theta_w + \theta_a H'}{\rho_b} \right)$$

Parameter/Definition (units)	Default	Source
C_t/screening level in soil mg/kg)	–	–
C_w/target leachate concentration (mg/L)	(nonzero MCLG, MCL, or HBL) × 20 DAF	Table 1 (MCL, nonzero MCLG); Section 2.5.6 (DAF for a 0.5-acre source)
K_{oc}/soil organic carbon-water partition coefficient (L/kg)	chemical-specific	see Part 5
f_{oc}/organic carbon content of soil (kg/kg)	0.002 (0.2%)	Carsel et al., 1988
θ_w/water-filled soil porosity (L_{water}/L_{soil})	0.3 (30%)	U.S. EPA/ORD
θ_a/air-filled soil porosity (L_{air}/L_{soil})	0.13	$n - \theta_w$
n/total soil porosity (L_{pore}/L_{soil})	0.43	$1 - \rho_b/\rho_s$
ρ_b/dry soil bulk density (kg/L)	1.5	U.S. EPA, 1991b
ρ_s/soil particle density (kg/L)	2.65	U.S. EPA, 1991b
H′/dimensionless Henry's law constant	H × 41, where 41 is a conversion factor	U.S. EPA, 1991b
H/Henry's law constant (atm-m^3/mol)	chemical-specific	see Part 5

As the ENM order limits for metals are for total concentrations and not the mobile or bioavailable fractions in soil, the following findings from a literature review were considered in the assessment of the potential impacts from the emplacement of ENM:

- A study of copper speciation in Victorian soils (Pietrzak and McPhail 2004) indicated that copper in uncontaminated soils exists mainly as less mobile fractions, such as those bound to iron and aluminium oxides, and residual copper. Potentially available copper species constituted 10 percent (by weight) of the total copper concentration in uncontaminated soil profiles. As such, a value of 10 mg/kg of copper was used as the input for the USEPA partition equation, which is representative of the mobile and bioavailable fraction that would be present in ENM with the highest acceptable maximum average concentration of 100 mg/kg.
- Stephan *et al.* (2008) studied the speciation of zinc in soil solutions from 66 sites representing a range of field conditions in North America and Europe. The study found that the partition coefficient for zinc was variable. However, of the dissolved zinc in the soil solutions, the fraction bound to dissolved organic matter varied from 60 to 98 percent. As zinc bound to dissolved organic matter is not bioavailable, it does not contribute to the concentration compared to the ANZECC (2000) GV when following the steps as prescribed by the decision tree for metal speciation guidelines (Figure 3.4.2 in ANZECC 2000). As a result, the concentration of zinc in ENM soil-water (as calculated by the USEPA partition equation) was multiplied by 0.4, so that the mixing modelling provided results which were representative of the highest probable bioavailable concentrations of zinc.

Table 3-3 Limiting concentrations in ENM as per the ENM order (EPA 2014)

Chemicals and other attributes	Maximum average concentration for characterisation (mg/kg 'dry weight' unless otherwise specified)	Absolute maximum concentration (mg/kg 'dry weight' unless otherwise specified)
1. Mercury	0.5	1.0
2. Cadmium	0.5	1.0
3. Lead	50	100
4. Arsenic	20	40
5. Chromium (total)	75	150
6. Copper	100	200
7. Nickel	30	60
8. Zinc	150	300
9. Electrical Conductivity	1.5 dS/m	3 dS/m
10. pH *	5 to 9 pH units	4.5 to 10 pH units
11. Total PAHs	20	40
12. Benzo(a)pyrene	0.5	1.0
13. Benzene	NA	0.5
14. Toluene	NA	65
15. Ethyl-benzene	NA	25
16. Xylene	NA	15
17. TPH C10-C36	250	500
18. Rubber, plastic, bitumen, paper, cloth, paint and wood	0.05 %	0.10 %

* The ranges given for pH are for the minimum and maximum acceptable pH values in the excavated natural material.

To account for the change in concentration of the ENM soil water by other water sources on site, the mixing of the two water sources was modelled in PHREEQc (Parkhurst and Appelo 1999), using the maximal ratios (i.e. highest proportion of ENM soil water to other water sources) obtained from the water balance modelling.

As the ENM order limiting concentrations are for substances other than major cations and anions, the results from the use of the USEPA soil-water partition equation were supplemented with the major cation and anion results from the sampling of a bore in Wianamatta Shale (Bartrop 2014). These concentrations were upscaled uniformly so that the EC of the modelled water was representative of the ENM order maximum average limit for EC. It is noted however, that assumptions related to the use of this ENM order limit should be interpreted with caution, as the method prescribed by the ENM order for the measurement of EC does not result in values representative of runoff from the tested material.

A Wianamatta Shale groundwater was chosen to supplement the PHREEQc ENM soil water input file due to the prevalence of the rock type in the Sydney basin and its effect on the salinity of interfacing water, making it a suitable example of a material which could be classified as ENM but which would have the potential to increase the salinity of site runoff.

Water quality results obtained from the PHREEQc modelling were compared against the ANZECC (2000) GVs as outlined in Section 3.3.1. This was a conservative application of the GVs, which apply to water quality in the receiving environment. Additionally, it is noted that the modelling accounted only for the effect of the reduction in concentration due to the mixing of water from areas where material was not emplaced and other rehabilitated and naturally vegetated areas, and not for that of attenuation of substance concentrations through reactions such as oxidation, precipitation and adsorption. As such, based on the approach taken, the results are expected to overestimate the concentrations of substances in the surface water released from the site (i.e., are conservative).

3.3.3 Representative VENM and ENM samples

In November 2017, ADE Consulting Group Pty Ltd collected nine samples of soil/rock from a range of geological landscapes in the Sydney region. These samples were analysed as per the ENM order (EPA 2014), and used in Australian Standard Leaching Potential (ASLP) tests where water sampled from Bell Quarry on 15 November 2017 was used as the leaching solution. The ADE Consulting Group report is provided as Appendix B.

The results from the leachate testing were used with the results from the flow proportions assessment (Section 3.2.3) to assess the potential impact of runoff from a mixture of the nine soil/rock types sampled by ADE Consulting Group Pty Ltd. As leachate results cannot be considered representative of runoff from the soil/rock (due to the exposure time and agitation involved in the test method), this modelling was undertaken to assess the sensitivity of water quality to the potential mitigation measures developed by the flow proportions assessment. The results of this assessment are presented in Section 5.4.2.

3.4 Groundwater environment

3.4.1 Drilling, well installation and groundwater sampling

Three boreholes were drilled at the site and converted to monitoring wells in August 2017. Well locations were selected to allow triangulation across the site, with one up-hydraulic gradient location and two down hydraulic gradient locations. Wells were drilled using high pressure rotary air and a down-hole hammer. Wells were constructed using 50 mm ND Class 18 PVC casing and in accordance with *Minimum Construction Requirements for Water Bores in Australia* (NUDLC, 2012).

Groundwater levels were recorded following installation and the wells were developed using airlifting methods thereafter.

Table 3-4 Well construction and water levels.

Well ID	Easting	Northing	Depth m BGL	Screen Interval m BGL	Gravel Interval m BGL	Standing Water Level m BGL
MB01	244741.99	6292321.70	21.52	18.52-21.52	18-21.52	20.35
MB02	244895.33	6292779.89	28.00	25-28	24.5-28	17.45
MB03	244965.82	6292697.24	23.00	20-23	19.5-23	11.95

m BGL – metres below ground level

Sampling of the groundwater was undertaken in March 2018 to gain representative groundwater data at the site. Samples were only able to be obtained from MB02 and MB03 as MB01 was dry at the time. Samples were submitted to a NATA accredited laboratory for analysis of the parameters listed in Table 3-5.

Table 3-5 Analytical schedule - groundwater quality samples

Analyte group	Analytes
Physicochemical parameters	pH, EC
Major cations and anions	Bicarbonate alkalinity, total alkalinity, chloride, sulfate, calcium, magnesium, sodium, potassium
Dissolved metals	Aluminium, iron, arsenic, cadmium, chromium, copper, lead, manganese, nickel, zinc, mercury.
Nutrients and organics	DOC, PAHs, ammonia, nitrate, nitrite, TKN, NOx, TP, RP, TPHs, TRHs, BTEX

3.4.2 Aquifer testing

Aquifer tests were undertaken at two wells (MB02 and MB03) to estimate aquifer hydraulic conductivity. Test were undertaken via introduction of a 20L ‘slug’ of water in wells MB02 and MB03 to displace the ambient water level. The water used in slug testing was taken from the on-site voids. MB01 was not assessed by this method given the water level was below the screen.

Water level displacement and recovery were monitored at half second intervals using a down-hole Level Troll 500 data logger connected to Win-Situ® software which allowed real-time tracking of the groundwater response. Response curves were plotted and gradients assessed using Horselv’s method (1951). Comparison of initial versus Horselv’s basic time lag estimates was conducted, and the latter relied on as representative of site conditions. The results are presented in Section 4.5.2.

3.4.3 Groundwater receptors

NSW bore database search

GHD obtained groundwater bore information using the NSW Department of Primary Industries Water ‘All Water Data’ database (http://allwaterdata.water.nsw.gov.au/water.stm) and the Bureau of Meteorology ‘Australian Groundwater Explorer’ (http://www.bom.gov.au/water/groundwater/explorer/map.shtml) on 15 September 2017. The search was performed for all areas within one kilometre of the site. Results are presented in Section 0.

Groundwater dependent ecosystems

The potential groundwater dependent ecosystems (GDEs) within the vicinity of the site have been mapped by Bureau of Meteorology in the Groundwater Dependent Ecosystem Atlas (BOM, 2017). They include ecosystems that rely on the surface presence of groundwater and ecosystems that rely on the subsurface presence of groundwater. The findings of the biodiversity assessment undertaken as part of this EIS were also reviewed in identifying potential GDEs. Results are presented in Section 0.

3.4.4 Impact assessment

The assessment of potential impacts of the project to groundwater quality was undertaken in a staged approach.

Criteria

The NSW Aquifer Interference Policy states that any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity. It is considered that the beneficial use category of groundwater at the site is environmental protection. Therefore, a change in groundwater quality is acceptable provided that it does not result in water quality impacts to surface water receptors. The immediate receptor has been identified as a swamp located approximately 200 m down-hydraulic gradient from the site.

Stage 1

An initial comparison between existing groundwater quality (based on sampling undertaken in March 2018) and likely source concentrations from the backfilled voids was carried out to identify whether any change to groundwater quality is likely. Groundwater quality was compared to both the predicted ENM soil water concentrations (outlined in Section 3.3.2 and Table 5-5) and the average concentrations from the ASLP tests (outlined in Section 3.3.3 and Table 5-9).

Stage 2 – geochemical modelling

In the case where change to existing groundwater quality is likely, geochemical modelling was undertaken to predict the migration of parameters to the down-hydraulic gradient swamp and the concentrations of these parameters flowing into the swamp via groundwater.

The first step in the geochemical modelling assessment was the development of a one-dimensional transport model simulated in PHREEQC to predict the potential metal concentrations over the 200 m pathway between the voids and swamp (20 cells, 10 m cell length). The model simulated solutions representative of ENM leachate and groundwater and considered secondary mineral formation and precipitation, however did not include natural attenuation mechanisms such as adsorption and ion exchange to maintain a conservative approach to the modelling.

The model relied on the TRANSPORT mechanism within PHREEQC to replicate the migration of solutes solely due to flow processes: advection, dispersion and diffusion. Dispersion was conceptualised as comparably high compared to advection, given the fractured rock environment (1:1). Diffusion was considered negligible (default value adopted). Groundwater inflow was represented as up-gradient groundwater through-flow. Outflow was represented by discharge to the swamp. Both inflow and outflow were simulated as constants (perennial flow). Constant and complete outflow to the swamp is considered a conservative approach.

Three simulations were carried out using PHREEQC:

- SIM 1 was a base case that assessed the existing migration of groundwater along the flow path to the swamp with no source concentration inputs from the ENM leachate. The groundwater chemistry was based on results from the sampling undertaken in March 2018. Predicted groundwater concentrations at the swamp were compared to actual concentrations sampled in March 2017 (Table 4-2) and, in the case where a predicted metal concentration was higher than the actual concentration, an attenuation factor was calculated. This attenuation factor accounts for natural attenuation processes within the aquifer between the site and the swamp as well as surface water / groundwater mixing within the swamp.
- SIM 2 introduced the ENM leachate based on the predicted ENM soil water concentrations. Major ion concentrations were as reported by Bartrop (2014). Predicted groundwater concentrations at the swamp were assessed against the ANZECC (2000) GVs. Where exceedances were identified, the attenuation factor derived from SIM 1 was applied and resulting concentration were reassessed against the criteria.

- SIM 3 used the average concentrations from the ASLP tests to represent ENM leachate (in place of the ENM soil water concentrations used in SIM 2). Again, the major ion concentrations were as reported by Bartrop (2014) and predicted groundwater concentrations at the swamp were assessed against the ANZECC (2000) GVs. Attenuation factors were suitably applied, as well as bioavailability factors. The bioavailability factors are based on literature and were applied to allow representation of the proportion of each metal with the potential to cause impact only.

Following the completion of the PHREEQC modelling, an additional analytical fate and transport model, coupled with a mass flux assessment, was completed as a further line of evidence to understand the impacts on the down gradient swamp water quality.

The analytical fate and transport model used was the P20 analytical model developed by the UK Environment Agency for assessing the impacts of groundwater at contaminated sites on down gradient surface water and groundwater bore receptors. The P20 model is based on analytical fate and transport equations developed by Domenico (1987). The equation assesses the attenuation along the groundwater pathway between a source and receptor associated with advection, dispersion and adsorption.

The simulated concentrations at the swamp were then included in a mass flux assessment. The mass flux equation adopted for the flux model is presented below:

Swamp concentration (above background) = ((retarded groundwater flow x discharge area x groundwater concentration) + (swamp area x swamp depth x swamp concentration) + (surface water volume * surface water concentration)) / (swamp area x swamp depth).

For the purposes of this assessment it was assumed that the swamp had a background concentration of zero and that there were not surface water inputs (highly conservative) such that:

Swamp concentration (above background) = ((retarded groundwater flow x discharge area x groundwater concentration)) / (swamp area x swamp depth).

Under this conceptual condition the results produced would:

- Be added to background swamp concentrations to get an actual in swamp concentration
- Be based on a period of only groundwater inputs to the swamp – for instance it was assumed for one run that there was no rain and therefore no surface water inputs to flush the swamp for an entire year.
- There was reasonable mixing of groundwater within the swamp such that groundwater inputs mixed instantaneously with the swamp water.

The mass flux assessment conservatively assumed that the entire width of the plume discharging from the site discharged into the swamp.

The retarded groundwater flow (U_d) to the swamp was estimated using the following equation:

$$U_d = \frac{K_s i}{\theta_s R_c}$$

Where:

R_c = retardation factor defined by:

$$R_c = \left[1 + \frac{K_d \rho_s}{\theta_s}\right]$$

Results are presented in Section 5.5.2.

3.5 Assumptions

3.5.1 Water balance

The water balance was developed based upon representation of parameters in Section 3.2.1.

3.5.2 Surface water quality

The assessment of the potential impacts to surface water quality assumed the following:

- All runoff interfacing with ENM was assumed to reach equilibrium with the ENM, thereby having the chemical characteristics calculated using the USEPA soil-water partition equation (USEPA 1996) and the limiting concentrations as per the ENM order (EPA 2014) (refer Section 3.3.2).
- All other sources of runoff were assumed to have the chemical characteristics of the water sampled at the site discharge on 9 March 2017. Where concentrations below the laboratory limit of reporting (LOR) were observed, half of the LOR was the assumed concentration for the water quality modelling.
- No substance amelioration via processes such as precipitation, adsorption and oxidation was modelled. Aqueous metal speciation was not considered when interpreting the water quality modelling results, though the findings of the literature reviewed in Section 3.3.2 were used for the calculations involving the USEPA soil-water partition equation.
- The PHREEQc modelling predictions for the distribution of chromium oxidation states were assumed to be accurate, which was supported by the findings of Kimbrough *et al.* (1999) and Palmer and Puls (1996).
- Where the leachate results from ADE Consulting Group (2017) were used, all runoff modelled to interface with ENM was assumed to contain the average leachate quality from the nine leachates prepared using water sampled from Bell quarry on 15 November 2017.

3.5.3 Groundwater

The groundwater impact assessment assumed the following:

- The swamp neighbouring the site is hydraulically connected to and receiving groundwater.
- Advection and dispersion are the dominant groundwater flow mechanisms.
- Dispersion equates to advection in the fractured rock.
- Diffusion is negligible.
- All reactions modelling within PHREEQC are instantaneous.
- No primary mineral dissolution occurs; and
- Concentrations in groundwater are received in full by surface water (i.e. no stratification otherwise occurs).

4. Existing conditions

4.1 Site description

4.1.1 General

Bell Quarry is located on Sandham Road in Newnes Junction approximately 10 kilometres east of Lithgow in NSW. The site is located to the east of Chifley Road (continuation of Bells Line of Road) and the Main Western Rail Line. The site is rectangular in shape and covers an area of 9.5 ha.

The quarry was progressively developed in a series of eight areas as shown in Figure 1-2. The quarry now contains three large voids which are partially filled with water. The north and the south voids are connected, forming one large water body which overflows to the east void. The quarry has been subject to some progressive revegetation and is at varying stages across the site with several areas still subject to active erosion. It is noted that the Soil Conservation Service of NSW has recently prepared the Bell Sand Quarry Closure Review DPI Soil Conservation Service (2014) and implemented some improvements to ground cover and drainage improvements at the site.

4.1.2 Surrounding land use

Newnes Junction is located approximately 250 metres to the north-west of the site and contains a small number of residential dwellings. Dargan and Clarence are located on the western side of Chifley Road and the Main Western Rail Line approximately one kilometre to the south and west of the site respectively. Bell is located approximately four kilometres to the south.

The Clarence Colliery pit top, rail loop and loading facilities are located approximately 750 metres to the north and the Hanson Kables Sand Quarry is located to the west of the mining operations.

The Blue Mountains National Park is located to the east of Clarence Colliery and is one of the eight protected areas making up the World Heritage Listed Greater Blue Mountains Area. The Newnes State Forest is located to the north and west of the site.

Bell Quarry is located within the upper reaches of the Wollangambe River catchment. This river drains towards the east where it eventually drains into the Colo River which forms part of the broader Hawkesbury-Nepean catchment area.

4.1.3 Soils

A search of the NSW government ‘eSPADE 2’ website (OEH 2016) was conducted to establish the existing soil landscapes in the vicinity of the Site. The site and the surrounding areas are composed of the following three soil landscapes:

- Disturbed terrain – comprises the majority of the Site due to the historical quarrying activities. The original soil has been removed, greatly disturbed, or buried. The original vegetation has been completely cleared.
- Medlow Bath – comprises the northern area of the Site, where there are moderately deep (<100 cm) yellow earths and earthy sands on the sideslope. Acidic soils with a high potential for aluminium toxicity.
- Wollangambe – comprises the area to the north east of the Site, where there are moderately deep (<100 cm) earthy sands, yellow earths and red earths on the sideslope to the north of the tributary of the Wollangambe River.

4.1.4 Topography

The study area is located on the southern edge of the Newnes Plateau (within the Sydney Basin) and adjacent to the Lithgow Valley. The Newnes Plateau is characterised by gentle to moderate slopes and undulating topography. Towards the edge of the plateau, the landscape is typically rugged with steep cliffs adjacent to water courses, talus slopes and near vertical relief. This is typical of many erosional sections of the Newnes Plateau, which are often associated with deep gullies, pagoda rock formations, creeks, gullies, gorges and bottleneck valleys. Elevation of the study area ranges from 900 to 1,200 metres above sea level (Department of Commerce 2004).

4.1.5 Hydrology

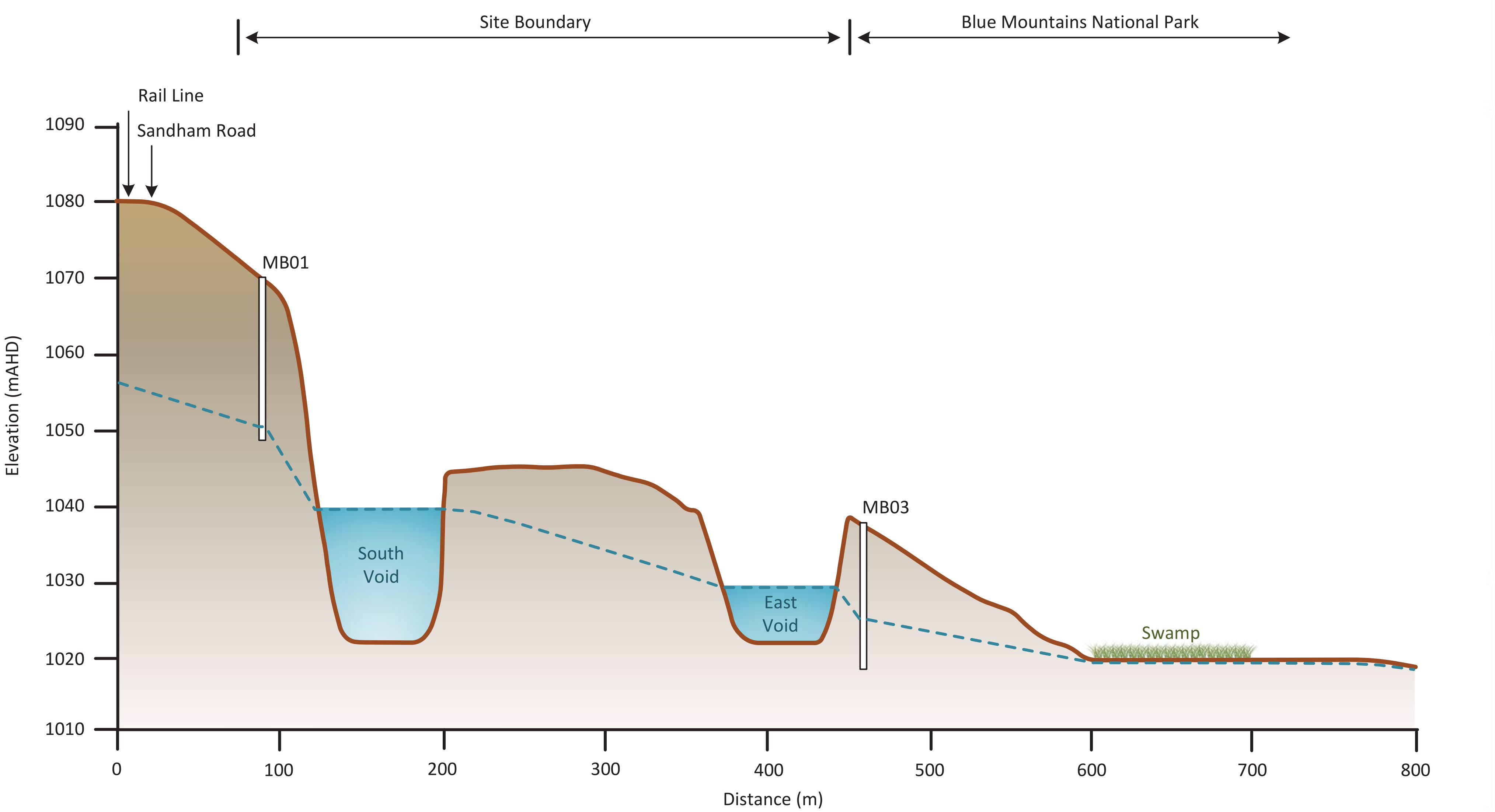
Due to the depths of the site voids, seepage of groundwater into the voids results in the surface water and groundwater environments at the site being interrelated. Groundwater from upstream of the site influences the water quality and quantity in the voids, and likewise, any impact on the quality of the surface water at the site is predicted to influence the groundwater quality downstream of the site. A conceptual cross section of the site is presented as Figure 4-1 based upon the cross section alignment presented on Figure 1-3.

The voids receive a mixture of runoff from adjacent areas and groundwater inflows, as evidenced by seepage from the void walls. Surface runoff in some areas of the site is diverted away from the voids towards the east.

An ephemeral tributary of the Wollangambe River runs in a north-easterly direction from the project site. The quarry intersected this tributary's catchment, which has its headwaters in the vicinity of the rail line upstream of the site. Surface flows from this area of the catchment now enter the site at the western edge of the north void, where some erosion form high flow events is evident. Water is discharged from the site through an established sediment basin on the eastern edge of the site. The sediment basin contains considerable reed growth and aquatic vegetation and discharges into a drainage line that forms a continuation of the ephemeral tributary downstream of the site.

Approximately 200 metres downstream of the Site the drainage line enters a swamp where under baseflow conditions flows are predominantly subsurface flows. The swamp occupies the majority of the drainage line upstream of the confluence with a similar tributary, which runs to the north of the site. Downstream of this confluence the tributary enters a meandering reach which is somewhat confined by sandstone outcropping, which continues for approximately 1.5 kilometres before the confluence with the Wollangambe river.

Water from this drainage line eventually enters the Wollangambe River, about 1.5 kilometres from the project site. The Wollangambe River winds eastwards through narrow canyons and is one of four major tributaries of the Colo River. The Wollangambe River, between its confluences with Bungleboori Creek and Colo river, forms part of the declared Colo Wild River (DECC 2008). The upper reaches of the Wollangambe River near Clarence Colliery are not part of the declared area as these areas have been disturbed by historic mining (DECC 2008).



- - - Groundwater Table

LOCATION	Bell Quarry
SEAM	NA
DRAWN	SM
CHECKED	JC
APPROVED	SG
SCALE	NTS

Conceptual cross-section of the site

DATE	Sep 2017	Figure 4-1

N:\AU\Sydney\Projects\21\25774\Tech\Visio\2125772_Visio_Conceptual Groundwater Flow.vsdx

4.2 Water balance

The current quarry configuration, intercepts groundwater and surface water in the voids, which are then subject to evaporation. There is currently no management of the voids with respect to water, such as pumping. Discharge from the site only occurs when the balance of rainwater, groundwater flow and evaporation are such that the voids are full and overflowing. The results of this, as can be seen in the flow duration results (refer section 5.2.1) is that whilst natural conditions would result in regular runoff from natural catchment , runoff from the existing site is intermittent, occurring approximately 50 percent of the time. However, during very high rainfall periods runoff from the existing site is greater than the natural condition. This is because during these periods, the quarry voids, full of water, would result in a higher proportion of rainfall being converted to runoff as the rain is falling directly onto the water storages rather than infiltrating into the ground under natural conditions.

4.3 Geomorphic condition

A site inspection of the waterways downstream of the site was undertaken by a GHD water resources engineer to review the general condition of the waterway. Based on the results of the flow duration assessment (Refer Section 5.2.1) a detailed geomorphological assessment was deemed not to be required.

The site inspection revealed that the downstream waterways are generally undisturbed by land disturbance activities with natural stream bed formation, bank formation and vegetation in place. Vegetation was generally thick and well established. One exception to the above is in the area immediately downstream of the site where historical filling, clearing and revegetation processes appear to have been undertaken, however this disturbance appears to extend only a short distance (less than 100 metres) downstream of the site.

Reaches consist of swamp areas, often with a small, defined, naturally incised channel surrounded by a larger swamp area with shallow groundwater flow and moisture evident. Other areas consist of steeper overbank areas with smaller swamp areas and a defined, naturally incised channel. No significant waterway erosion was observed and bedrock controls were identified in some locations.

Shallow pools were observed and in some locations were flowing at the time of the site inspection. This flow is likely to be due to discharge of shallow groundwater into the waterways from upstream swamp areas.

In general, downstream reaches were found to be in very good condition with regards to waterway stability. They are anticipated to have a relatively high resistance to geomorphologic change due to a stable stream profile and thick, well established vegetation throughout.

4.4 Surface water quality

DECC (2008) reports that impacts from mining have occurred in the headwaters of the Wollangambe River, and details the Clarence Colliery licensed discharge (under EPL 726) to the river. OEH (2015) assessed the impact of the Clarence Colliery discharge on the Wollangambe River based on water quality sampling at locations upstream and downstream of the discharge. Key results from OEH (2015) have been presented in Table 4-1. Site W1 is approximately 1.2 km upstream of the Clarence Colliery discharge, and site W10 is approximately 1.9 km downstream of the discharge.

As Table 4-1 shows, the Wollangambe River becomes substantially more saline downstream of the discharge, with EC increasing by a factor of ten. The ionic balance changes from that observed upstream, from ionically dilute water dominated by sodium and chloride, to calcium sulfate dominated water. Chloride and sodium concentrations decreased between W1 and W10. There were multiple exceedances of the ANZECC (2000) GVs, though many were due to the LORs of the analysis methodologies that were used by OEH (2015). These 'default' exceedances were observed for both sites for concentrations of dissolved arsenic, cadmium, chromium, and total nitrogen. Additionally, the LOR for nitrate, and nitrite plus nitrate nitrogen (NO_X) exceeded the relevant GV, though the concentration observed at W10 was at this LOR.

The concentration of dissolved aluminium exceeded the GV at W1, and dissolved iron concentration was also elevated at this location. This may have been an influence of the local sandstone, or potentially from the nearby Hanson Kables Sand Quarry, noting that that site holds an EPL allowing for a discharge to water. Dissolved aluminium at W10 also exceeded the GV, though it is noted that the concentration was below the LOR. Dissolved iron was also below the LOR at W10.

Dissolved concentrations of nickel and zinc exceeded the relevant GVs at W10. Dissolved zinc also exceeded the GV at W1, though at a concentration less than a third of that observed at W10.

These historical results indicate that the principal impacts of the existing land uses on water quality in the Wollangambe River are:

- Increased salinity
- Increased concentrations of the major ions bicarbonate, sulfate, calcium, magnesium and potassium.
- Decreased concentrations of the major ions chloride and sodium
- Increased concentrations of heavy metals nickel and zinc
- Decreased concentrations of metals aluminium and iron.

Table 4-1 Water quality data for the Wollangambe River upstream and downstream of the Clarence Colliery discharge (OEH 2015).

Analyte/analyte grouping	Units	W1 13/11/2014	W10 13/11/2014	ANZECC (2000) GVs
Physicochemical parameters				
EC	µS/cm	32	320	30 - 350
Major cations and anions				
Total Alkalinity as $CaCO_3$	mg/L	<6	29	NA
Sulfate as SO_4	mg/L	1.1	120	NA
Chloride	mg/L	7.1	3.9	NA
Calcium	mg/L	0.48	37	NA
Magnesium	mg/L	0.57	11	NA
Sodium	mg/L	3.9	3.1	NA
Potassium	mg/L	0.2	3.6	NA
Dissolved metals				
Aluminium	mg/L	**0.06**	**<0.04**	0.027
Arsenic	mg/L	**<0.001**	**<0.001**	0.0008 (AsV)
Cadmium	mg/L	**<0.0001**	**<0.0001**	0.00006
Chromium	mg/L	**<0.001**	**<0.001**	0.00001 (CrVI)
Copper	mg/L	<0.0005	<0.0001	0.001
Iron	mg/L	1.4	<0.03	NA
Lead	mg/L	<0.0001	<0.0005	0.001
Manganese	mg/L	0.25	0.24	1.2
Nickel	mg/L	0.0015	**0.037**	0.008

Analyte/analyte grouping	Units	W1 13/11/2014	W10 13/11/2014	ANZECC (2000) GVs
Zinc	mg/L	**0.0056**	**0.019**	0.0024
Mercury	mg/L	<0.00005	<0.00005	0.00006
Nutrients				
Ammonia as N	mg/L	0.02	0.01	0.32
NOx	mg/L	**<0.02**	**0.02**	0.015
TKN	mg/L	<0.2	0.02	NA
Total nitrogen as N	mg/L	**<0.3**	**<0.3**	0.25
Total phosphorous as P	mg/L	<0.015	<0.015	0.02
Reactive phosphorous as P	mg/L	<0.003	0.004	0.015

Orange bold denotes exceedances of the ANZECC (2000) GVs

Water quality results obtained from the site visit on 9 March 2017 are presented in Table 4-2. The laboratory certificate of analysis is provided in Appendix A.

The results in Table 4-2 show that the water at all sites sampled was ionically dilute, with all EC values being below 35 µS/cm. The exposed rock surfaces at the site and the contribution of groundwater seepage to surface water flow appears to slightly increase salinity in the catchment, as the site Tributary DS, which receives inputs from the relatively unimpacted tributary to the north, had the lowest EC of all sites.

pH results indicated that surface water in the catchment is naturally slightly acidic, with all sites having a pH below the lower ANZECC (2000) GV. This acidity is likely attributable to natural organic acids and the acidity produced when dissolved iron and manganese are oxidised and precipitated, noting that low but observable concentrations of both of these metals were recorded for each site.

TSS was below the LOR at each site, indicating that little sediment is transported by surface flows in the catchment under baseflow conditions.

Dissolved metal concentrations were generally low and there were no exceedances of the ANZECC (2000) GVs for the protection of 99 percent of aquatic species. Aluminium was elevated at sites Tributary and Tributary DS, indicating the influence of the local lithology, though as pH was below 6.5 at these sites there was no exceedance of the GV.

Nutrient concentrations were generally low, though the concentrations of nitrate (a substance that can cause impact) and NO_x (considered a chemical stressor) exceeded the relevant ANZECC (2000) GVs at all sites. Within the Site footprint, this may have been indicative of inhabitation of the standing water bodies by bird species, and also some algal activity, noting that the limited shading of the voids may at times lead to eutrophication. Downstream of the Site, the observed nitrate concentrations are more likely to have been the result of the decomposition of stream detritus.

DOC concentrations were highest within the Site footprint, suggesting that DOC concentrations reduce downstream of the Site due to the reaches of subsurface flow.

There were no detectable (> LOR) concentrations of PAHs, TPH/TRH, or BTEXN at any site, indicating that there is no pre-existing influence of these substances at the site and that they are also below available GVs.

Table 4-2 Surface water quality results, 9 March 2017.

Analyte/analyte grouping	Units	LOR	North void	East void	Site discharge	Tributary	Tributary DS	ANZECC (2000) GVs
Physicochemical parameters								
pH	pH unit	0.01	**5.71**	**5.55**	**4.97**	**4.34**	**4.95**	6.5 – 8.0
EC	µS/cm	1	32.4	32.3	32.0	34.3	**29.5**	30 - 350
TSS	mg/L	5	<5	<5	<5	<5	<5	NA
Major cations and anions								
Total Alkalinity as $CaCO_3$	mg/L	1	5	3	4	2	2	NA
Sulfate as SO_4	mg/L	1	2	2	2	2	2	NA
Chloride	mg/L	1	5	5	3	4	4	NA
Calcium	mg/L	1	<1	<1	<1	<1	<1	NA
Magnesium	mg/L	1	<1	<1	<1	<1	<1	NA
Sodium	mg/L	1	3	3	3	3	3	NA
Potassium	mg/L	1	<1	<1	<1	<1	<1	NA
Dissolved metals								
Aluminium	mg/L	0.005	0.007	<0.005	<0.005	0.068	0.048	0.027
Arsenic	mg/L	0.0002	0.0003	0.0002	0.0002	<0.0002	<0.0002	0.0008 (AsV)
Cadmium	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00006
Chromium	mg/L	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00001 (CrVI)
Copper	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.001
Iron	mg/L	0.002	0.025	0.014	0.135	0.025	0.034	NA
Lead	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001
Manganese	mg/L	0.0005	0.0021	0.0046	0.143	0.0024	0.0027	1.2
Nickel	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.008
Zinc	mg/L	0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.0024
Mercury	mg/L	0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	0.00006
Nutrients								
Ammonia as N	mg/L	0.01	0.04	0.02	<0.01	<0.01	0.02	0.32
Nitrite as N	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA
Nitrate as N	mg/L	0.01	**0.04**	**0.03**	**0.02**	**0.03**	**0.04**	0.017
NOx	mg/L	0.01	**0.04**	**0.03**	**0.02**	**0.03**	**0.04**	0.015
TKN	mg/L	0.1	0.2	0.1	0.2	<0.1	<0.1	NA
Total nitrogen as N	mg/L	0.1	0.2	0.1	0.2	<0.1	<0.1	0.25

Analyte/analyte grouping	Units	LOR	North void	East void	Site discharge	Tributary	Tributary DS	ANZECC (2000) GVs
Total phosphorous as P	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02
Reactive phosphorous as P	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.015
Other								
DOC	mg/L	1	5	4	4	1	1	NA
PAHs								
Naphthalene	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0025
Sum of PAHs	mg/L	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	NA
Total Petroleum Hydrocarbons								
C10 - C36 Fraction (sum)	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA
Total Recoverable Hydrocarbons								
>C10 - C40 Fraction (sum)	mg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
BTEXN								
Benzene	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.600
meta- & para-Xylene	mg/L	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.140 (p-xylene)
ortho-Xylene	mg/L	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.200
Sum of BTEXN	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	NA

Orange bold denotes exceedances of the ANZECC (2000) GVs

4.5 Groundwater environment

4.5.1 Groundwater elevation

The wells shown in Figure 1-3 were installed on 15 and 31 August 2017. Groundwater elevations calculated based on surveyed surface elevation and gauged depth to water are presented in Table 4-3 (in mAHD). These data indicate groundwater at the site flows to the north east, in the direction of the tributary.

The water level observed in MB01 was higher than the surface water level in the north and south voids (approximately 1041 m AHD), which indicates that the site voids intercept groundwater from upgradient areas.

Hydraulic gradients between MB01 and the south void, and between the east void and MB03, were calculated based on the SWLs in Table 4-3 and the surface water levels of the north and east voids, which were 1041 m and 1039 m AHD based on the water levels observed at sites North void and East void on 9 March 2017 (Figure 1-3). These hydraulic gradients were 0.11 and 0.51 respectively.

Table 4-3 Groundwater levels, 15 and 31 August 2017.

Site	Surface elevation (m AHD)	Total depth (m BGL)	Standing Water Level (m BGL)	Groundwater Elevation (m AHD)
MB01	1067.6	21.5	19.3	1048.3
MB02	1043.8	28.0	17.5	1026.3
MB03	1038.1	23.3	12.8	1025.3

m AHD - metres Australian height datum

4.5.2 Aquifer Permeability

The results of aquifer permeability testing conducted within the onsite wells MB02 and MB03 indicated a hydraulic conductivity (K) of 10^{-7} m/s. A comparison to initial response estimates and estimates allowing Horslev's basic time lag are presented in Table 4-4. The results are generally comparable with the latter considered more accurate of site conditions.

Table 4-4 Hydraulic conductivity

Site	K (m/s) Initial response	K (m/s) Horvlev's basic time lag
MB02	2.0 x 10-6	6.9 x 10-7
MB03	3.4 x 10-7	2.6 x 10-7

4.5.3 Groundwater quality

Groundwater quality results are presented in Table 4-5. In summary, the results indicate background groundwater to be:

- Slightly acidic pH ranging 5.0-6.0
- Freshwater quality (<100 µS/cm)
- Low alkalinity (<50 mg/L as $CaCO_3$)
- Soft water (<50 mg/L as $CaCO_3$)
- Low metal concentrations with detection of aluminium, copper, manganese, mercury and zinc attributed to the host sandstone rock.

Comparison of the groundwater quality results with the ANZECC (2000) GVs shows that exceedances were observed for pH and the metals copper, manganese, zinc and mercury. This suggests that elevated concentrations of these metals occur naturally in the groundwater at the site.

Table 4-5 Groundwater quality results, March 2018

Analyte/analyte grouping	Units	LOR	MB01	MB02	MB03	ANZECC (2000) GVs
pH (field)	pH units	0.01	-	**5.91**	**5.05**	6.5 - 8.0
pH (lab)	pH units	0.01	-	6.74	**5.92**	6.5 - 8.0
EC (field)	µS/cm	1	-	55.1	45.5	30 - 350
EC (lab)	µS/cm	1	-	65	52	30 - 350
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	-	21	8	NA
Total Alkalinity as $CaCO_3$	mg/L	1	-	21	8	NA
Sulfate as SO_4	mg/L	1	-	3	3	NA
Chloride	mg/L	1	-	5	5	NA
Calcium	mg/L	1	-	2	<1	NA
Magnesium	mg/L	1	-	<1	<1	NA
Sodium	mg/L	1	-	7	3	NA
Potassium	mg/L	1	-	1	2	NA
Aluminium	mg/L	0.005	-	0.011	0.019	0.027
Iron	mg/L	0.002	-	0.042	0.018	NA
Arsenic	mg/L	0.0002	-	<0.0002	<0.0002	0.0008 (AsV)
Cadmium	mg/L	0.00005	-	<0.00005	0.00006	0.00006
Chromium	mg/L	0.0002	-	<0.0002	<0.0002	0.00001
Copper	mg/L	0.0005	-	**0.0024**	**0.0089**	0.001
Lead	mg/L	0.0001	-	<0.0001	0.0002	0.001
Manganese	mg/L	0.0005	-	0.192	**1.66**	1.2
Nickel	mg/L	0.0005	-	0.001	0.0025	0.008
Zinc	mg/L	0.001	-	**0.039**	**0.043**	0.0024
Mercury	mg/L	0.0001	-	**0.00007**	**0.00027**	0.00006

Orange bold denotes exceedances of the ANZECC (2000) GVs

4.5.4 Groundwater receptors

NSW bore database search

The search revealed two registered bores within a 1 km radius of the site. These bores lie to the north west and north of the site, and are therefore not in the direction of groundwater flow from the Site. The available information for these bores, including the standing water level (SWL) and water bearing zone (WBZ) is presented in Table 4-6.

As Table 4-6 indicates, minimal data was available on the bore to the north of the site, which was designated as a monitoring bore. The data for GW103734, which lies approximately 600 metres to the north west of the site, indicate that groundwater in the general area is likely to be accessible at around 21 mBGL, though with a low yield (0.25 L/s).

Table 4-6 Registered groundwater bores within 1 km of the site.

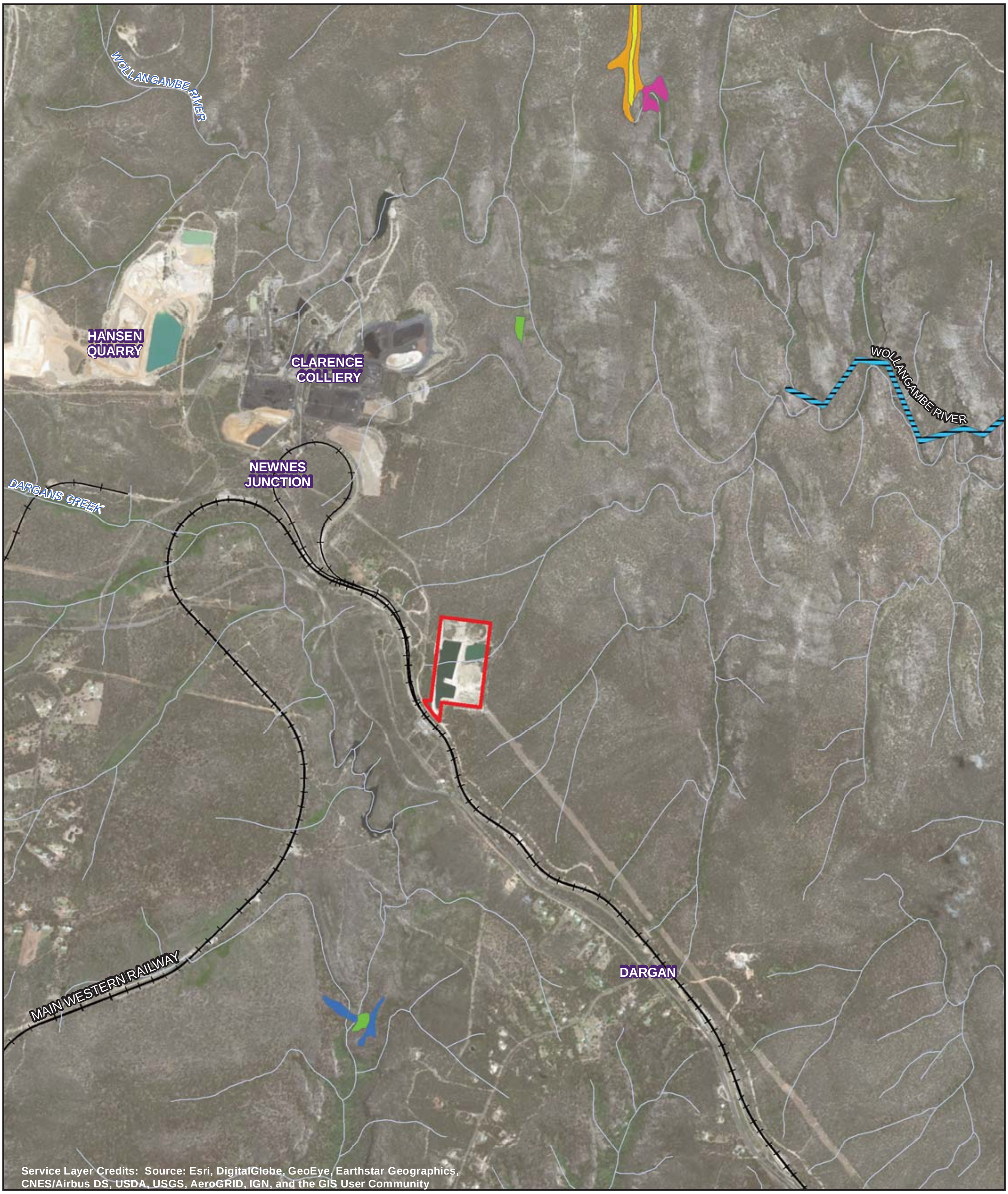
Bore	Depth (m)	Purpose	SWL (mBGL)	Yield (L/s)	WBZ	Screened depth (mBGL)
GW103734	104	Stock, domestic	21	0.25	100-104	100-104
GW113278	-	Monitoring bore	-	-	-	-

Groundwater dependant ecosystems

The GDEs mapped by BoM (2017) in the vicinity of the site are shown in Figure 4-2. The following terrestrial GDEs are present within 3 kilometres of the site:

- Exposed Blue Mountains Sydney Peppermint - Silver-top Ash Shrubby Woodland
- Newnes Sheltered Peppermint – Brown Barrel Shrubby Forest
- Newnes Plateau Narrow-leaved Peppermint – Silver-top Ash Layered Open Forest
- Newnes Plateau Shrub Swamp
- Tableland Mountain Gum – Snow Gum – Daviesia Montane Open Forest

The Wollangambe River is mapped as an “Aquatic” GDE downstream of the confluence of the tributary which receives runoff from the site. This is the only mapped GDE which could potentially be affected by the Project, as none of the terrestrial GDEs identified are in the same catchment as the site. While not a mapped GDE, a swamp downstream of the site has been assessed to be representative of a Newnes Plateau Shrub Swamp by the biodiversity assessment undertaken as part of this EIS (GHD 2018). This swamp is considered a sensitive receptor for the purpose of the WRA.



LEGEND

- Bell Quarry site
- Rail
- Waterways

Groundwater dependent ecosystem

- Exposed Blue Mountains Sydney Peppermint - Silver-top Ash Shrubby Woodland
- Newnes Sheltered Peppermint - Brown Barrel Shrubby Forest
- Newnes Plateau Narrow-leaved Peppermint - Silver-top Ash Layered Open Forest
- Newnes Plateau Shrub Swamp
- Tableland Mountain Gum - Snow Gum - Daviesia Montane Open Forest
- Aquatic

Paper Size A4

0 95 190 380 570 760 950

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Bell Quarry Rehabilitation Project
Water Resources Assessment

Job Number | 21-25774
Revision | 0
Date | 16 Mar 2018

Groundwater
Dependent Ecosystems

Figure 4-2

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

Data source: LPI: Aerial imagery, 2015. Commonwealth of Australia (Geoscience Australia): 250K Topographic Data Series 3, 2006. LPI: DTDB, 2015. Created by: tmorton, gmcdiarmid

5. Impact assessment

5.1 Introduction

Approximately 1.2 million cubic metres of fill material are proposed to be imported to the site for the purpose of rehabilitating the quarry. All clean fill material will meet the definition of either VENM, ENM or material permitted under a specific resource recovery order and associated exemption. The PoEO Act defines virgin excavated natural material (VENM) as ‘natural’ material (such as clay, gravel, sand, soil or rock fines):

- that has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial, mining or agricultural activities, and
- that does not contain any sulfidic ores or soils or any other waste.

ENM refers naturally occurring rock and soil (including but not limited to materials such as sandstone, shale, clay and soil) that has:

- been excavated from the ground, and
- contains at least 98% (by weight) natural material, and
- does not meet the definition of Virgin Excavated Natural Material in the Act.

Excavated natural material does not include material located in a hotspot; that has been processed; or that contains asbestos, Acid Sulfate Soils (ASS), Potential Acid Sulfate soils (PASS) or sulfidic ores.

Acceptance criteria for material imported to the site is included in Table 5-1.

Table 5-1 Limiting concentrations in ENM as per the ENM order (EPA 2014b)

Chemicals and other attributes	**Maximum average concentration for characterisation** (mg/kg ‘dry weight’ unless otherwise specified)	**Absolute maximum concentration** (mg/kg ‘dry weight’ unless otherwise specified)
1. Mercury	0.5	1.0
2. Cadmium	0.5	1.0
3. Lead	50	100
4. Arsenic	20	40
5. Chromium (total)	75	150
6. Copper	100	200
7. Nickel	30	60
8. Zinc	150	300
9. Electrical Conductivity	1.5 dS/m	3 dS/m
10. pH *	5 to 9 pH units	4.5 to 10 pH units
11. Total PAHs	20	40
12. Benzo(a)pyrene	0.5	1.0
13. Benzene	NA	0.5
14. Toluene	NA	65
15. Ethyl-benzene	NA	25
16. Xylene	NA	15
17. TPH C10-C36	250	500
18. Rubber, plastic, bitumen, paper, cloth, paint and wood	0.05 %	0.10 %

* The ranges given for pH are for the minimum and maximum acceptable pH values in the excavated natural material.

A range of potential impacts to surface and groundwater resources surrounding the site as a result of the proposed emplacement activities. Potential risks include:

- Impacts to the flow regimes downstream of the site associated with altered runoff and discharge patterns from the site.
- Impacts to the stability and geomorphology of the tributary of the Wollangambe River located downstream of the Site through alteration of flow regimes.
- Impacts to surface water and groundwater quality downstream of the site associated with rainfall and run-off coming into contact with emplaced material prior to discharging from the site or infiltration to groundwater.

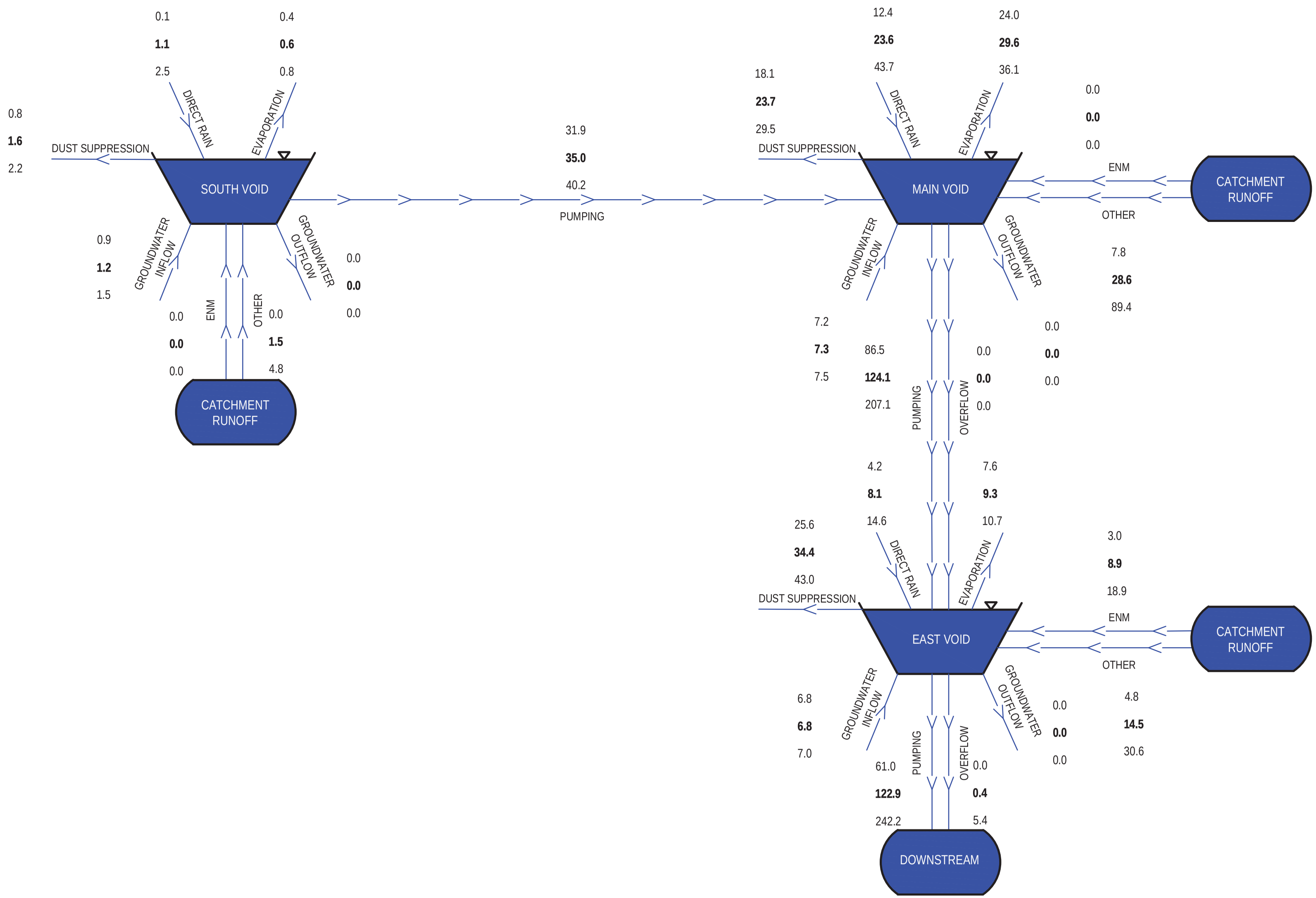
The following section provides the analysis of a targeted methodology to consider the potential risks to the receiving environment.

5.2 Water balance

The volumetric results of the water balance for all stages of rehabilitation of the site are shown on Figure 5-1. The figures indicate, the total volume of water transferred over each of the stages. The minimum, average and maximum volumes correspond to the different simulations for different rainfall series, thereby providing an indication of the range of potential values depending on the actual rainfall conditions experienced.

Key outcomes of the results are as follows:

- Direct rainfall on the voids, catchment runoff and groundwater inflow occur throughout the different stages at varying volumes depending primarily on catchment areas. Evaporation also occurs throughout the stages generally at a similar rate to direct rainfall.
- A net groundwater inflow occurs in all stages of operations, and at a greater rate during stages where void water levels are maintained low.
- Dust suppression is a significant outflow from the system, particularly for voids with a larger application area, such as the East Void during later stages.
- Key features of each stage are as follows:
  - Stage 1: The dewatering of South Void and partial dewatering of the Main Void with a net excess of outflows over inflows propagating through the system to the discharge point.
  - Stage 2: The South Void is maintained generally empty of water to allow emplacement. The Main Void and East Void are generally maintained at their current level.
  - Stage 3: The dewatering of the Main Void with a net excess of outflows over inflows propagating through the system to the discharge point.
  - Stage 4: The Main Void is maintained generally empty of water to allow emplacement. The East Void is maintained at its current level.
  - Stage 5: The Main Void is maintained generally empty of water to allow emplacement. The dewatering of the East Void with a net excess of outflows over inflows propagating through the system to the discharge point.
  - Stage 6: The East Void is maintained generally empty of water to allow emplacement.
  - The potential impact of these predicted flow rates is discussed in subsequent sections with respect to effect on downstream flow regimes and the effect on water quality through flow proportions of different types of water.



LEGEND

MINIMUM (ML)
AVERAGE (ML)
MAXIMUM (ML)

FLOWS INDICATE TOTAL FLOW VOLUME OVER PHASE FOR RANGE OF POTENTIAL CLIMATE CONDITIONS

GHD

BELL QUARRY REHABILITATION PROJECT

WATER BALANCE
RESULTS STAGE 1

Job Number 21-25774
Revision A
Date FEB 2018

Figure 5-1-1

230 Harbour Drive Coffs Harbour NSW 2450 Australia **T** 61 2 6650 5600 **F** 61 2 6650 5601 **E** cfsmail@ghd.com **W** www.ghd.com

Plot Date: 20 February 2018 - 2:24 PM Plotted by: Steve Young Cad File No: N:\AU\Sydney\Projects\21\25774\Tech\Surface Water\Water Balance\21-25774-Bell Quarry Water Cycle Schematic-FIG_01.dwg

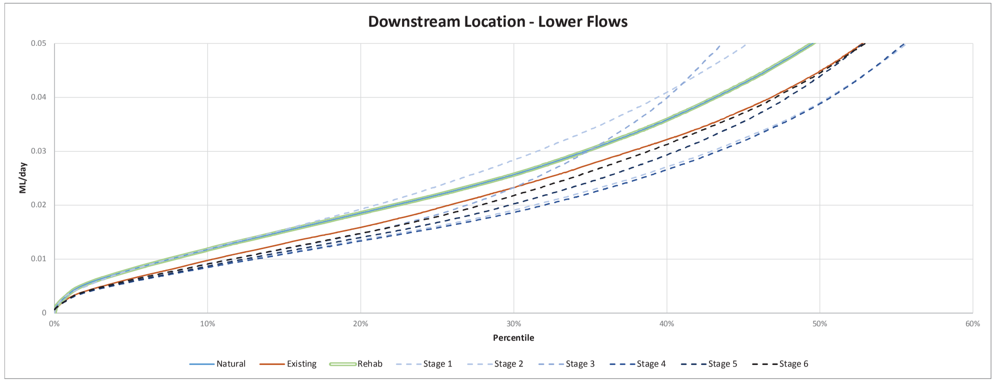
5.2.1 Flow Duration Assessment

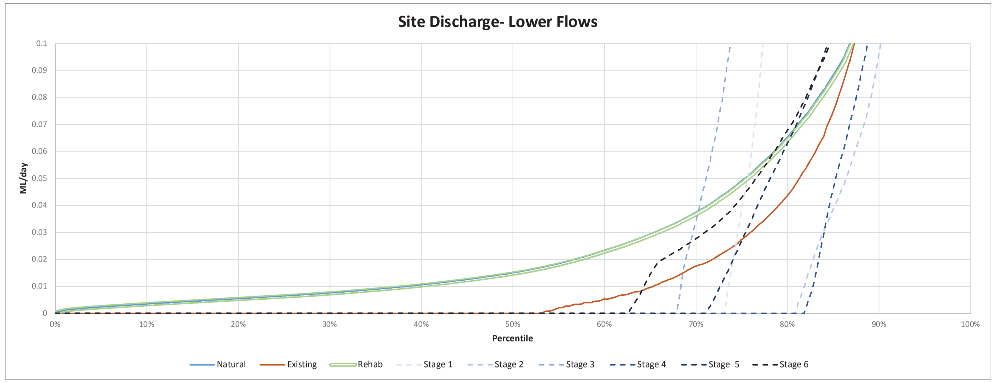
The results of the flow duration assessment are indicated on Figure 5-2. The results show the results at both the site discharge location and downstream location as indicated on Figure 5-2 For the purpose of clarity the results are separated into lower flows and higher flows, with higher flows indicated on a logarithmic scale. Key results are as follows for the site discharge location:

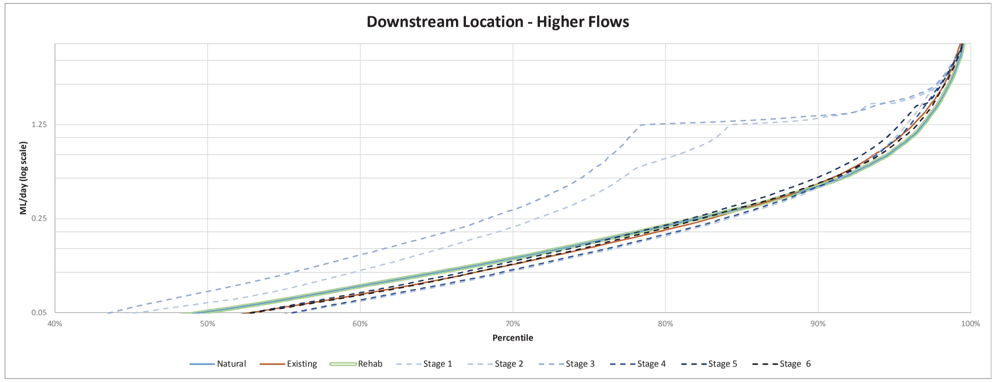
- The flow regimes after rehabilitation of the site restores natural conditions as closely as possible to pre-quarrying conditions.
- As discussed in Section 4.2 the existing conditions result in less frequent flows than the natural scenario, with peak flows during heavy rainfall increasing compared to the natural scenario.
- The occurrence of flow is less frequent for all stages than for the existing or natural/rehabilitated scenarios. This is due to dewatering during the project reducing the overflow frequency from the system compared to existing. This impact is most significant during stages where voids are maintained empty such as Stage 4 when no flow occurs approximately 86% of the time.
- Moderate flows are more regular during stages involving dewatering (particularly Stage 3). This is due to dewatering and discharge occurring at a higher rate than the existing or natural discharges. The existing voids will be dewatered at moderate flow rates of between 1 and 2 ML/day, which is considerably less than current discharges associated with storm flows during wet weather events of up to 10 ML/day.
- All of these impacts subside considerably for the downstream location.

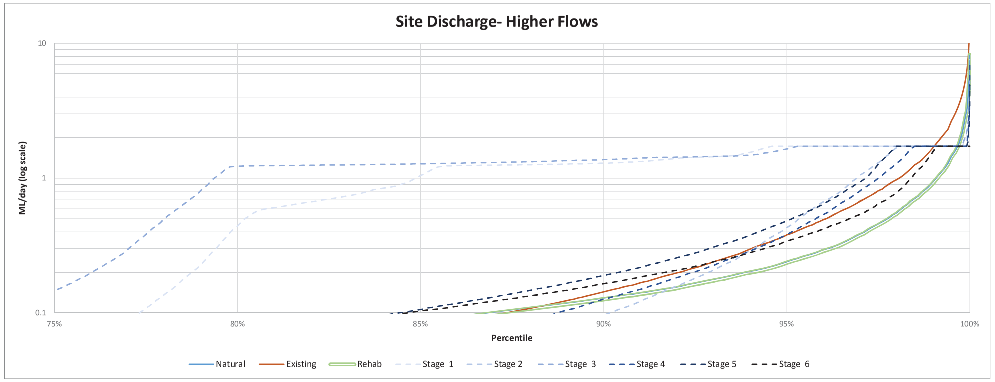
In summary, the proposed project will alter the flow regimes temporarily, including less frequent low flows and more frequent moderate flows, during the life of the project. However, after completion of the project and rehabilitation flows will be restored to natural conditions as closely as possible to pre-quarrying conditions and will be significantly closer to natural conditions than is currently the case. These results were considered in the geomorphic conditions impact assessment as outlined in Section 5.3.

Figure 5-2: Flow Duration Results









5.2.2 Flow Proportions Assessment

Table 5-2 shows the predicted median proportions of the total flow that come in contact with emplaced material for each stage. These are shown for the flow proportion assessment locations as indicated on Figure 3-2. This includes analysis of all the climatic realisations simulated as discussed in Section 3.2.

These results were considered in the water quality impact assessment as detailed in Section 5.4

Table 5-2 Flow Proportion Results

Stage	Discharge	Downstream	Wollangambe River
1	4.8%	2.8%	0.7%
2	2.1%	0.7%	0.05%
3	6.6%	5.1%	1.5%
4	16.1%	5.7%	0.3%
5	19.6%	7.9%	0.4%
6	31.6%	12.3%	0.7%

As discussed in Section 6, reducing emplaced ENM areas has been developed as a potential mitigation measure should actual concentrations of runoff from emplaced material be higher than predicted in this assessment. Table 5-3 shows the flow proportion results for the reduced areas outlined in Table 5-4.

Table 5-3 Flow Proportion Results – Reduced Emplacement Areas

Stage	Discharge	Downstream	Wollangambe River
1	4.8%	2.8%	0.7%
2	2.1%	0.7%	0.05%
3	5.2%	4.0%	1.2%
4	10.6%	3.7%	0.2%
5	10.3%	3.9%	0.2%
6	10.1%	3.8%	0.2%

Table 5-4 Maximum Exposed ENM Areas

Stage	Maximum Exposed ENM Area (m^2)
1	No restriction on areas developed for staging plans
2	
3	8,500
4	16,800
5	11,400
6	8,900

5.2.3 Groundwater licensing

Dewatering of the voids results in groundwater take from the underlying groundwater source. The water balance predicts that the peak groundwater take will be up to 80 ML/year during Stage 5 based upon very conservative modelling assumptions.

The groundwater source underlying the site is the Sydney Basin Richmond Groundwater Source, managed under the Greater Metropolitan Region Groundwater Sources WSP. A search of the National Water Market website (www.nationalwatermarket.gov.au) was undertaken in March 2018 and identified 16,635 ML of tradeable water access entitlement in the Sydney Basin Richmond Groundwater Source divided between 86 licences (DoE, 2018). This indicates that there is sufficient tradeable water available within the water source to meet the requirements of BQRP. Based on data from DoE (2018), there were three trades totalling 91 ML carried out within this water source over the 2016-2017 water year and four trades totalling 50 ML during the 2014-2015 water year. This indicates that there is active trading within the water source similar to the volumetric requirement of BQRP.

5.3 Geomorphic Conditions

As discussed in Section 4.3 downstream reaches are expected to have a relatively high resistance to geomorphologic change. However, the temporary increase in frequency of moderate flows associated with Stages 1 and 3, as discussed in Section 5.2.1, has some potential to result in scouring and modification to downstream creek formations, although this risk is considered to be low. In particular, long periods of a highly regular flow rate, in contrast to varying natural flow regimes, could result in erosive stresses being applied continuously at the same level and result in scour. Regular fluctuation of discharge regimes would greatly reduce this impact and is therefore proposed as mitigation and discussed in Section 6. With implementation of this mitigation the project is not expected to result in significant impacts on downstream waterway formation and geomorphic conditions.

5.4 Surface water environment

5.4.1 Potential impacts of ENM emplacement

The predicted ENM soil water quality based on the use of maximum average concentrations in the ENM order, the USEPA (1996) soil-water partition equation, and the major ion concentrations from Bartrop (2014) is presented in Table 5-5. The derivation of these values is described in detail in Section 3.3.2.

Table 5-5 shows that water equilibrating with the (theoretical) acceptable quality ENM is predicted to exceed the ANZECC (2000) GVs for the following parameters: EC, cadmium, copper, arsenic, zinc, chromium, naphthalene, ortho-xylene, and para-xylene. As this water will naturally mix with runoff which has not interfaced with ENM prior to discharge from the Site, the quality of discharged water has been assessed below.

Table 5-5 Predicted ENM soil water quality based on maximum acceptable concentrations as per the ENM order.

Parameter	Units	ENM soil water	ANZECC (2000) GV
pH	pH unit	8.0	6.5 – 8.0
EC	µS/cm	**1436**	30 - 350
Alkalinity as $CaCO_3$	mg/L	412.5	NA
Sulfate as SO_4	mg/L	20	NA
Chloride	mg/L	435	NA
Calcium	mg/L	60	NA
Magnesium	mg/L	67.5	NA
Sodium	mg/L	210	NA
Potassium	mg/L	12.5	NA
Cadmium	mg/L	**0.000063**	0.00006
Copper	mg/L	**0.002**	0.001
Nickel	mg/L	0.002	0.008
Lead	mg/L	0.00032	0.001
Arsenic	mg/L	**0.0008**	0.0008 (AsV)
Zinc	mg/L	**0.0048**	0.0024
Mercury	mg/L	0.00001	0.00006
Chromium	mg/L	**0.588**	0.00001 (CrVI)
Naphthalene	mg/L	**0.0032**	0.0025
Benzo(a)pyrene	mg/L	0.00004	NA
Benzene	mg/L	0.103	0.600
Toluene	mg/L	10.057	NA
Ethylbenzene	mg/L	2.294	NA
ortho-xylene	mg/L	**0.319**	0.200
meta-xylene	mg/L	0.950	NA
para-xylene	mg/L	**0.317**	0.140
TPH C10-C36	mg/L	14.120	NA

Orange bold denotes exceedances of the ANZECC (2000) GVs

The results in Table 5-5 and the results for pre-rehabilitation site discharge quality (refer Table 4-2) were used as inputs for the PHREEQc modelling as described in Section 3.3.2. Results from this modelling are presented below in Table 5-6.

As Table 5-6 shows, there are no exceedances of the ANZECC (2000) GVs for metals predicted for any stage for the Project.

pH is predicted to remain slightly acidic during all stages except stage 6, with all predicted pH values being above those which were observed during the site visit on 9 March 2017.

EC is predicted to remain below the ANZECC (2000) GV for upland rivers for all stages except stage 6, though it is noted that the EC analysis method prescribed by the ENM order does not give results which indicate the likely salinity of runoff from the material. As such, the modelled EC values presented in Table 5-6 are for indicative purposes only, considering that the assumed EC of ENM soil water was close to that of the ENM order limit, and adopted for all runoff interfacing with the ENM stockpiles.

The assessment predicted that concentrations of naphthalene, benzene and ortho- and para-xylene in the site runoff would remain below the relevant ANZECC (2000) GVs during all stages. There is no ANZECC (2000) GV for the most prevalent xylene isomer, meta-xylene.

Table 5-6 Water quality modelling results for the Site discharge.

Parameter	Units	ANZECC (2000) GV	Stage 1 discharge	Stage 2 discharge	Stage 3 discharge	Stage 4 discharge	Stage 5 discharge	Stage 6 discharge
ENM soil water to site runoff ratio			0.048:0.952	0.021:0.979	0.066:0.934	0.161:0.839	0.196:0.804	0.316:0.684
pH	pH unit	6.5–8.0	**5.70**	**5.42**	**5.82**	**6.21**	**6.30**	6.57
EC	µS/cm	30-350	87	48	114	252	302	**476**
Arsenic	mg/L	0.0008	0.0002	0.0002	0.0002	0.0003	0.0003	0.0004
Copper	mg/L	0.001	0.0003	0.0003	0.0004	0.0005	0.0006	0.0008
Nickel	mg/L	0.008	0.0003	0.0003	0.0004	0.0005	0.0006	0.0008
Zinc	mg/L	0.0024	0.0007	0.0006	0.0008	0.0012	0.0017	0.0018
Mercury	mg/L	0.00006	0.00002	0.00002	0.00002	0.00003	0.00003	0.00004
Cadmium	mg/L	0.00006	0.00003	0.00003	0.00003	0.00003	0.00003	0.00004
Lead	mg/L	0.001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Chromium (VI)	mg/L	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Naphthalene	mg/L	0.0025	0.0002	0.0001	0.0002	0.0005	0.0006	0.0010
Benzene	mg/L	0.6	0.005	0.002	0.007	0.017	0.020	0.033
Ortho-xylene	mg/L	0.2	0.015	0.007	0.021	0.051	0.062	0.101
Meta-xylene	mg/L	NA	0.046	0.020	0.063	0.153	0.186	0.300
Para-xylene	mg/L	0.14	0.015	0.007	0.021	0.051	0.062	0.100

Orange bold denotes exceedances of the ANZECC (2000) GVs

5.4.2 Representative VENM and ENM samples

A summary of the sites and sampling dates for the collection of the nine representative VENM and ENM samples is provided as Table 5-7, which has been reproduced from ADE Consulting Group (2017).

Table 5-7 Soil/rock sampling sites (ADE Consulting Group 2017).

Landscape	Address	Depth (m BGL)	Soil Description	Date
Ashfield Shale	6-14 Walker Street, Rhodes NSW	2.0	Weathered SHALE, dark grey, brittle with ironstone bands, dry.	9/11/2017
Glenorie	2-4 Lodge Street, Hornsby NSW	2.0	Silty CLAY (CL), medium plasticity, light grey / light brown with trace subangular shale fragments, moist.	13/11/2017
Blacktown	490 Twelfth Avenue, Rossmore NSW	0.5	Silty CLAY (CH), high plasticity, medium red mottled light grey, moist.	13/11/2017
South Creek	490 Twelfth Avenue, Rossmore NSW	0.5	Silty SAND (SM), fine grained, well sorted, light brown / light orange, moist.	15/11/2017
Lucas Heights	250 Railway Parade, Kogarah NSW	2.0	Clayey SAND (SC), fine grained, well sorted, medium / high plasticity, dark red / light grey with sub angular iron coated gravels, moist.	16/11/2017
Hawkesbury Sandstone	457-459 Pacific Highway, Asquith NSW	7.0	SANDSTONE, medium / coarse grained, well graded, light orange / dark yellow with dark red ironstone bands, dry.	16/11/2017
Disturbed Terrain	Governor Macquarie Drive, Warwick Farm NSW	2.0	Silty SAND (SM), fine grained, well graded, dark brown / medium orange, moist.	16/11/2017
Faulconbridge	12 Tenth Street, Warragamba NSW	0.5	Silty SAND (SM), medium grained, well graded, dark brown, moist.	16/11/2017
Tuggerah	18 Huntley Street, Alexandria NSW	3.5	SAND (SW), fine grained, well sorted, light orange / light brown, moist.	16/11/2017

The testing of the samples detailed in Table 5-7 was conducted with the purpose of reviewing the accuracy of the assessment detailed in Section 5.4.1 with data from sites considered representative of the areas which may supply ENM to the Project. It is noted that leachate results are not representative of the quality of runoff from the tested material, due to the contact time and agitation involved in the ASLP. The results, however, were used for this purpose to provide a conservative estimate of the maximum potential substance concentrations in runoff from the samples detailed in Table 5-7.

Results of the soil/rock testing of the nine samples are presented in Table 5-8. There were no exceedances of the ENM order maximum average concentrations, with the exception of pH for the Glenorie and Lucas Heights samples, which had pH values lower than the minimum average pH as per the ENM order. The pH of these samples however, was not lower than the absolute minimum pH (4.5 pH units). For the theoretical mix of the nine samples, the average pH was 5.58, which is within the ENM order average range.

Table 5-8 Results of soil/rock testing (ADE Consulting Group 2017).

Parameter	Units	ENM order maximum average concentration	Tuggerah	Faulconbridge	Blacktown	Ashfield	Glenorie	Lucas Heights	Hawkesbury sandstone	South Creek	Disturbed Terrain
Arsenic	mg/kg	20	<5	<5	11	8	18	7	<5	13	<5
Cadmium	mg/kg	0.5	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	mg/kg	75	<2	8	17	4	23	14	7	28	<2
Copper	mg/kg	100	<5	5	32	13	18	<5	6	28	<5
Lead	mg/kg	50	<5	24	19	15	21	24	16	17	<5
Mercury	mg/kg	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	30	<2	<2	10	<2	<2	2	<2	7	3
Zinc	mg/kg	150	9	18	43	<5	6	<5	<5	23	<5
Benzene	mg/kg	0.5*	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Ethylbenzene	mg/kg	25*	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	mg/kg	65*	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total xylenes	mg/kg	15*	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total PAHs	mg/kg	20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TPH C10-C36	mg/kg	250	<50	<50	<50	<50	<50	<50	<50	<50	<50
pH	pH unit	5 - 9	6.1	5.8	5.7	5.3	**4.9**	**4.7**	5.8	5.6	6.3
EC	µS/cm	1500	13	14	224	29	53	43	33	712	21

* Absolute maximum concentration.

Orange bold denotes exceedances of the ENM order maximum average concentration.

Leachate water quality results for each of the soil/rock samples are presented in Table 5-9. Results for BTEX, PAHs and petroleum hydrocarbons have not been included in Table 5-9 as all observations were below the respective LORs. In Table 5-9, concentrations below the LOR have been tabulated as half of the LOR for the purpose of calculating the average leachate quality.

Table 5-9 shows that exceedances of the ANZECC (2000) GVs were observed for the following parameters in the leachates: arsenic, cadmium, chromium, copper, lead, zinc, total nitrogen, total phosphorous and pH. It is noted that the results were variable, and that exceedances for arsenic, copper, lead, total nitrogen and total phosphorous were observed in less than half of the samples.

There was generally good agreement between the leachate results and the results of the USEPA (1996) partition equation when using the soil/rock testing results (Table 5-8). Some variability was observed, particularly for the metals lead, nickel and zinc, which had higher concentrations in the leachate than predicted by the partition equation. Calculation of K_d values for these metals based on the leachate results indicated that the samples were within the K_d range observed by Allison and Allison (2005). Considering Allison and Allison (2005) provided median K_d values based on a review of over 240 articles and reports, with a total of 1170 individual Kd values used, the variability observed in the representative VENM and ENM sample results did not justify reassessment of the potential impacts of ENM emplacement, but is instead indicative of the inherent variability in K_d values. Regardless, an assessment of the potential impacts of the emplacement of a theoretical mixture of the nine samples from ADE Consulting Group (2017) has been provided below.

The average leachate quality results in Table 5-9 show that this theoretical mixture would have NO_x and TN concentrations which exceed the relevant GVs, however, it is likely that biotic uptake and decomposition would reduce these concentrations significantly prior to discharge from the site. Additionally, it is noted that these average values are skewed by the elevated nutrient concentrations observed in the Blacktown sample. The averages calculated without the use of the Blacktown results were 0.034 mg/L for NO_x and 0.156 mg/L for TN, i.e. a NO_x concentration below that which has been observed at the site discharge under existing conditions (refer Table 4-2), and a TN concentration below the relevant ANZECC (2000) GV. As such, elevated nutrient concentrations in surface water and groundwater are not likely to result from the emplacement of ENM at the site, and nutrient concentrations have not been modelled in this section or in Section 5.5. Regardless, nutrients have been included in the proposed monitoring suite (Section 6.1.2).

Table 5-9 Leachate results (ADE Consulting Group 2017).

Parameter	Units	ANZECC (2000) GVs	Tuggerah	Faulconbridge	Blacktown	Ashfield	Glenorie	Lucas Heights	Hawkesbury sandstone	South Creek	Disturbed Terrain	Average leachate quality
Arsenic	mg/L	0.0008 (AsV)	0.0005	0.0005	**0.001**	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00056
Cadmium	mg/L	0.00006	0.00005	**0.0002**	**0.0004**	**0.0002**	0.00005	0.00005	0.00005	**0.0003**	**0.0002**	**0.00017**
Chromium	mg/L	0.00001 (CrVI)	**0.001**	**0.002**	**0.007**	**0.001**	0.0005	0.0005	0.0005	**0.007**	0.0005	**0.00222**
Copper	mg/L	0.001	0.0005	**0.002**	**0.013**	**0.002**	0.0005	0.0005	0.0005	**0.007**	0.001	0.003
Lead	mg/L	0.001	0.0005	**0.003**	**0.01**	**0.004**	0.0005	0.0005	0.0005	**0.007**	0.0005	0.0029
Mercury	mg/L	0.00006	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005
Nickel	mg/L	0.008	0.0005	0.001	0.006	0.0005	0.0005	0.006	0.0005	0.004	0.002	0.0023
Zinc	mg/L	0.0024	**0.03**	**0.074**	**0.484**	**0.054**	**0.043**	**0.135**	**0.042**	**0.064**	**0.160**	**0.121**
Ammonia	mg/L	0.320	0.11	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.01	0.017
Nitrite	mg/L	NA	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Nitrate	mg/L	NA	0.01	0.02	2.35	0.02	0.02	0.03	0.005	0.04	0.13	0.291
Total Kjeldahl Nitrogen	mg/L	NA	0.4	0.2	0.6	0.05	0.1	0.05	0.1	0.05	0.2	0.194
Total Nitrogen	mg/L	0.250	**0.4**	0.2	**3**	0.05	0.1	0.05	0.1	0.05	**0.3**	**0.472**
Total Phosphorous	mg/L	0.020	**0.04**	0.005	**0.08**	0.005	0.01	0.005	0.005	0.005	0.005	0.018
Reactive Phosphorous	mg/L	0.015	0.005	0.005	0.005	0.005	0.01	0.005	0.005	0.005	0.005	0.006
pH	pH units	6.5-8.0	6.67	**6.16**	**6.38**	**6.04**	**4.86**	**5.28**	**5.76**	**6.42**	**6.42**	**6.00**
EC	µS/cm	350	30	36	124	58	35	33	31	248	43	70.89
Chloride	mg/L	NA	5	8	20	10	5	5	5	48	9	12.78
Sulfate	mg/L	NA	2	2	21	8	8	6	5	21	2	8.33
Total alkalinity as $CaCO_3$	mg/L	NA	5	3	3	0.5	0.5	0.5	0.5	4	4	2.33

Parameter	Units	ANZECC (2000) GVs	Tuggerah	Faulconbridge	Blacktown	Ashfield	Glenorie	Lucas Heights	Hawkesbury sandstone	South Creek	Disturbed Terrain	Average leachate quality
Calcium	mg/L	NA	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.50
Magnesium	mg/L	NA	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.50
Sodium	mg/L	NA	4	16	23	11	5	4	6	43	8	13.33
Potassium	mg/L	NA	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5	0.5	0.67

Orange bold denotes exceedances of the ANZECC (2000) GVs

Similar water quality to that of the leachate samples is not expected in runoff from emplaced ENM, as interfacing times between the ENM and rainfall runoff will be lower than that of the ASLP tests, which involves tumbling the soil/rock sample with water for 18 hours. As such, the predictions made in Section 5.4.1 using the USEPA (1996) partition equation and the ENM Order maximum average concentrations are considered to be more representative of the likely quality of the site discharge. Regardless, the average leachate water quality data were used as inputs for the PHREEQc modelling (as described in Section 3.3.2) to assess the potential risk associated with the discharge of water which has equilibrated with ENM. In this instance the ENM is a theoretical mix of the nine samples collected by ADE Consulting Group (2017), and the mitigation measure of limiting the area of exposed emplaced material (refer Section 5.2.2) has been assumed due to the higher parameter concentrations from the ASLP leachate samples. The results of this assessment are presented below in Table 5-10.

Table 5-10 indicates that no exceedances of the ANZECC (2000) GVs are predicted at the site discharge assuming the average leachate water quality, with the exceptions of pH and zinc. pH is naturally low at the site and in the receiving environment. Minor exceedances of the GV for zinc were predicted for all Stages except Stage 2, however the model does not allow for zinc complexation with organic matter. Stephan *et al.* (2008) observed 60% to 98% of free Zn2+ to bind in organic complexes in a study of 66 soils representative of a wide range of field conditions. Levels of dissolved organic matter found in most freshwaters are generally sufficient to remove zinc toxicity (ANZECC, 2000). Organic matter within the site sediment basin and the swamp are therefore expected to considerably reduce the availability of zinc. The naturally low pH levels recorded in surface waters proximal to the site (4-6), may also aid the removal of free zinc.

It is also noted that the minor exceedances were at or below the zinc concentration observed by OEH (2015) in the Wollangambe River at a point upstream of the Clarence Colliery (refer Table 4-1). As such, the predicted zinc concentrations presented in Table 5-10 are expected to not have any adverse impact in the receiving environment if they were to result from run-off from the site. Water quality was also modelled for the site Tributary DS using the average leachate water quality, the results for which are presented in Table 5-11. These results indicate that no elevated metal concentrations are predicted at Tributary DS, despite the conservative assumption that all runoff from emplaced ENM would have water quality equivalent to that of the average of the leachate samples reported in ADE Consulting Group (2017).

Table 5-10 Water quality modelling results for the Site discharge, assuming average leachate water quality.

Parameter	Units	ANZECC (2000) GV	Stage 1 discharge	Stage 2 discharge	Stage 3 discharge	Stage 4 discharge	Stage 5 discharge	Stage 6 discharge
Average leachate to site runoff ratio			0.046:0.954	0.02:0.98	0.053:0.947	0.107:0.893	0.096:0.904	0.102:0.898
pH	pH unit	6.5–8.0	**4.96**	**4.96**	**4.97**	**4.97**	**4.97**	**4.97**
EC	µS/cm	30-350	73.0	41.5	81.4	146.7	133.4	140.6
Arsenic	mg/L	0.0008	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Copper	mg/L	0.001	0.0004	0.0003	0.0004	0.0005	0.0005	0.0005
Nickel	mg/L	0.008	0.0003	0.0003	0.0003	0.0004	0.0004	0.0004
Zinc	mg/L	0.0024	**0.0027**	0.0015	**0.0030**	**0.0056**	**0.0051**	**0.0054**
Mercury	mg/L	0.00006	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
Cadmium	mg/L	0.00006	0.00003	0.00003	0.00003	0.00004	0.00004	0.00004
Lead	mg/L	0.001	0.0002	0.0001	0.0002	0.0004	0.0003	0.0004
Chromium (VI)	mg/L	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001

Orange bold denotes exceedances of the ANZECC (2000) GVs

Table 5-11 Water quality modelling results for Tributary DS, assuming average leachate water quality.

Parameter	Units	ANZECC (2000) GV	Stage 1 discharge	Stage 2 discharge	Stage 3 discharge	Stage 4 discharge	Stage 5 discharge	Stage 6 discharge
Average leachate to site runoff ratio			0.027:0.973	0.007:0.993	0.04:0.96	0.037:0.963	0.036:0.964	0.039:0.961
pH	pH unit	6.5–8.0	**4.96**	**4.97**	**4.96**	**4.96**	**4.96**	**4.96**
EC	µS/cm	30-350	50.0	25.8	65.7	62.1	60.9	64.5
Arsenic	mg/L	0.0008	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Copper	mg/L	0.001	0.0003	0.0003	0.0004	0.0004	0.0003	0.0004
Nickel	mg/L	0.008	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Zinc	mg/L	0.0024	0.0018	0.0008	0.0024	0.0023	0.0022	0.0024
Mercury	mg/L	0.00006	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
Cadmium	mg/L	0.00006	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003
Lead	mg/L	0.001	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002
Chromium (VI)	mg/L	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001

Orange bold denotes exceedances of the ANZECC (2000) GVs

5.5 Groundwater environment

5.5.1 Site conceptualisation

The following groundwater conditions are expected to occur, prior to, during and post operations.

Pre-operation

Based on the current conceptualisation works (see Figure 4.1) groundwater from up-gradient (west) of the site flows into the south and main voids, which discharges to the east void, which subsequently discharges to the down-gradient swamp.

These conditions are expected to prevail regardless of the surface water levels in the pit voids provide that there is no artificial pumping from the pits.

Operation

During operation there will be a staged approach (6 stages) where the south void is dewatered and infilled, followed by the main void and then the east void. During these times the specific void being dewatered would act as a sink for groundwater migrating from up-gradient. The voids with water remaining in them would create isolated recharge sources that would result in groundwater flow to the dewatered pits and groundwater flow to the down gradient swamp.

Due to the relative elevations of the down gradient swamp (approx. 1020 m AHD) relative to the base of the pit voids (approx. 1,022 m AHD) some groundwater will always migrate from the pits to the swamp regardless. The amount of groundwater migration down gradient would change during operation depending on which pit was being dewatered and which pit was infilled. During stages where the east void is full of water there would be nothing to intercept groundwater seeping from the pit. Alternatively when the east void is dewatered it will preferentially intercept all groundwater migrating from up-gradient and the filled north and main voids. Due to this progression it is expected that most ENM impacted water migrating from the filled south and main voids would be captured in the east void (Stage 6). Subsequently the development of a groundwater quality influence associated with the ENM would begin emerging toward the end of the operation.

After each void is filled migration of ENM influenced groundwater to an actively dewatered pit could occur. This has the potential to result in additional ENM influenced water being incorporated into the surface water discharge system. The overall potential for this to occur is expected to be negligible based on the following factors:

- Groundwater within the pits recently infilled will be deflated and recovery rates will be reduced by preferential dewatering in the active pit.
- Substance migration rates in groundwater between the pits are expected to be low. For example the retarded migration rates in groundwater for zinc discussed section 5.5.3 (below), approximate 0.007 m/yr, although this assumes existing flow gradients across the site. As a pit recharges this gradient and therefore migration rates could be up to 10 times higher (0.07 m/yr), which is still insignificant.

Post-Operation

A front of groundwater quality influenced by the emplaced material would then slowly generate over time reaching the swamp thousands of years after completion of operation. The metals in groundwater would be relatively similar to existing background concentrations and have a minor effect on overall in swamp water quality.

The slow migration times of ENM affected groundwater will mean that the emergence of groundwater at the down gradient swamp will occur a long time after surface water run-off affects during operation and when the site has been fully rehabilitated. After rehabilitation it is expected that surface run-off water quality will not be affected by ENM as it will be capped and revegetated.

Conclusion

Due to the different times of emergence of ENM affects, the groundwater and surface impacts assessments have been treated as separate impacts that do not overlap. This conclusion will be proactively confirmed during site operations via monitoring of water quality and quantity and a review of the modelled predictions for the future stages of the project, to identify if additional adaptive management controls need to be implemented to meet the GVs. This is detailed below in Sections 6 and 6.3.

5.5.2 Water quality comparison

Comparison of background groundwater quality (average concentrations between MB02 and MB03 from March 2018) and estimated ENM leachate quality (both the calculated soil:water partition concentrations and the average ADE ASLP) is presented in Table 5-12. ENM leachate concentration estimates are higher than existing groundwater concentrations for a number of metal species, including As, Cd, Cr, Ni, Pb and Zn. The increased concentrations indicate that additional assessment is required to determine the potential for impact on the beneficial use of the groundwater. Risk to beneficial use of the groundwater resource is assessed below in relation to discharge quality at surface water receiving points. In this instance, the surface water receptor is the swamp / tributary 200 m down gradient of the site boundary.

Table 5-12 Groundwater and ENM leachate quality comparison

Analyte	Units	MB02	MB03	Average (a)	ENM soil water (b)	ADE avg (c)
Arsenic	mg/L	<0.0002	<0.0002	0.0001	**0.0008**	**0.00056**
Cadmium	mg/L	<0.00005	0.00006	0.000043	**0.000063**	**0.00017**
Chromium(d)	mg/L	<0.0002	<0.0002	0.0001	**0.59**	**0.0022**
Copper	mg/L	0.0024	0.0089	0.006	0.002	0.003
Lead	mg/L	<0.0001	0.0002	0.0001	**0.00032**	**0.0029**
Nickel	mg/L	0.001	0.0025	0.002	0.002	**0.0023**
Zinc	mg/L	0.039	0.043	0.041	0.0048	**0.121**
Mercury	mg/L	0.00007	0.00027	0.0002	0.00001	0.00005

Orange bold denotes exceedances of average background groundwater quality

(a) Average of MB02 and MB02. Half LOR used in calculation.

(b) Table 5-4

(c) Table 5-8

(d) Total dissolved concentration (both III and VI forms).

5.5.3 Geochemical modelling

The predicted metal concentrations at 200 m from the site boundary, based on PHREEQC simulations 1-3, are shown in Table 5-13.

Simulated concentrations of groundwater seeping into the swamp at 200 m from the site boundary under existing conditions (SIM 1) exceed actual concentrations in the tributary (sampled in March 2017) for Cu, Ni, Zn and Hg. This suggests that metal attenuation along the migration pathway swamp is greater than simulated by the model. Calculated attenuation factors for Cu, Ni, Zn and Hg are 12, 4, 41 and 5 respectively as shown in Table 5-13.

Attenuation factors were not calculated for the other metals since their predicted groundwater concentrations for SIM 1 were less than the actual concentrations in the tributary.

Simulated concentrations of groundwater seeping into the swamp under proposed conditions (i.e. including input of ENM leachate at the voids) are shown in Table 5-13 (SIM 2 and SIM 3). Predicted concentrations were compared to ANZECC (2000) GVs. The concentrations of Cu and Zn are predicted to exceed the GV for SIM 2 and Cu, Zn and Cd are predicted to exceed the GV for SIM 3. It should be noted that Cu concentrations in background groundwater are above ENM leachate concentrations (Table 5-12) so Cu is not a metal of concern. In addition, since the GV for Cr applies to the Cr VI species, this species has been reported in Table 5-13 (rather than total dissolved chromium).

Table 5-13 PhreeqC predicted metal concentrations 200 m down-gradient of site boundary

Parameter	Units	ANZECC (2000) GV	Tributary [(a)]	SIM 1	SIM 2	SIM 3	AF [(b)]
Arsenic	mg/L	0.0008	<0.0002	0.0001	0.0003	0.0002	NA
Copper	mg/L	0.001	<0.0005	0.006	**0.005**	**0.005**	12
Nickel	mg/L	0.008	<0.0005	0.002	0.002	0.002	4
Zinc	mg/L	0.0024	<0.001	0.041	**0.031**	**0.063**	41
Mercury	mg/L	0.00006	<0.00004	0.0002	0.000003	0.00001	5
Cadmium	mg/L	0.00006	<0.00005	0.000043	0.00005	**0.00009**	NA
Lead	mg/L	0.001	<0.0001	0.0001	0.0002	0.0009	NA
Chromium (VI)	mg/L	0.00001[(c)]	<0.0002	0.0001	< 0.00001	< 0.00001	NA

Orange bold denotes exceedances of the ANZECC (2000) GVs (for SIM 2 and SIM 3 only)

(a) Results for the tributary from sampling undertaken in March 2017

(b) Attenuation factor (SIM 1: tributary concentration ratio)

(c) GV for Cr (VI)

Attenuation factors were applied to Cu and Zn concentrations and results are shown in Table 5-14. Predicted concentrations of Cu and Zn in groundwater seepage into the swamp were below the GV for both SIM 2 and SIM 3 when attenuation factors were applied. Therefore, the only exceedance remaining is a minor exceedance of Cd for SIM 3.

Table 5-14 PhreeqC predicted metal concentrations with attenuation applied

Parameter	Units	ANZECC (2000) GV	SIM 2 (AF)	SIM 3 (AF)	AF
Copper	mg/L	0.001	0.0004	0.0004	12
Zinc	mg/L	0.0024	0.0008	0.002	41
Cadmium	mg/L	0.00006	0.00005	**0.00009**	NA

Orange bold denotes exceedances of the ANZECC (2000) GVs

Based on the results of the geochemical modelling with PhreeqC, it was considered that additional fate and transport modelling should be undertaken as a further line of evidence to assess the potential impact of Cd migration through groundwater on the surface water receptor. The additional modelling incorporated adsorption onto the solid phase using partition coefficient (Kd) values calculated from the ADE ASLP results, since attenuation via adsorption was not considered in the PhreeqC modelling. Zinc was also included in this additional modelling, although the predicted concentration of Zn at the swamp was found to be below the GV after the application of the AF (Table 5-14).

Input parameters for the P20 model are shown in Table 5-15. Model results are shown in Table 5-16.

Table 5-15 P20 model input parameters

Input parameter	Units	Value	Details
Initial substance concentration in groundwater at plume core (Zn)	mg/l	0.12	Average ADE concentration
Initial substance concentration in groundwater at plume core (Cd)	mg/L	0.00017	Average ADE concentration
Half life for degradation of substance in water	days	9.00E+99	Default value – assumed no degradation (conservative)
Width of plume in aquifer at source (perpendicular to flow)	m	100	Estimated width of pit perpendicular to flow direction – from interpolated groundwater plots for the site
Plume thickness at source	m	20	Estimated depth of pit below the water table
Saturated aquifer thickness	m	21	Same as depth of pit
Bulk density of aquifer materials	g/cm^3	1.7	Literature value for sandstone
Effective porosity of aquifer / volumetric water content	fraction	0.05	Assumed fracture flow dominated and that fractures represent 5% of bulk volume.
Hydraulic gradient	fraction	0.06	Interpolated using groundwater data at site to elevation of swamp.
Hydraulic conductivity of aquifer	m/d	0.07	Site slug test data - average
Distance to compliance point	m	200	200 metres to swamp discharge point measured on six maps.
Time since substance entered groundwater	days	3.65E+06	10,000 years – assumed to be steady state, however, steady state model was also run to understand even longer term concentrations.
Partition coefficient (Kd) – Zinc	l/kg	126	Estimated from ADE data using USEPA (2005)
Partition coefficient (Kd) – Cadmium	l/kg	5,020	Estimated from ADE data using USEPA (2005)

Table 5-16 P20 model results

Parameter	Source concentration (mg/L)	Concentration at 200 m (mg/L)	Simulation time	Attenuation factor
Zinc	0.12	0.000013	10,000 yrs	92,308
		2	Steady State	1.0
Cadmium	0.00017	0.0	10,000 yrs	> 10,000
		0.00017	Steady State	1.0

The results of the P20 modelling suggest that the steady state groundwater concentrations at the swamp would be similar to the source leachate concentrations when they reach the swamp, however it would take more than 10,000 years to arrive at the receptor and to achieve steady state conditions. The predicted PhreeqC concentrations for zinc and cadmium from Table 5-13 are between the 10,000 year and steady state values from the P20 model.

The mass flux assessment (methodology outlined in Section 3.4.4) utilised the steady state concentrations from Table 5-16 as a conservative assumption and had the following inputs:

- The retarded substance flow velocity was estimated as 0.0073 m/year for zinc and 0.00018 m/year for cadmium.
- Given a discharge area from the pit of 100 m x 20 m discharging directly to the swamp at a steady state concentration of 0.12 mg/L (kg/m^3) for zinc and 0.00017 mg/L for cadmium the total mass discharge to the swamp per day from groundwater is 4.8×10^{-6} kilograms per day (0.0017 kilograms per year) for zinc and 1.7×10^{-10} kilograms per day for cadmium (6.2×10^{-08} kilograms per year).
- The swamp length was estimated to be 220 m by an average width of 30 m and was assumed to have a depth of 0.5 m. This gave a volume of 3,300 m^3 for the swamp.

The results of the mass flux assessment are as follows:

- The concentration of zinc in the swamp would increase by 0.00053 mg/L over one year due to groundwater discharge, assuming no additional surface water inputs or rainfall inputs to the swamp. This increase in concentration is approximately 22% of the GV concentration of 0.0024 mg/L.
- The concentration of cadmium in the swamp would increase by 1.9×10^{-08} mg/L over one year due to groundwater discharge, assuming no additional surface water inputs or rainfall inputs to the swamp. This increase in concentration is approximately 0.3% of the GV concentration of 0.00006 mg/L.
- Note that this assessment assumes complete mixing between the groundwater discharge and the water within the swamp. It is possible that there would be some localised areas where metal concentrations are temporarily higher and closer to the values modelled in Phreeqc and P20. However, on a swamp wide scale the impacts would be insignificant.

Discussion

A conservative assessment of groundwater geochemistry and solute fate and transport has been undertaken to assess potential impacts of the project to the beneficial use of groundwater. Risk to beneficial use of the groundwater resource has been assessed in relation to discharge quality at surface water receiving points. In this instance, the surface water receptor is the swamp / tributary 200 m down gradient of the site boundary.

The initial comparison between existing groundwater quality and predicted ENM leachate concentrations (based on the both the calculated soil:water partition concentrations and the average ADE ASLP) indicate that the project may result in an increase in the concentrations of As, Cd, Cr, Ni, Pb and Zn in groundwater and therefore geochemical modelling was required to assess the extent of impact (if any).

PhreeqC modelling indicated that the concentration of groundwater discharge into the swamp may exceed the concentrations within the swamp for Cu, Zn and Cd. Since Cu concentrations in the groundwater currently exceed the concentrations in the swamp and the project is not expected to increase these concentrations in groundwater, no further assessment of Cu is required. Further PhreeqC modelling predicted that the concentrations of As, Cr (VI), Pb and Ni in groundwater discharge to the swamp will be less than the GV under proposed conditions and therefore these metals do not pose a risk of impact to water quality within the swamp.

The predicted concentration of zinc in groundwater discharge to the swamp (based on PhreeqC modelling) was found to be less than the GV after application of an attenuation factor based on the ratio of the existing groundwater concentration to the existing swamp concentration. As a further line of evidence, fate and transport modelling was undertaken to assess the migration of zinc between the backfilled voids and the swamp when natural attenuation (adsorption) is considered. The P20 model suggests that the concentration of zinc in groundwater discharge will approach the ENM leachate source concentration under steady state conditions, however this will take over 10,000 years. Based on this steady state concentration, the mass flux assessment suggests that the project will result in a very minor increase to the zinc concentration within the swamp under very conservative conditions of zero additional rainfall or surface water inputs over the period of a year. Overall, the lines of evidence from the modelling suggests that the project will results in a very minor change (if any) to zinc concentrations in the swamp and will not result in a change to the beneficial use of groundwater as a source of water to the surface water environment.

In the same way, additional fate and transport modelling was undertaken for Cd to assess the migration of Cd between the backfilled voids and the swamp when natural attenuation (adsorption) is considered. As for zinc, the P20 model suggests that the concentration of Cd in groundwater discharge will approach the ENM leachate source concentration under steady state conditions, however this will take over 10,000 years to occur. Based on this steady state concentration, the mass flux assessment suggests that the project will result in a very minor increase to the Cd concentration within the swamp under very conservative conditions of zero additional rainfall or surface water inputs. Overall, the lines of evidence from the modelling suggests that the project will results in a very minor change (if any) to Cd concentrations in the swamp and will not result in a change to the beneficial use of groundwater as a source of water to the surface water environment.

Since the beneficial use of groundwater is not expected to be lower as a result of the project, it is considered that the project satisfies the Level 1 minimal impact criterion under the NSW Aquifer Interference Policy. The slow travels times simulated demonstrate that a suitably designed monitoring program would be appropriate for monitoring the development of groundwater quality influences and triggering the implementation of mitigation measures if required. The proposed monitoring program is detailed in Section 6.1.3.

6. Avoidance, mitigation and management measures

Surface water and groundwater monitoring recommendations are detailed in Sections 6.1.2 and 6.1.3 below. Results from this monitoring will be compared to the ANZECC (2000) GVs relevant to the site as detailed in Table 2-1. In the case that an exceedance of these GVs is observed in two consecutive monitoring rounds at either the site discharge or the downstream tributary located within the swamp, and the exceedance is not observed at the reference tributary site, a review will be undertaken. This review would involve a review of the water balance and water quality modelling following the decision tree frameworks as recommended by ANZECC (2000). Should this review indicate that during site operations significant impacts on water quality were occurring as a result of the Project, this assessment has demonstrated that the mitigation measure of limiting the exposed areas of emplaced ENM (refer Sections 5.2.2) would successfully reduce the concentrations of potential contaminants in the receiving waterway to concentrations below the ANZECC (2000) GVs (refer Section 5.4.2).

Also detailed below in Section 6.2 is a proactive review process whereby water quality and quantity data from each emplacement stage will be collected and compared to the modelled predictions for the subsequent stages. The intent is to provide further confidence in the modelled predictions and if needed identify if additional adaptive management controls need to be implemented for the future stages to meet the GVs for the rehabilitation of the site.

As discussed in Section 5.3 dewatering rates should be regularly varied to minimise downstream geomorphic impacts. This will be undertaken by varying the dewatering pumping rate on a daily basis. The required average daily pumping rate shall be calculated before a period of pumping is required and the pumping rate adjusted on each consecutive day such that the average pumping requirement is achieved and a variation between maximum and minimum pumping rates of at least 100 percent is achieved.

An erosion and sediment control plan (ESCP) will be developed for the site prior to the commencement of filling. The ESCP will be developed following the guidance of *Managing urban stormwater: soils and construction, volume 2E – mines and quarries* (DECC 2008) "*The Blue Book"*.

Erosion and sediment control strategies will comprise the following:

- Minimisation of the extent and duration of disturbed areas, and prompt topsoiling and revegetation following the completion of each project stage.
- Ongoing filling works will maintain landforms which minimise the erosion hazard.
- Runoff from the site will be diverted around active filling areas and toward the voids in a manner which minimises erosion.
- Temporary control measures such as geotextile sediment fencing and straw bale filters.

The ESCP will detail the monitoring and maintenance required, such as inspections following significant rainfall events, and the removal of trapped sediments from control structures.

Management of sediment laden water will be undertaken through the provision of freeboard sediment control storage in the voids. In accordance with Blue Book requirements approximately 800 cubic metres of settling zone storage per hectare of catchment would be required. This would allow for capture and storage of sediment laden runoff, allowing for testing and controlled discharge in accordance with water quality limits to re-establish this freeboard within 5 days of the cessation of rainfall. Based on the volume of the voids this volume is expected to be readily achievable.

Before any pumped discharge from site, due either to management of recent rainfall or dewatering requirements, the turbidity of the water at the proposed pumping point would be tested and only discharged if a turbidity criteria is satisfied. This testing would be undertaken weekly during discharge or daily during discharge if rainfall has occurred during that day.

The discharge criteria is proposed to be initially 25 NTU based on the ANZECC (2000) default GV for turbidity in upland rivers in south-east Australia. Based on sampling of current water quality in the voids this is expected to be readily achievable, without treatment, during the early stages before significant emplacement of material. During later stages, if ongoing discharge quality monitoring indicates this criteria may not be satisfied a low impact potential flocculant such as gypsum may be utilised and the discharge criteria may be reviewed based on a greater availability of monitoring data than is currently available.

6.1 Monitoring and management requirements

6.1.1 Erosion and sediment controls

An erosion and sediment control plan (ESCP) will be developed for the site prior to the commencement of filling. The ESCP will be developed following the guidance of *Managing urban stormwater: soils and construction, volume 2E – mines and quarries* (DECC 2008).

Erosion and sediment control strategies will comprise the following:

- Minimisation of the extent and duration of disturbed areas, and prompt topsoiling and revegetation following the completion of each project stage.
- Ongoing filling works will maintain landforms which minimise the erosion hazard.
- Runoff from the site will be diverted around active filling areas and toward the site discharge pond in a manner which minimises erosion.
- Temporary control measures such as geotextile sediment fencing and straw bale filters.

The ESCP will detail the monitoring and maintenance required, such as inspections following significant rainfall events, and the removal of trapped sediments from control structures.

6.1.2 Surface water monitoring

During active filling and before whole of site rehabilitation, it is proposed that the site discharge, the downstream tributary, and a reference site on the tributary to the north of the site be monitored monthly (during discharge) and the pit water monthly and runoff from clean fill and other areas monthly (when there is rainfall) or as otherwise agreed with the appropriate authority and following whole of site rehabilitation for a period agreed with the determining authority via a post closure monitoring plan for the following parameters:

- **Physicochemical parameters**: pH, EC, turbidity, TSS, TDS, O&G.
- **Cations:** sodium, calcium, potassium, magnesium.
- **Anions:** alkalinity, sulfate, chloride.
- **Metals (dissolved)**: aluminium, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, zinc
- **Nutrients**: ammonia, nitrate, nitrite, NO_x, TKN, TN, TP, RP
- **Organic compounds:** BTEX, naphthalene, benzo(a) pyrene, TPH (C10-C36).

6.1.3 Groundwater monitoring

Groundwater quality will initially be established from a minimum of four seasonally variable groundwater monitoring events (GMEs), relying on the installed monitoring network onsite (MB01-MB03) and by installing an additional deeper bore beside MB01. Baseline GMEs will represent a minimum of two post summer and two post winter periods during the initial operation of the project. Groundwater will be assessed for the same suite as surface water (Section 6.1.2).

Ongoing groundwater monitoring will then be undertaken on potentially an annual basis or more frequently should the baseline GME conclude variability in the groundwater quality or levels at the site. Scheduling of the frequency of the ongoing GME will be determined following review of initial monitoring data and if seasonal trends are observed. In such case, the GME may be undertaken in the determined concentration high period.

Groundwater quality will be assessed in comparison to the established baseline, the GVs and the surface water data obtained at the site's discharge location and downstream of the site.

6.2 Review

A review of the potential for impacts of the emplacement of VENM and ENM (or other clean fill material)) on water quality, volumes and levels is to be undertaken every two years (and at least for each rehabilitation stage) during operations, or specifically as a result of:

- Any statutory or regulatory requirements.
- More than two consecutive exceedances of the ANZECC (2000) 99 percent protection level GVs observed at the site discharge or the downstream tributary located within the swamp and the during the monitoring program as described in Sections 6, 6.1.2 and 6.1.3.
- Any incident that requires reporting.

The review will also be undertaken of all previous monitoring data and sampling of surface water run-off directly from emplaced ENM and other relevant areas and the dewatered pits and by measuring site rainfall, catchment, dewatered and discharged volumes. The results will be used to predict the discharge quality in the later stages of the operation and compare the results against the predicted modelling work undertaken within this WRA to identify if additional adaptive management controls need to be implemented to meet the GVs before emplacement activities commence in the future stages.

Post closure management will be developed at the commencement of Stage 6 for approval by Lithgow City Council and NPWS including an agreed ongoing monitoring program based upon the previous operational performance of the project.

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7. Conclusions

The emplacement of fill clean material has potential to impact upon the receiving waters through altering the run-off characteristics from the site and altering water quality through rainfall and groundwater interfacing with the emplacement material.

The project will restore the flow regime to natural run-off conditions, but will temporarily result in a reduction to the frequency of low flows and more frequent moderate flows for stages requiring dewatering. The changes to the flow regime are relatively minor and are not anticipated to significantly impact upon downstream geomorphological processes due to the natural stream profile and thick and well established vegetation.

The USEPA soil-water partition equation was used to estimate the quality of runoff from ENM with the maximum average acceptable concentrations as per the ENM Order. This indicated that the substances of potential concern in the ENM water were limited to metals, naphthalene and xylene. Analysis of representative VENM and ENM samples from the Sydney region indicated that the latter organic contaminants were not of concern.

The results from the flow proportions assessment were used along with the results from the USEPA soil-water partition equation, and leachate results for the representative VENM and ENM samples. No exceedances of the GVs were predicted at the site boundary, with the exceptions of pH when using the partition equation results, and pH and zinc when using the leachate from ASLP tests. The low pH values predicted were similar to those observed at the site and in the downstream tributary of the Wollangambe River.

The zinc exceedances predicted when using the leachate results were minor and not anticipated to be reflective of the quality of run-off from the site as a result of the conservative nature of the ASLP tests. They also did not exceed the zinc concentrations in background water quality in the Wollangambe River upstream of the Clarence Colliery discharge and are not predicted to be observed approximately 200 metres downstream of the site boundary.

A detailed assessment of groundwater geochemistry and solute fate and transport has been undertaken to assess potential impacts of the project to the beneficial use of groundwater. The project satisfies the Level 1 minimal impact criterion under the NSW Aquifer Interference Policy and is not anticipated to result in a noticeable alteration to the quality of water at the nearest sensitive environmental receiver comprising a swamp approximately 200 metres down gradient from the site.

Water management and monitoring commitments in this report will be undertaken as part of the environmental management plan for the project to actively manage the performance of the Project on water resources.

Disclaimer

This report: has been prepared by GHD for Bell Quarry Rehabilitation Project Pty Ltd and *may only be used and relied on by Bell Quarry Rehabilitation Project Pty Ltd for the purpose agreed between GHD and the Bell Quarry Rehabilitation Project Pty Ltd as set out in section 1.5 of this report.*

GHD otherwise disclaims responsibility to any person other than Bell Quarry Rehabilitation Project Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 3.5 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Bell Quarry Rehabilitation Project Pty Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

8. References

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Appendices

Appendix A – Laboratory certificates of analysis

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1705702**	Page	: 1 of 7
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR KARL ROSEN	Contact	: Vanessa Mattes
Address	: PO BOX 5403 NEWCASTLE WEST NSW, AUSTRALIA 2302	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 6393 6400	Telephone	: +61-2-8784 8555
Project	: ----	Date Samples Received	: 10-Mar-2017 08:00
Order number	: ----	Date Analysis Commenced	: 10-Mar-2017
C-O-C number	: ----	Issue Date	: 17-Mar-2017 17:16
Sampler	: ----		
Site	: ----		
Quote number	: EN/005/15		
No. of samples received	: 5		
No. of samples analysed	: 5		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Dian Dao		Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Sanjeshni Jyoti	Senior Chemist Volatiles	Sydney Organics, Smithfield, NSW

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 no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

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.
~ = Indicates an estimated value.

- EA006: Sodium absorption ratio for sample ES1705702-#001-#005 could not be calculated as Ca and Mg results are below the detection limits.
- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- 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	MAIN POND	L POND	SITE DISCHARGE	TRIBUTARY	TRIB.DS
			Client sampling date / time	09-Mar-2017 11:10	09-Mar-2017 11:40	09-Mar-2017 12:10	09-Mar-2017 14:00	09-Mar-2017 13:13
Compound	*CAS Number*	*LOR*	*Unit*	**ES1705702-001**	**ES1705702-002**	**ES1705702-003**	**ES1705702-004**	**ES1705702-005**
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.19**	**6.33**	**6.22**	**5.36**	**5.73**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**30**	**28**	**30**	**26**	**23**
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	**20**	**18**	**20**	**17**	**15**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	<5	<5	<5	<5
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	<1	<1	<1	<1	<1
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**5**	**3**	**4**	**2**	**2**
Total Alkalinity as CaCO3	----	1	mg/L	**5**	**3**	**4**	**2**	**2**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**2**	**2**	**2**	**2**	**2**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**5**	**5**	**3**	**4**	**4**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	<1	<1	<1	<1
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	<1
Sodium	7440-23-5	1	mg/L	**3**	**3**	**3**	**3**	**3**
Potassium	7440-09-7	1	mg/L	<1	<1	<1	<1	<1
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.00004	mg/L	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS								
Aluminium	7429-90-5	5	µg/L	**7**	<5	<5	**68**	**48**
Arsenic	7440-38-2	0.2	µg/L	**0.3**	**0.2**	**0.2**	<0.2	<0.2
Cadmium	7440-43-9	0.05	µg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	7440-47-3	0.2	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Copper	7440-50-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Iron	7439-89-6	2	µg/L	**25**	**14**	**135**	**25**	**34**
Lead	7439-92-1	0.1	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	MAIN POND	L POND	SITE DISCHARGE	TRIBUTARY	TRIB.DS
			Client sampling date / time	09-Mar-2017 11:10	09-Mar-2017 11:40	09-Mar-2017 12:10	09-Mar-2017 14:00	09-Mar-2017 13:13
Compound	CAS Number	LOR	Unit	ES1705702-001	ES1705702-002	ES1705702-003	ES1705702-004	ES1705702-005
				Result	Result	Result	Result	Result
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS - Continued								
Manganese	7439-96-5	0.5	µg/L	**2.1**	**4.6**	**143**	**2.4**	**2.7**
Nickel	7440-02-0	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc	7440-66-6	1	µg/L	<1	<1	**1**	<1	<1
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.04**	**0.02**	<0.01	<0.01	**0.02**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.04**	**0.03**	**0.02**	**0.03**	**0.04**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.04**	**0.03**	**0.02**	**0.03**	**0.04**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.2**	**0.1**	**0.2**	<0.1	<0.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**0.2**	**0.1**	**0.2**	<0.1	<0.1
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**0.28**	**0.24**	**0.21**	**0.19**	**0.19**
Total Cations	----	0.01	meq/L	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**
EP002: Dissolved Organic Carbon (DOC)								
Dissolved Organic Carbon	----	1	mg/L	**5**	**4**	**4**	**1**	**1**
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	MAIN POND	L POND	SITE DISCHARGE	TRIBUTARY	TRIB.DS
			Client sampling date / time	09-Mar-2017 11:10	09-Mar-2017 11:40	09-Mar-2017 12:10	09-Mar-2017 14:00	09-Mar-2017 13:13
Compound	CAS Number	LOR	Unit	ES1705702-001	ES1705702-002	ES1705702-003	ES1705702-004	ES1705702-005
				Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Fluoranthene	206-44-0	1	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	1330-20-7	2	µg/L	<2	<2	<2	<2	<2

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	MAIN POND	L POND	SITE DISCHARGE	TRIBUTARY	TRIB.DS
			Client sampling date / time	09-Mar-2017 11:10	09-Mar-2017 11:40	09-Mar-2017 12:10	09-Mar-2017 14:00	09-Mar-2017 13:13
Compound	CAS Number	LOR	Unit	ES1705702-001	ES1705702-002	ES1705702-003	ES1705702-004	ES1705702-005
				Result	Result	Result	Result	Result
EP080: BTEXN - Continued								
^ **Sum of BTEX**	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1	%	**20.1**	**24.9**	**19.9**	**21.4**	**22.1**
2-Chlorophenol-D4	93951-73-6	1	%	**41.6**	**51.3**	**42.3**	**46.4**	**45.8**
2.4.6-Tribromophenol	118-79-6	1	%	**64.6**	**65.1**	**56.3**	**59.9**	**63.3**
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1	%	**65.3**	**74.2**	**66.2**	**71.4**	**75.0**
Anthracene-d10	1719-06-8	1	%	**77.6**	**79.0**	**69.5**	**73.5**	**79.1**
4-Terphenyl-d14	1718-51-0	1	%	**72.1**	**68.0**	**60.5**	**65.3**	**72.7**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**114**	**114**	**116**	**112**	**114**
Toluene-D8	2037-26-5	2	%	**105**	**105**	**107**	**107**	**106**
4-Bromofluorobenzene	460-00-4	2	%	**100**	**101**	**102**	**104**	**101**

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1809234**	Page	: 1 of 7
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR KARL ROSEN	Contact	: Chloe Leong
Address	: LEVEL 15, 133 CASTLEREAGH STREET SYDNEY NSW, AUSTRALIA 2000	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 6393 6400	Telephone	: +61-2-8784 8555
Project	: 2125774	Date Samples Received	: 28-Mar-2018 16:30
Order number	:	Date Analysis Commenced	: 28-Mar-2018
C-O-C number	: ----	Issue Date	: 04-Apr-2018 15:11
Sampler	: Jarrad Mawbey		
Site	: ----		
Quote number	: EN/005/17		
No. of samples received	: 3		
No. of samples analysed	: 3		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Dian Dao		Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW

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.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

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.
~ = Indicates an estimated value.

- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- 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	MB02	MB03	QC1	----	----
			Client sampling date / time	28-Mar-2018 00:00	28-Mar-2018 00:00	28-Mar-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	ES1809234-001	ES1809234-002	ES1809234-003	--------	--------
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**6.74**	**5.92**	**6.69**	----	----
EA006: Sodium Adsorption Ratio (SAR)								
^ Sodium Adsorption Ratio	----	0.01	-	**1.15**	**0.72**	**1.13**	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**65**	**52**	**66**	----	----
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	**42**	**34**	**43**	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**46**	**30**	**50**	----	----
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	**5**	<1	**7**	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**21**	**8**	**22**	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**21**	**8**	**22**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**3**	**3**	**3**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**5**	**5**	**5**	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**2**	<1	**3**	----	----
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	----	----
Sodium	7440-23-5	1	mg/L	**7**	**3**	**8**	----	----
Potassium	7440-09-7	1	mg/L	**1**	**2**	**1**	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.00004	mg/L	**0.00007**	**0.00027**	**0.00007**	----	----
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS								
Aluminium	7429-90-5	5	µg/L	**11**	**19**	**9**	----	----
Arsenic	7440-38-2	0.2	µg/L	<0.2	<0.2	<0.2	----	----
Cadmium	7440-43-9	0.05	µg/L	<0.05	**0.06**	<0.05	----	----
Chromium	7440-47-3	0.2	µg/L	<0.2	<0.2	<0.2	----	----
Copper	7440-50-8	0.5	µg/L	**2.4**	**8.9**	**2.5**	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	MB02	MB03	QC1	----	----
			Client sampling date / time	28-Mar-2018 00:00	28-Mar-2018 00:00	28-Mar-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	ES1809234-001	ES1809234-002	ES1809234-003	--------	--------
				Result	Result	Result	----	----
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS - Continued								
Iron	7439-89-6	2	µg/L	**42**	**18**	**40**	----	----
Lead	7439-92-1	0.1	µg/L	<0.1	**0.2**	<0.1	----	----
Manganese	7439-96-5	0.5	µg/L	**192**	**1660**	**186**	----	----
Nickel	7440-02-0	0.5	µg/L	**1.0**	**2.5**	**1.0**	----	----
Zinc	7440-66-6	1	µg/L	**39**	**43**	**36**	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	<0.1	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.01	**0.10**	**0.01**	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.09**	**0.89**	**0.09**	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.09**	**0.89**	**0.09**	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	**0.2**	**0.1**	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	<0.1	**1.1**	**0.2**	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.13**	**0.05**	**0.11**	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	**0.06**	**0.02**	**0.01**	----	----
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**0.62**	**0.36**	**0.64**	----	----
Total Cations	----	0.01	meq/L	**0.43**	**0.18**	**0.52**	----	----
EP002: Dissolved Organic Carbon (DOC)								
Dissolved Organic Carbon	----	1	mg/L	<1	**2**	**1**	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	MB02	MB03	QC1	----	----
			Client sampling date / time	28-Mar-2018 00:00	28-Mar-2018 00:00	28-Mar-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	ES1809234-001	ES1809234-002	ES1809234-003	--------	--------
				Result	Result	Result	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	----	----
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	----	----
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	----	----
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	----	----
Toluene	108-88-3	2	µg/L	<2	<2	<2	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**MB02**	**MB03**	**QC1**	**----**	**----**
			Client sampling date / time	28-Mar-2018 00:00	28-Mar-2018 00:00	28-Mar-2018 00:00	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1809234-001**	**ES1809234-002**	**ES1809234-003**	--------	--------
				Result	Result	Result	----	----
EP080: BTEXN - Continued								
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	----	----
^ **Total Xylenes**	----	2	µg/L	<2	<2	<2	----	----
^ **Sum of BTEX**	----	1	µg/L	<1	<1	<1	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	**20.9**	**17.7**	**23.2**	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	**58.9**	**65.2**	**60.3**	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%	**50.9**	**71.1**	**46.4**	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	**80.7**	**73.1**	**73.9**	----	----
Anthracene-d10	1719-06-8	1.0	%	**79.2**	**98.2**	**72.4**	----	----
4-Terphenyl-d14	1718-51-0	1.0	%	**77.5**	**67.9**	**89.5**	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**93.5**	**103**	**105**	----	----
Toluene-D8	2037-26-5	2	%	**93.9**	**100**	**104**	----	----
4-Bromofluorobenzene	460-00-4	2	%	**89.8**	**97.4**	**99.1**	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%)	
		Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

Appendix B – ADE Consulting Group report

ADE Consulting Group Pty Ltd
6/7 Millennium Court
Silverwater, NSW 2128
(02) 8541 7214

6th December 2017

Robin El-Chalouhi
Chalouhi
2/22 Centenary Avenue
Moorebank, NSW 2170
(02) 9790 3799

RE: Soil and water sampling - Bell Quarry Rehabilitation Project, Blue Mountains NSW.

Dear Robin,

ADE Consulting Group Pty Ltd (ADE) is pleased to provide you with the results of sampling and laboratory testing undertaken for Chalouhi Pty Ltd (Chalouhi), to assist with groundwater quality modelling for the Bell Quarry Remediation project, located in the Blue Mountains, New South Wales (NSW) (hereafter referred to as 'the Quarry').

1. BACKGROUND

The Quarry is located within the Upper reaches of the Wollangambe River catchment in the Lithgow Local Government Area. The River forms part of the broader Hawkesbury Nepean Catchment.

The Quarry is on Sandham Road in Newnes Junction, approximately 10 Km east of Lithgow. Active quarry operations at the site began in 1967 and have now ceased. The licence was surrendered on 1 October 2014. The Bell Quarry Rehabilitation Project is required to return the site to a condition that is comparable to the original land form and the adjoining Blue Mountains National Park.

During the course of the quarries remediation, the site has the potential to discharge water into a tributary nearby the upper Wollangambe River. Due to the sensitive nature of the receptor, water quality modelling is being completed by GHD Pty Ltd (GHD). The modelling completed thus far has indicated that emplacement of *Excavated Natural Material* (ENM), as defined under the NSW Environmental Protection Agency's (NSW EPA's) '*Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014 – The excavated natural material order 2014*', could result in the discharge of water from the Quarry to Wollangambe River with Contaminants of Potential Concern (CoPC) above adopted guideline values (GVs) for protection of aquatic species.

As a result of the data from the model, GHD developed soil screening levels (SSLs) to assess potentially imported materials. The SSL's were developed to allow for the emplacement of ENM, whilst minimising the likelihood of exceedance of the GVs.

The study was limited by the lack of knowledge of the proposed materials proposed to be imported into the quarry and conservative assumptions into the input of the model. This resulted in conservative (i.e. low) SSLs, which were identified to be potentially prohibitive to the project. As such, further metrics regarding the potentially imported material, for example the chemical reactivity of soils from various landscape groups when interacting with water within the quarry, was considered warranted.

To assist with the GHD's modelling, ADE has been engaged by Chalouhi to collect and test soil/rock samples representative of natural materials with the greater Sydney region.

2. OBJECTIVES AND SCOPE OF WORKS

The objective of works issued to ADE by the Chalouhi was collect soil samples from various landscape groups within the Sydney region, analysis of background quality and condition of pooled water within the quarry, and assessment of the leaching characteristics of the collected soils when subject to water derived from within the quarry.

The scope of work required to achieve the objectives of the investigation involved the following:

- Completion of a Safe Work Method Statement (SWMS) prior to undertaking works.
- Soil sampling from various subject sites across the Sydney region from a range of various geological landscapes.
- Collection of water samples from pooled water within Bell Quarry to be used as solvent/reagent to determine the leaching characteristics of the soils when subject to Quarry Water.
- Collection of blind (intra-laboratory) and split (inter-laboratory) samples for Quality control / Quality Assurance (QA/QC).
- Submission of collected samples under chain of custody (COC) conditions to a NATA Accredited laboratory for analysis.
- Preparation of a report outlining the investigation methodology, interpretation of the site data (results), classification and conclusions.

3. SAMPLING PLAN, METHODOLOGY AND FIELD INVESTIGATION

3.1. Soil Sampling and Analytcial Program

The following Site's with various soil landscapes were available to ADE during the course of the investigation for sampling. A summary of the Site's is provided in Table 1.

Table 1 - Summary of source sites and samples collected from various soil landscapes or rock formations.

Landscape	Address	Depth (m BGL)	Soil Description	Date
Ashfield Shale	6-14 Walker Street, Rhodes NSW	2.0	Weathered SHALE, dark grey, brittle with ironstone bands, dry.	09.11.2017
Glenorie	2-4 Lodge Street, Hornsby NSW	2.0	Silty CLAY (CL), medium plasticity, light grey / light brown with trace sub-angular shale fragments, moist.	13.11.2017
Blacktown	490 Twelfth Avenue, Rossmore NSW	0.5	Silty CLAY (CH), high plasticity, medium red mottled light grey, moist.	13.11.2017
South Creek	490 Twelfth Avenue, Rossmore NSW	0.5	Silty SAND (SM), fine grained, well sorted, light brown / light orange, moist.	15.11.2017
Lucas Heights	250 Railway Parade, Kogarah NSW	2.0	Clayey SAND (SC), fine grained, well sorted, medium / high plasticity, dark red / light grey with sub angular iron coated gravels, moist.	16.11.2017
Hawkesbury Sandstone	457-459 Pacific Highway, Asquith NSW	7.0	SANDSTONE, medium / coarse grained, well graded, light orange / dark yellow with dark red ironstone bands, dry.	16.11.2017
Disturbed Terrain	Governor Macquarie Drive, Warwick Farm NSW	2.0	Silty SAND (SM), fine grained, well graded, dark brown / medium orange, moist.	16.11.2017
Faulconbridge	12 Tenth Street, Warragamba NSW	0.5	Silty SAND (SM), medium grained, well graded, dark brown, moist.	16.11.2017
Tuggerah	18 Huntley Street, Alexandria NSW	3.5	SAND (SW), fine grained, well sorted, light orange / light brown, moist.	16.11.2017

In consultation with the Client, it is to ADE's understanding that the intention of the assessment was to derive preliminary soil/rock results for the purpose of the input into GHD's model. The soil/rock sampling undertaken is limited in nature and is not considered to constitute detailed site investigation of each source site, or each soil/rock landscape/formation. As such, ADE's brief by the client was to collect one (1) soil sample from available landscapes across the Sydney region, and one (1) rock sample from Hawkesbury Sandstone, Ashfield Shale, and Bringelly Shale formations (subject to change based on availability). It must be noted that the soil landscapes and rock formations outlined, excluding samples collected 'disturbed terrain' in Warwick Farm, consisted of naturally occurring naturally occurring materials and not ENM.

Based on the scope of works issued to ADE by Chalouhi, ADE analysed the collected soils and rock for the following suite of analytes:

- Heavy Metals (arsenic, chromium, cadmium, copper, lead, mercury, nickel, zinc).
- Total Petroleum Hydrocarbons (TPH), with silica gel clean-up.
- Benzene, Toluene, Ethyl-Benzene and Xylenes (BTEX).
- Polycyclic Aromatic Hydrocarbons (PAHs).
- Organochlorine Pesticides (OCP).
- Organphosphorus Pesticides (OPPs).
- Polychlorinated Biphenyls (PCBs).
- pH & Electrical Conductivity (EC).
- Major Cations and Anions (Ca, Mg, Na, K, Cl, SO_4).

To assess the leaching potential of the collected soil samples when subject to water within Bell Quarry, Australian Standard Leaching Potential (ASLP) was undertaken on soil/rock samples using water sampled from within the quarry as the solvent/reagent. It must be noted that using water derived from the quarry as the reagent/solvent is not a NATA accredited test, under ALS Global's NATA accreditation. The resultant ASLP solution was analysed for aforementioned suite of analysis listed above, in addition to the following analytes:

- Pathogens (E.Coli and Total Coliforms).
- Alkalinity.
- Nutrients (Nitrate, Nitrite, NOx, Total Ammonia, TKN, Total Phosphorous and Reactive Phosphorous).

Further information regarding the location of soil samples collected, including the specific site addess and photographs of the materials sampled is provided in Appendix I – Soil & Water Sampling Locations and Appendix II – Photographs, respectively. The results of the soil samples collected and ASLP are presented in Appendix III – Summary Result Tables with analytical reports and COC's presented in Appendix IV – Analytical Laboratory Reports.

3.2. Quarry Water Sampling Program

In order to obtain background physiochemical data of water within the Quarry, and to collect water to be used as a solvent/reagent to undertake ASLP analysis of soils, ADE sampled water pooled within Bell Quarry on the 15th November 2017.

As per the scope of works issued to ADE by the client, the water samples collected from the quarry were analysed for the general suite of analysis adopted for rock/ soils samples, with further analysis of pathogens, alkalinity and nutrients.

Water samples were collected in accordance with Australian Standard (AS) 5667:1998 Water Quality – Sampling. At the time of sampling, physiochemical data of the pooled quarry water was measured at five (5) discrete accessible locations within the quarry. Measurements were undertaken using a calibrated TPS 90FLMV Water Quality Meter supplied by ThermoFisher Scientific.

A map outlining the location of water sampling within the quarry is provided in Appendix I – Soil & Water Sampling Locations. Photographs collected at the time of sampling is provided in Appendix II – Photographs. The results of the water samples collected and the measured physiological parameters at five (5) discrete locations within the quarry are presented in Appendix III – Summary Result Tables with analytical reports presented in Appendix IV – Analytical Laboratory Reports.

4. QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

As per the scope of works issued to ADE by the client, QA/QC program consisting of blind replicate (intra-laboratory) and split replicate (inter-laboratory) were collected and analysed to determine the Relative Percentage Difference (RPD) between primary and secondary samples. As sampling was undertaken at various sites across multiple dates, one (1) blind replicate and one (1) split replicate was agreed upon between ADE and GHD as being adequate for the purpose of the investigation, due to the small quantity of samples to be collected and analysed (i.e. <20 samples). In addition, one (1) soil/rock sample was analysed for ASLP, using both deionised water and water collected from Bell Quarry as the reagent to determine the difference and variance in output.

Water and soil/rock samples were collected using dedicated, disposal equipment for each sample location [enter in exposed soil surfaces]. As such, decontamination of field equipment and sampling of rinsate as part of the QA/QC program was not considered necessary. As per the scope of works, utilisation of a trip blank and trip spike to assess the potential loss of Volatile Organic Compounds (VOCs) during the sampling and transport of samples was undertaken for each day of sampling

The submission of samples to a NATA Accredited lab was undertaken under Chain of Custody (COC) conditions. The results of the QA/QC sampling are provided in Appendix V – QA/QC Reconciliation. Analytical reports and a copy of the COC's generated through the course of the investigation are provided in Appendix IV – Analytical Laboratory Reports.

5. CONCLUSION

We thank you for using ADE's services. If you have any questions regarding the information contained within this letter, please feel free to contact the undersigned on (02) 8541 7214.

Kind regards,

Prepared by Justin Eccles	Behrooz Tehrani
Environmental Consultant	Principal Scientist
M.Sc.Tech (Environmental Science)	M.Sc. (Engineering Geology)

6. LIMITATIONS

A detailed assessment of each landscape grouping/rock formation was not undertaken as per the scope of the assessment given to ADE by the client and outlined in ADE quotation ENV-17-66.v3d. Due to the natural variability of the subsurface environment, and due to the limited nature of the scope of works issued to ADE by the client, ADE cannot guarantee that the sample collected at each source site will be truly representative of the landscape grouping in which the material is sourced. Due care must be undertaken by both Chalouhi and GHD in interpreting the results derived from the limited investigation.

This report has been prepared for the exclusive use of the client. ADE has used a degree of care and skill ordinarily exercised in similar investigations by reputable members of the environmental industry in Australia. No other warranty, expressed or implied, is made or intended. No one section or part of a section, of this report should be taken as giving an overall idea of this report. Each section must be read in conjunction with the whole of this report, including its appendixes and attachments.

Any other party should satisfy themselves that the scope of work conducted and report herein meets their specific needs. ADE cannot be held liable for third party reliance on this document, as ADE is not aware of the specific needs of the third party.

The subsurface environment can present substantial uncertainty due to it complex heterogeneity. The conclusions presented in this report are based on limited investigation of conditions at specific sampling locations chosen to be as representative as possible under the given circumstances. However, it is possible that this investigation may not have encountered all areas of contamination at the site due to the limited sampling and testing program undertaken.

The material subject to classification pertains only to the site and subject area outlined within the report and must be consistent with the waste description reported. If there are any unexpected finds that are not consistent with this classification, ADE must be notified immediately.

ADE's professional opinions are based upon its professional judgement, experience, training and results from analytical data. In some cases further testing and analysis may be required, thus producing different results and/or opinions. ADE has limited its investigation to the scope agreed upon with its client.

APPENDIX I – SOIL & WATER SAMPLING LOCATIONS

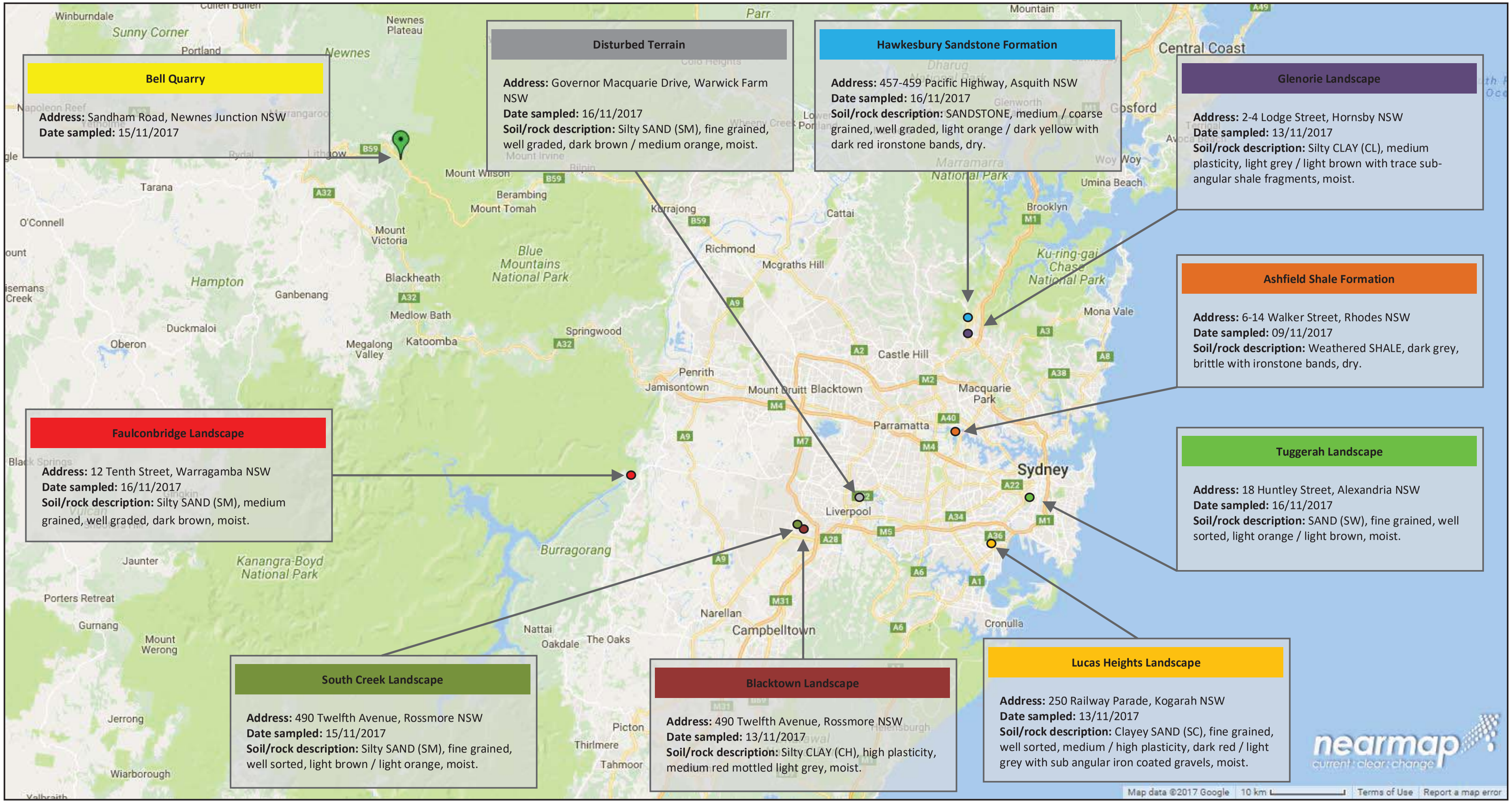
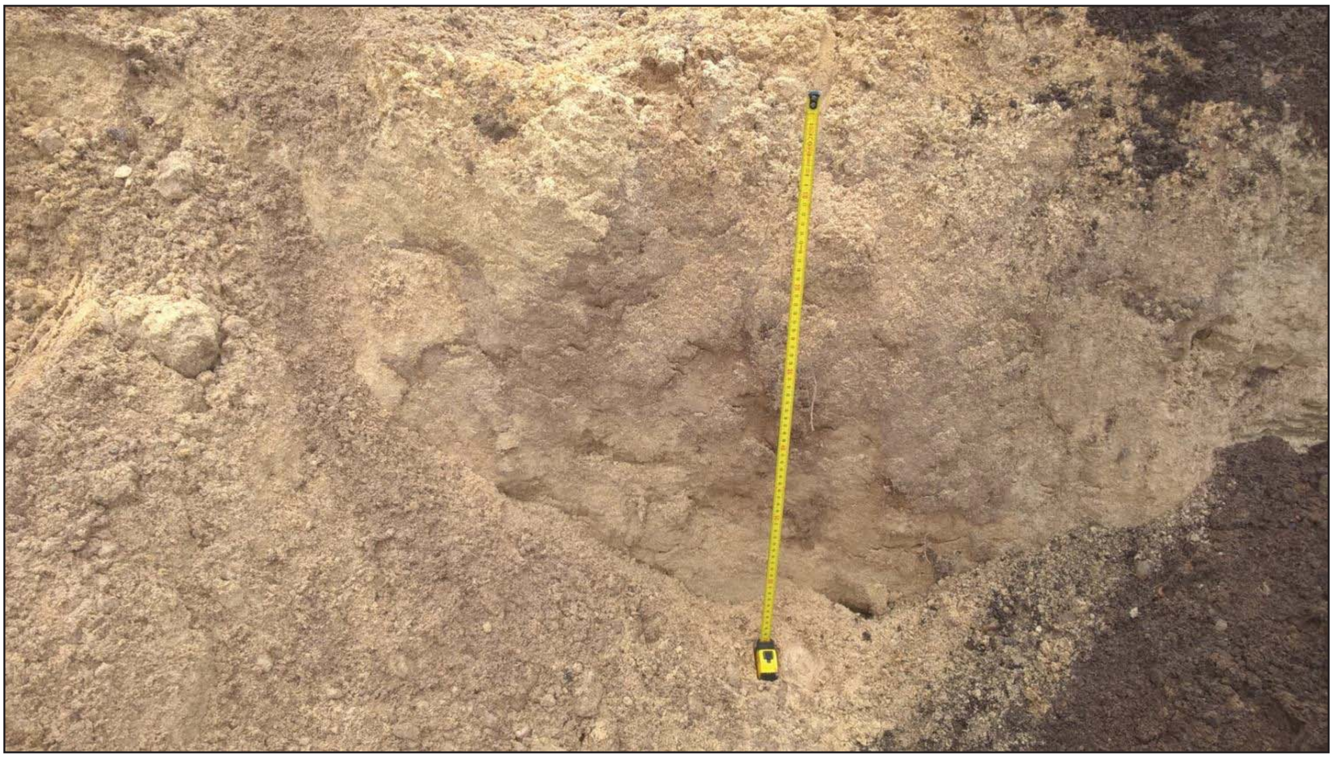


Figure 1- Outline of the location of Bell Quarry and selected sites for soil/rock sampling from varouis geological landscapes (map adapted from Nearmap 2017).

Figure 2 - Outline of water sampling locations within the Bell Quarry.

APPENDIX II – PHOTOGRAPHS

Photograph 1 – Tuggerah soil landscape, collected in Alexandria on 16/11/2017.



Photograph 2 – Typical soil profile of Tuggerah soil landscape, collected in Alexandria on 16/11/2017.

New South Wales Office:
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Silverwater, NSW 2128

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ABN:
14 617 358 808

Photograph 3 – Falconbridge soil landscape, collected in Warragamba on 16/11/2017.

Photograph 4 – Typical soil profile of Falconbridge soil landscape, collected in Warragamba on 16/11/2017.

Photograph 5 – Ashfield soil landscape, collected in Rhodes on 09/11/2017.

Photograph 6 – Typical soil profile of Ashfield soil landscape, collected in Rhodes on 09/11/2017.

Photograph 7 – Glenorie soil landscape, collected in Hornsby on 13/11/2017.

Photograph 8 – Typical soil profile of Glenorie soil landscape, collected in Hornsby on 13/11/2017.

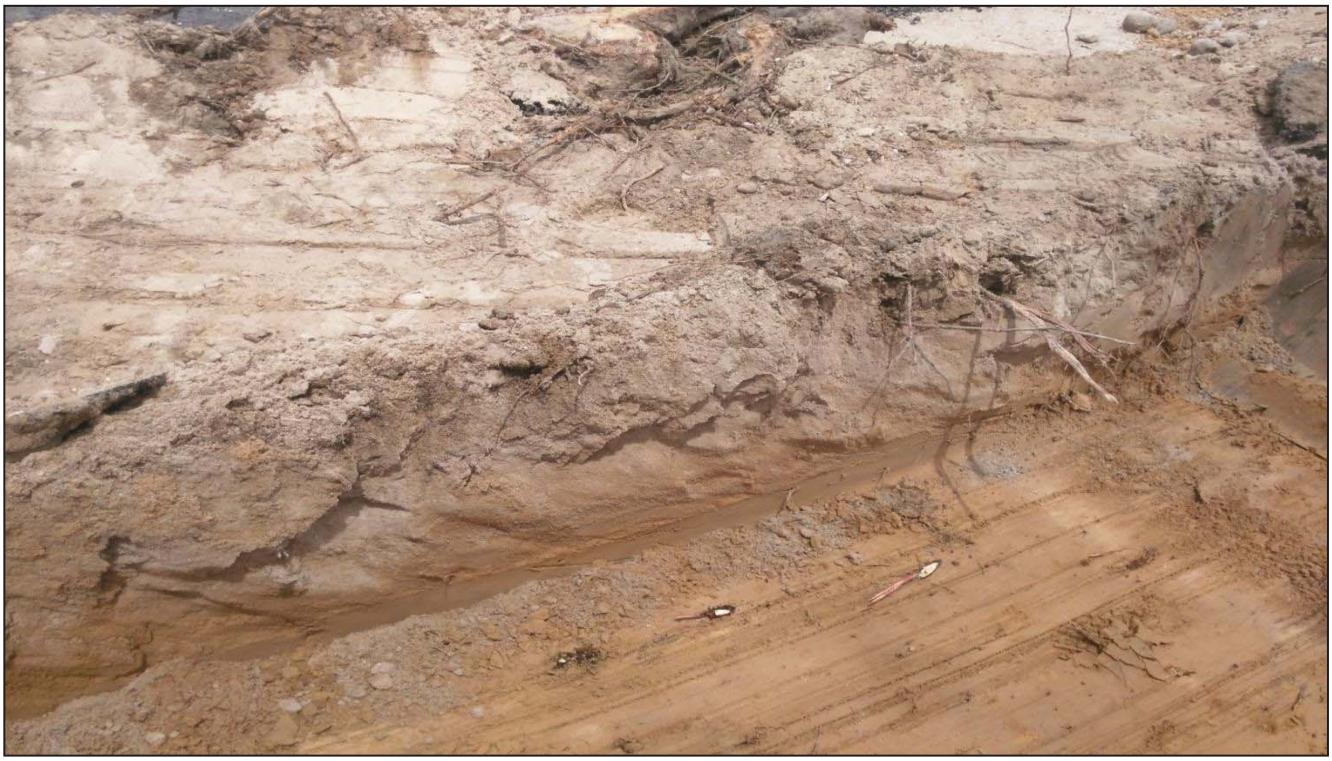
Photograph 9 – Lucas Heights soil landscape, collected in Kogarah on 13/11/2017.

Photograph 10 – Typical soil profile of Lucas Heights soil landscape, collected in Kogarah on 13/11/2017.

Photograph 11 – Hawkesbury Sandstone formation, collected in Asquith on 16/11/2017.

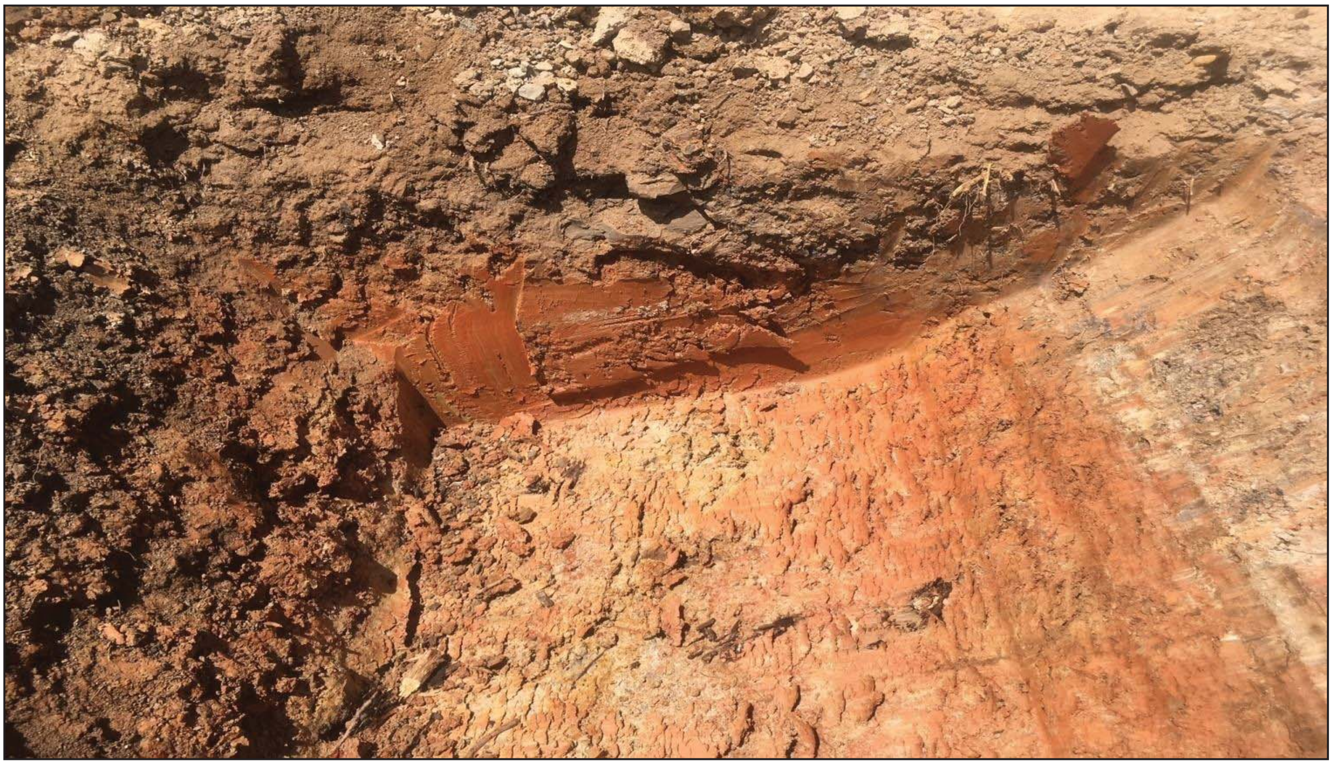
Photograph 12 – Typical profile of Hawkesbury Sandstone formation, collected in Asquith on 16/11/2017.

Photograph 13 – Disturbed Terrain landscape, collected in Warwick Farm on 16/11/2017.



Photograph 14 – Typical soil profile of Disturbed Terrain landscape, collected in Warwick Farm on 16/11/2017.

Photograph 15 – Blacktown soil landscape, collected in Rossmore on 13/11/2017.

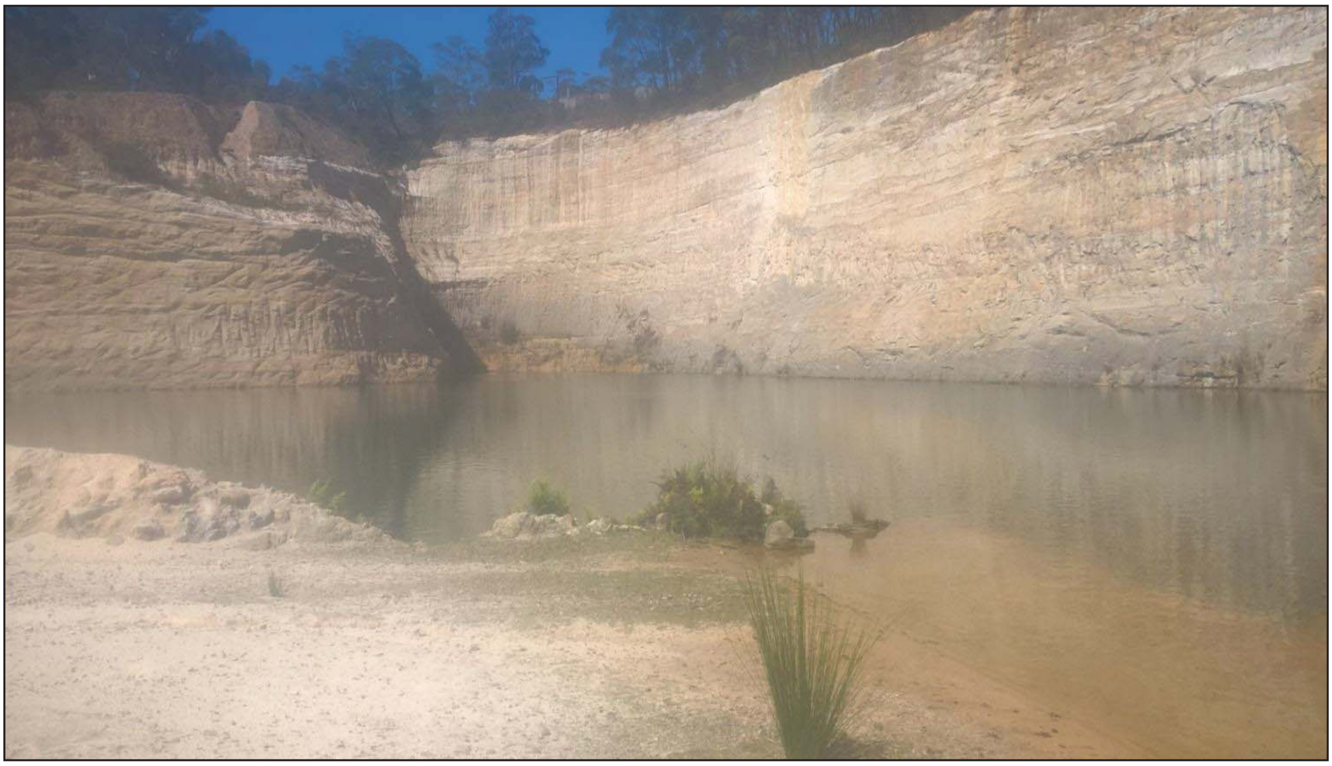


Photograph 16 – Typical soil profile of Blacktown soil landscape, collected in Rossmore on 13/11/2017.


Photograph 17 – South Creek soil landscape, collected in Rossmore on 15/11/2017.


Photograph 17 – Typical soil of South Creek soil landscape, collected in Rossmore on 15/11/2017.

Photograph 18 – Ridge at Bell Quarry facing south-east, dated 15/11/2017.



Photograph 19 – Bell Quarry between sampling location 1 and location 2, dated 15/11/2017.

APPENDIX III – RESULT TABLES

ADECONSULTINGGROUP
SOLUTIONS THROUGH INNOVATION

Consultant	Sample Name	Date	Depth (mBGL)	Sample description	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
					Heavy Metals							
	Limits of Reporting (LOR)				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
					1	0.1	1	1	1	0.1 / 0.05	1	5 / 1
	ANZECC (2000) Guidelines for Freshwater Quality[1] (µg/L)				0.8[f]	0.06	0.01[e]	1	1	0.06	8	2.4
	ANZECC (2000) Guidelines for Marine Water Quality[1] (µg/L)				2.3[a,f]	0.7[a]	4.4[d]	1.3	4.4	0.1	7[g]	15[c]
	Adopted SAC				0.8	0.06	0.01	1	1	0.06	8	2.4
ADE	12950-Tuggerah	16.11.2017	1.5	ASLP Leachate using Quarry Water - SAND	<1	<0.1	1	<1	<1	<0.1	<1	30
ADE	12950-Faulconbridge	16.11.2017	0.5	ASLP Leachate using Quarry Water -Silty SAND	<1	0.2	2	2	3	<0.1	1	74
ADE	12950-Blacktown	13.11.2017	0.5	ASLP Leachate using Quarry Water - Silty CLAY	1	0.4	7	13	10	<0.1	6	484
ADE	12950-Ashfield	09.11.2017	2.0	ASLP Leachate using Quarry Water - Weathered SHALE	<1	0.2	1	2	4	<0.1	<1	54
ADE	12950-Glenorie	13.11.2017	2.0	ASLP Leachate using Quarry Water -SILT / Silty CLAY	<1	<0.1	<1	<1	<1	<0.1	<1	43
ADE	12950-Lucas Heights	16.11.2017	2.0	ASLP Leachate using Quarry Water - Clayey SAND	<1	<0.1	<1	<1	<1	<0.1	6	135
ADE	12950-Hawkesbury	16.11.2017	7.0	ASLP Leachate using Quarry Water - SANDSTONE	<1	<0.1	<1	<1	<1	<0.1	<1	42
ADE	12950-South Creek	15.11.2017	0.5	ASLP Leachate using Quarry Water - Silty SAND	<1	0.3	7	7	7	<0.1	4	64
ADE	12950-Disturbed Terrain	16.11.2017	2.0	ASLP Leachate using Quarry Water - Silty SAND	<1	0.2	<1	1	<1	<0.1	2	160
ADE	12950-ASLP	15.11.2017	-	Quarry Water	<1	<0.1	<1	<1	<1	<0.1	<1	<5
ADE	12950-Tuggerah (DI)	16.11.2017	1.5	QAQC-ASLP Leachate using Deionised Water - SAND	<1	0.3	15	3	2	<0.1	6	528
ADE	12950-BR1	16.11.2017	1.5	QAQC-Duplicate of 12950-Tuggerah	<1	<0.1	14	5	2	<0.1	7	22
ADE	12950-SR1	15.11.2017	1.5	QAQC-Duplicate of 12950-Tuggerah	<1	<0.1	<1	<1	<1	<0.05	<1	9
	Number of Results				13	13	13	13	13	13	13	13
	Number of Detects				1	6	7	7	6	0	7	12
	Minimum Concentrations				<1	<0.1	<1	<1	<1	<0.05	<1	<5
	Minimum Detect				1	0	1	1	2	ND	1	9
	Maximum Concentration				1	0	15	13	10	<0.1	7	528
	Maximum Detect				1	0	15	13	10	ND	7	528
	Average Concentration				0.54	0.15	3.8	2.8	2.4	0.048	2.7	127
	Median Concentration				0.5	0.05	1	1	0.5	0.05	1	54
	Standard Deviation				0.14	0.12	5.3	3.7	3	0.0069	2.7	175

Sample Name	Benzo(a)pyrene	Napthalene	Anthracene	C10-C16 Fraction	C16-C34 Fraction	C34-C40 Fraction	Heptachlor	Endosulfan	Endrin	4,4 -DDT	Chlorpyrifos
	PAHs			**TRHs**			**OCPs**				**OPPs**
Limits of Reporting (LOR)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
	0.5	1	1	100	100	100	0.5	0.5	0.5	2	0.5
ANZECC (2000) Guidelines for Freshwater Quality[1] (µg/L)	0.01[ab]	2.5	0.01[a]	6000			0.01	0.03	0.01	0.006	0.00004
ANZECC (2000) Guidelines for Marine Water Quality[1] (µg/L)	0.1	50	0.01[a]					0.005	0.004		0.0005
Adopted SAC	0.01	2.5	0.01	6000	100[g]	100[g]	0.01	0.03	0.01	0.006	0.00004
12950-Tuggerah	<0.5	<1	<1	<100	<100	<100	<0.5	<0.5	<0.5	<2.0	<0.5
12950-Faulconbridge	<0.5	<1	<1	<100	<100	<100	<0.5	<0.5	<0.5	<2.0	<0.5
12950-Blacktown	<0.5	<1	<1	<100	<100	<100	<0.5	<0.5	<0.5	<2.0	<0.5
12950-Ashfield	<0.5	<1	<1	<100	<100	<100	<0.5	<0.5	<0.5	<2.0	<0.5
12950-Glenorie	<0.5	<1	<1	<100	<100	<100	<0.5	<0.5	<0.5	<2.0	<0.5
12950-Lucas Heights	<0.5	<1	<1	<100	<100	<100	<0.5	<0.5	<0.5	<2.0	<0.5
12950-Hawkesbury	<0.5	<1	<1	<100	<100	<100	<0.5	<0.5	<0.5	<2.0	<0.5
12950-South Creek	<0.5	<1	<1	<100	<100	<100	<0.5	<0.5	<0.5	<2.0	<0.5
12950-Disturbed Terrain	<0.5	<1	<1	<100	<100	<100	<0.5	<0.5	<0.5	<2.0	<0.5
12950-ASLP	<0.5	<1	<1	<100	<100	<100	<0.5	<0.5	<0.5	<2.0	<0.5
12950-Tuggerah (DI)	<0.5	<1	<1	<100	<100	<100	<0.5	<0.5	<0.5	<2.0	<0.5
12950-BR1	<0.5	<1	<1	<100	<100	<100	<0.5	<0.5	<0.5	<2.0	<0.5
12950-SR1				<50	<100	<100					
Number of Results	12	12	12	13	13	13	12	12	12	12	12
Number of Detects	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentrations	<0.5	<1	<1	<50	<100	<100	<0.5	<0.5	<0.5	<2	<0.5
Minimum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration	<0.5	<1	<1	<100	<100	<100	<0.5	<0.5	<0.5	<2	<0.5
Maximum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration	0.25	0.5	0.5	48	50	50	0.25	0.25	0.25	1	0.25
Median Concentration	0.25	0.5	0.5	50	50	50	0.25	0.25	0.25	1	0.25
Standard Deviation	0	0	0	6.9	0	0	0	0	0	0	0

Sample Name	Arochlor 1242	Arochlor 1254	Ammonia	Nitrite	Nitrate	Total Kjeldahl Nitrogen	Total Nitrogen	Total Phosphorus	Reactive Phosphorus
	PCBs		**Nutrients**						
Limits of Reporting (LOR)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
	1	1	0.01	0.01	0.01	0.1	0.1	0.01	0.01
ANZECC (2000) Guidelines for Freshwater Quality[1] (µg/L)	0.3[b]	0.01[b]	320		17				
ANZECC (2000) Guidelines for Marine Water Quality[1] (µg/L)			50						
Adopted SAC	0.3	0.01	320	-	17	-	200[h]	20[h]	15[h]
12950-Tuggerah	<1	<1	110	<10	10	400	400	40	<10
12950-Faulconbridge	<1	<1	<10	<10	20	200	200	<10	<10
12950-Blacktown	<1	<1	<10	<10	2350	600	3000	80	<10
12950-Ashfield	<1	<1	<10	<10	20	<100	<100	<10	<10
12950-Glenorie	<1	<1	<10	<10	20	100	100	10	10
12950-Lucas Heights	<1	<1	<10	<10	30	<100	<100	<10	<10
12950-Hawkesbury	<1	<1	<10	<10	<10	100	100	<10	<10
12950-South Creek	<1	<1	<10	<10	40	<100	<100	<10	<10
12950-Disturbed Terrain	<1	<1	10	<10	130	200	300	<10	<10
12950-ASLP	<1	<1	<10	<10	<10	200	200	<10	-
12950-Tuggerah (DI)	<1	<1	<10	<10	<10	400	400	20	30
12950-BR1	<1	<1	80	<10	20	200	200	<10	20
12950-SR1									
Number of Results	12	12	12	12	12	12	12	12	12
Number of Detects	0	0	3	0	9	9	9	4	4
Minimum Concentrations	<1	<1	<10	<10	<10	<100	<100	<10	<10
Minimum Detect	ND	ND	10	ND	10	100	100	10	10
Maximum Concentration	<1	<1	110	<10	2350	600	3000	80	30
Maximum Detect	ND	ND	110	ND	2350	600	3000	80	30
Average Concentration	0.5	0.5	20	5	221	213	421	16	9.1
Median Concentration	0.5	0.5	5	5	20	200	200	5	5
Standard Deviation	0	0	35	0	671	172	822	23	8.3

Sample Name	pH	Electrical Conductivity	Chloride	Sulfate	Total Alkalinity	Calcium	Magnesium	Sodium	Potassium	Faecal Coliforms	E.coli
	pH	**EC**	**Major Anions**			**Major Cations**				**Microbiology**	
Limits of Reporting (LOR)	Unit	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	CFU/100ml	CFU/100ml
	-	-	1	1	1	1	1	1	1	1	1
ANZECC (2000) Guidelines for Freshwater Quality[1] (µg/L)											
ANZECC (2000) Guidelines for Marine Water Quality[1] (µg/L)											
Adopted SAC	-	-	-	-	-	-	-	-	-	-	-
12950-Tuggerah	6.67	30	5	2	5	<1	<1	4	<1	2600	<2
12950-Faulconbridge	6.16	36	8	2	3	<1	<1	16	<1	<1	<1
12950-Blacktown	6.38	124	20	21	3	<1	<1	23	<1	<2	<2
12950-Ashfield	6.04	58	10	8	<1	<1	<1	11	<1	<2	<1
12950-Glenorie	4.86	35	5	8	<1	<1	<1	5	<1	<1	<1
12950-Lucas Heights	5.28	33	5	6	<1	<1	<1	4	2	<1	<1
12950-Hawkesbury	5.76	31	5	5	<1	<1	<1	6	<1	<1	<1
12950-South Creek	6.42	248	48	21	4	<1	<1	43	<1	<2	<2
12950-Disturbed Terrain	6.42	43	9	2	4	<1	<1	8	<1	<1	<1
12950-ASLP	6.6	7	5	2	4	<1	<1	<1	<1	5300	4
12950-Tuggerah (DI)	5.93	4	<1	<1	<1	<1	<1	<1	<1	32	<2
12950-BR1	5.65	31	5	2	6	<1	<1	5	<1	3	<1
12950-SR1											
Number of Results	12	12	12	12	12	12	12	12	12	12	12
Number of Detects	12	12	11	11	7	0	0	10	1	4	1
Minimum Concentrations	5	4	<1	<1	<1	<1	<1	<1	<1	<1	<1
Minimum Detect	5	4	5	2	3	ND	ND	4	2	3	4
Maximum Concentration	7	248	48	21	6	<1	<1	43	2	5300	4
Maximum Detect	7	248	48	21	6	ND	ND	43	2	5300	4
Average Concentration	6	57	10	6.6	2.6	0.5	0.5	11	0.63	662	0.96
Median Concentration	6.1	34	5	3.5	3	0.5	0.5	5.5	0.5	1	0.5
Standard Deviation	0.55	67	13	7.2	2	0	0	12	0.43	1640	0.99

Notes to table

1 -Trigger values adopted (level of protection: 99% of species), Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Environment and Conservation Council, 2000.

a. In the absence of a high reliability concentration, the moderate or low reliability guideline concentration has been adopted.
b. Moderate reliability trigger values (99% protection) were adopted.
c. Figure may not protect key species from chronic toxicity, ANZECC 2000.
d. ADE notes ANZECC (2000) outlines potential for bioaccumulation, 95% percent protection level has been adopted as a screening level.
e. As total concentration was reported for the analyte, the most stringent valence threshold was adopted.
f. As total Arsenic is provided in analytical results, the most stringent criteria of As III and As V has been adopted.
g. Detection limit adopted as Site Assessment Criteria
h. Trigger values supplied by Australian State and Territory and New Zealand research and regulatory organisations for Upland Rivers in NSW

CHALOUHI

CHL-28-12950

Results of soil sampling from various landscape/geological formations - Compared against the ENM Order 2014.

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						Heavy Metals								BTEX				PAHs		TPHs	pH	EC	PCB	Major Anions		Major Cations			
						Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Benzene	Ethylbenzene	Toluene	Xylenes (total)	Benzo(a)pyrene	Total PAHs	Total Petroleum Hydrocarbos C_{10}-C_{36}	pH[1]	Electrical Conductivity	Total PCB	Chloride	Sulfate	Calcium	Magnesium	Sodium	Potassium
Limits of Reporting (LOR)						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	Unit	us/cm	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
						4/5	0.4/1	1/2	1/5	1/5	0.1	1/2	5	0.2	0.5/1	0.5	0.5/1	0.05/0.5	0.05/0.5	50/250	-	-	-	10	10	10	10	10	10
Maximum average concentration, for characterisation assigned for Excavated Natural Material (ENM)						20	0.5	75	100	50	0.5	30	150	NA	NA	NA	NA	0.5	20	250	5 to 9	1.5							
Absolute maximum concentration, for characterisation assigned for Excavated Natural Material (ENM)						40	1	150	200	100	1	60	300	0.5	25	65	15	1	40	500	4.5 to 10	3							
Adopted SAC						20	0.5	75	100	50	0.5	30	150	0.5	25	65	15	0.5	20	250	5 to 9	1.5							
Consultant	Sample Name	Date Sampled	Depth (mBGL)	Type	Soil description																								
ADE	12950-Tuggerah	16.11.2017	1.5	Primary	SAND	<5	<1	<2	<5	<5	<0.1	<2	9.0	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<50	6.1	13	<0.1	<10	<10	<10	<10	<10	<10
ADE	12950-Faulconbridge	16.11.2017	0.5	Primary	Silty SAND	<5	<1	8.0	5.0	24	<0.1	<2	18	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<50	5.8	14	<0.1	<20	<10	<10	<10	<10	10
ADE	12950-Blacktown	13.11.2017	0.5	Primary	Silty CLAY	11	<1	17	32	19	<0.1	10	43	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<50	5.7	224	<0.1	210	210	<10	30	240	40
ADE	12950-Ashfield	09.11.2017	2.0	Primary	Weathered SHALE	8.0	<1	4.0	13	15	<0.1	<2	<5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<50	5.3	29	<0.1	20	21	<10	<10	20	10
ADE	12950-Glenorie	13.11.2017	2.0	Primary	Silty CLAY	18	<1	23	18	21	<0.1	<2	6.0	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<50	4.9	53	<0.1	<20	50	<10	<10	20	<10
ADE	12950-Lucas Heights	16.11.2017	2.0	Primary	Clayey SAND	7	<1	14	<5	24	<0.1	2.0	<5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<50	4.7	43	<0.1	<10	40	<10	<10	20	10
ADE	12950-Hawkesbury	16.11.2017	7.0	Primary	SANDSTONE	<5	<1	7.0	6.0	16	<0.1	<2	<5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<50	5.8	33	<0.1	<10	40	<10	<10	20	<10
ADE	12950-South Creek	15.11.2017	0.5	Primary	Silty SAND	13	<1	28	28	17	<0.1	7.0	23	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<50	5.6	712	<0.1	1180	200	<10	20	770	<10
ADE	12950-Disturbed Terrain	16.11.2017	2.0	Primary	Silty SAND	<5	<1	<2	<5	<5	<0.1	3.0	<5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<50	6.3	21	<0.1	<10	<10	<10	<10	<10	<10
ADE	12950-BR1	16.11.2017	1.5	QA/QC	Duplicate of 12950-Tuggerah	<5	<1	<2	<5	<5	<0.1	<2	9.0	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<50	7.3	15	<0.1	<10	<10	<10	<10	<10	<10
ADE	12950-SR1	16.11.2017	1.5	QA/QC	Duplicate of 12950-Tuggerah	<4	<0.4	1.0	<1	<1	<0.1	<1	10	<0.2	<1	<0.5	<1	<0.05	<0.05	<250			<0.1	<10	<10	40	30	40	10
Number of Results						11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	10	10	11	11	11	11	11	11	11
Number of Detects						5	0	8	6	7	0	4	7	0	0	0	0	0	0	0	10	10	0	3	6	1	3	7	5
Minimum Concentrations						<4	<0.4	1	<1	<1	<0.1	<1	<5	<0.2	<0.5	<0.5	<0.5	<0.05	<0.05	<50	4.7	13	<0.1	<10	<10	<10	<10	<10	<10
Minimum Detect						7	ND	1	5	15	ND	2	6	ND	ND	ND	ND	ND	ND	ND	4.7	13	ND	20	21	40	20	20	10
Maximum Concentration						18	<1	28	32	24	<0.1	10	43	<0.2	<1	<0.5	<1	<0.5	<0.5	<250	7.3	712	<0.1	1180	210	40	30	770	40
Maximum Detect						18	ND	28	32	24	ND	10	43	ND	ND	ND	ND	ND	ND	ND	7.3	712	ND	1180	210	40	30	770	40
Average Concentration						6.5	0.47	9.5	10	13	0.05	2.6	12	0.1	0.27	0.25	0.27	0.23	0.23	34	5.8	116	0.05	133	53	8.2	11	105	10
Median Concentration						2.5	0.5	7	5	16	0.05	1	9	0.1	0.25	0.25	0.25	0.25	0.25	25	5.75	31	0.05	5	21	5	5	20	5
Standard Deviation						5.5	0.09	9.6	11	9.3	0	3.1	12	0	0.075	0	0.075	0.068	0.068	30	0.74	219	0	353	77	11	10	231	10

Notes to table

1 - The ranges given for pH are for the minimum and maximum acceptable pH valus in the ENM.

CHL-28-12950

CHALOUHI

Results of physiochemical paramters measured during collection of water samples at Bell Quarry.

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Consultant	Sample Name	Date Sampled	Time	Type	Dissolved Oxygen	Electrical Conductivity	pH	Redox	Temperature
					Physiochemical Field Parameters				
Limits of Reporting (LOR)					ppm	µS	pH units	mV	°C
					0.00	0.0	0.00	0	0.0
ADE	Location 1	15.11.2017	11:35	In-situ	6.21	33.7	6.34	121	23.3
ADE	Location 2	15.11.2017	11:42	In-situ	6.20	21.6	6.59	121	19.6
ADE	Location3	15.11.2017	11:57	In-situ	6.48	22.2	6.27	152	19.1
ADE	Location 4	15.11.2017	12:10	In-situ	6.66	21.4	6.19	155	21.8
ADE	Location 5	15.11.2017	12:25	In-situ	5.98	21.1	6.35	154	21.0
Number of Results					5	5	5	5	5
Number of Detects					5	5	5	5	5
Minimum Concentrations					6	21	6	121	19
Minimum Detect					6	21	6	121	19
Maximum Concentration					7	34	7	155	23
Maximum Detect					7	34	7	155	23
Average Concentration					6.3	24	6.3	141	21
Median Concentration					6.21	21.6	6.34	152	21
Standard Deviation					0.27	5.4	0.15	18	1.7

APPENDIX IV – ANALYTICAL LABORATORY REPORTS

Sydney Laboratory Services

A division of A. D. Envirotech Australia Pty Ltd A.C.N. 093 452 950
Unit 4/10-11 Millennium Court,
Silverwater 2128
Ph: (02) 9648-6669

Analysis report: CHL-28-12950-1

Customer: A. D. Envirotech Australia Pty. Ltd.
Attention: Justin Eccles & Nicholas Bernardini

Sample Log In Details

Your reference:	CHL-28-12950-1
No. of Samples:	18
Date Received:	17.11.2017
Date completed instructions received:	17.11.2017
Date of analysis:	17-21.11.2017

Report Details

Report Date:	22.11.2017
Method number:**	ESA-P-ORG08

Results Authorised By:

R. Nefodov

Ross Nefodov, B.Sc. (Environmental Sc.), M.PE.(Civil Engineering)
Managing Director
NATA approved signatory

Accreditation No.14664.
Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Tests not covered by NATA are denoted with *.

General Comments and Glossary

Samples are analysed on "as received" basis.	
Samples were delivered chilled	**Yes**
Samples were preserved in correct manner	**Yes**
Sample containers for volatile analysis were received with minimal headspace	**Yes**
Samples were analysed within holding time	**Yes**
Some samples have been subcontracted	**No**

1. All samples are tested in batches of 20.
2. All results for soil samples are reported per gram of dry soil, unless otherwise stated.
3. However surrogate standards are added to samples due to PAH and BTEX analysis and recoveries are calculated, samples' results are not corrected for standards recoveries.
4. Analysis of VOC in water samples are performed on unfiltered waters (as received), spiked with surrogate
5. If heterogenous or insufficient material provided LCS is used as matrix spike for QA/QC purposes.
6. Duplicate sample and matrix spike recoveries may not be prepared on smaller jobs, however, were analysed at a frequency
7. QA/QC samples shown within the report that states the word "BATCH"; Batch Blank, Matrix Spike and Duplicate were prepared on samples from outside of reported job.

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.
Surr. (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.

INS: Insufficient sample for this test
>: Greater than
LCS: Laboratory Control Sample
NT: Not tested
<: Less than
RPD: Relative Percent Difference
NA: Test not required
PQL: Practical Quantitation Limit

Laboratory Acceptance Criteria

Matrix Spikes and LCS: Generally 70-130% for inorganics/metals, 60-140% for organics is acceptable.
Matrix heterogeneity may result in matrix spike analyses falling outside these limits.

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:
Results <10 times the PQL : No Limit
Results between 10-20 times the PQL : RPD must lie between 0-50%
Results >20 times the PQL : RPD must lie between 0-30%
Surrogate Recoveries : Recoveries must lie between 50-150% - Phenols 20-130%.

Accreditation No.14664.
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New South Wales Office:
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Unit 4, 10-11 Millennium Court
Silverwater, NSW 2128

Telephone:
(02) 9648 6669
e-mail: info@ADenvirotech.com.au

ABN: 520 934 529 50

**Methods Number Description:

ESA-MP-01	Determination of metals by MP-AES
ESA-MP-02	Digestion of soil samples for MP-AES analysis
ESA-MP-03	Preparation of water samples for metals determination by MP-AES
ESA-MP-04	TCLP for inorganic contaminants
ESA-MP-05	Digestion of paint and dust samples for lead content determination
ESA-MP-06	Digestion of air filters
ESA-MP-07	Digestion of swabs for determination of lead content in dust
ESA-P-ORG03	Analysis of TRH and TPH by GC-FID
ESA-P-ORG04	Separatory funnel extraction of PAHs from water matrices including TCLP extracts
ESA-P-ORG05	Separatory funnel extraction of TRH and TPH from water matrices
ESA-P-ORG07	Extraction of BTEX and VTRX from soil matrices
ESA-P-ORG08	Analysis of soil extracts and waters by P&T GCMS
ESA-P-ORG09	Extraction of TRH from solid matrices
ESA-P-ORG11	Extraction of OCP OPP and PAH from soil matrices
ESA-P-ORG12	Analysis of OCP OPP and PAHs by GC-MS
AS 1289.4.3.1	Determination of the pH value of a soil-Electrometric method

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ABN: 520 934 529 50

Lab ID	PQL (µg/L)	12950-C1	12950-C2	12950-C3	12950-C4
Sample Name		12950-Trip Blank - Hawkesbury	12950-Trip Spike - Hawkesbury	12950-Trip Blank - Tuggarah	12950-Trip Spike - Tuggarah
BTEX					
Benzene	1	<1	94%	<1	97%
Toluene	1	<1	96%	<1	98%
Ethylbenzene	1	<1	96%	<1	98%
m, p- Xylene(s)	2	<2	97%	<2	98%
o-Xylene	1	<1	98%	<1	99%
Fluorobenzene	surr.	87%	97%	87%	99%

Lab ID	PQL (µg/L)	12950-C5	12950-C6	12950-C7	12950-C8
Sample Name		12950-Trip Blank - Blacktown	12950-Trip Spike - Blacktown	12950-Trip Blank - Ashfield	12950-Trip Spike - Ashfield
BTEX					
Benzene	1	<1	98%	<1	96%
Toluene	1	<1	98%	<1	96%
Ethylbenzene	1	<1	96%	<1	93%
m, p- Xylene(s)	2	<2	96%	<2	93%
o-Xylene	1	<1	99%	<1	96%
Fluorobenzene	surr.	100%	99%	99%	97%

Lab ID	PQL (µg/L)	12950-C9	12950-C10	12950-C11	12950-C12
Sample Name		12950-Trip Blank - Disturbed	12950-Trip Spike - Disturbed	12950-Trip Blank - Faulconbridge	12950-Trip Spike - Faulconbridge
BTEX					
Benzene	1	<1	98%	<1	95%
Toluene	1	<1	99%	<1	98%
Ethylbenzene	1	<1	99%	<1	98%
m, p- Xylene(s)	2	<2	99%	<2	98%
o-Xylene	1	<1	100%	<1	99%
Fluorobenzene	surr.	84%	101%	86%	98%

Lab ID	PQL (µg/L)	12950-C13	12950-C14	12950-C15	12950-C16
Sample Name		12950-Trip Blank - Glenorie	12950-Trip Spike - Glenorie	12950-Trip Blank - Lucas Heights	12950-Trip Spike - Lucas Heights
BTEX					
Benzene	1	<1	96%	<1	103%
Toluene	1	<1	97%	<1	104%
Ethylbenzene	1	<1	96%	<1	103%
m, p- Xylene(s)	2	<2	96%	<2	103%
o-Xylene	1	<1	97%	<1	105%
Fluorobenzene	surr.	98%	98%	99%	106%

Lab ID	PQL (µg/L)	12950-C17	12950-C18
Sample Name		12950-Trip Blank - South Creek	12950-Trip Spike - South Creek
BTEX			
Benzene	1	<1	101%
Toluene	1	<1	103%
Ethylbenzene	1	<1	101%
m, p- Xylene(s)	2	<2	100%
o-Xylene	1	<1	103%
Fluorobenzene	surr.	108%	104%

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Telephone:
(02) 9648 6669
e-mail: info@ADenvirotech.com.au

ABN: 520 934 529 50

Lab ID	PQL (µg/L)	Batch Blank 1	Batch Blank spike 1	Batch Matrix spike 1	Batch Duplicate 1 - Value 1	Batch Duplicate 1 - Value 2	Batch Duplicate 1
Sample Name							
BTEX							
Benzene	1	<1	97%	123%	<1	<1	ACCEPT
Toluene	1	<1	98%	128%	<1	<1	ACCEPT
Ethylbenzene	1	<1	98%	132%	<1	<1	ACCEPT
m, p- Xylene(s)	2	<2	99%	132%	<2	<2	ACCEPT
o-Xylene	1	<1	99%	132%	<1	<1	ACCEPT
Fluorobenzene	surr.		101%	129%	128%	106%	

Lab ID	PQL (µg/L)	Batch Duplicate 2 - Value 1	Batch Duplicate 2 - Value 2	Batch Duplicate 2
Sample Name				
BTEX				
Benzene	1	<1	<1	ACCEPT
Toluene	1	<1	<1	ACCEPT
Ethylbenzene	1	<1	<1	ACCEPT
m, p- Xylene(s)	2	<2	<2	ACCEPT
o-Xylene	1	<1	<1	ACCEPT
Fluorobenzene	surr.	129%	96%	

Lab ID	PQL (µg/L)	Batch Blank 2	Batch Blank spike 2	Batch Matrix spike 2	Batch Duplicate 3 - Value 1	Batch Duplicate 3 - Value 2	Batch Duplicate 3
Sample Name							
BTEX							
Benzene	1	<1	99%	102%	<1	<1	ACCEPT
Toluene	1	<1	95%	96%	<1	<1	ACCEPT
Ethylbenzene	1	<1	94%	96%	<1	<1	ACCEPT
m, p- Xylene(s)	2	<2	93%	94%	<2	<2	ACCEPT
o-Xylene	1	<1	96%	99%	<1	<1	ACCEPT
Fluorobenzene	surr.		99%	97%	99%	96%	

Lab ID	PQL (µg/L)	Batch Duplicate 4 - Value 1	Batch Duplicate 4 - Value 2	Batch Duplicate 4
Sample Name				
BTEX				
Benzene	1	<1	<1	ACCEPT
Toluene	1	<1	<1	ACCEPT
Ethylbenzene	1	<1	<1	ACCEPT
m, p- Xylene(s)	2	<2	<2	ACCEPT
o-Xylene	1	<1	<1	ACCEPT
Fluorobenzene	surr.	100%	101%	

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CERTIFICATE OF ANALYSIS 180739

Client Details

Client	A.D. Envirotech Australia Pty Ltd
Attention	Info AD Envirotech
Address	Unit 6, 7 Millenium Court, Silverwater, NSW, 2128

Sample Details

Your Reference	CHL-28-12950
Number of Samples	1 SOIL, 1 WATER
Date samples received	27/11/2017
Date completed instructions received	27/11/2017

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	28/11/2017
Date of Issue	29/11/2017

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Results Approved By
Dragana Tomas, Senior Chemist
Long Pham, Team Leader, Metals
Priya Samarawickrama, Senior Chemist
Steven Luong, Senior Chemist

Authorised By

David Springer, General Manager

vTRH(C6-C10)/BTEXN in Soil		
Our Reference		180739-1
Your Reference	UNITS	12950-SR1
Date Sampled		16/11/2017
Type of sample		SOIL
Date extracted	-	27/11/2017
Date analysed	-	28/11/2017
TRH C_6 - C_9	mg/kg	<25
TRH C_6 - C_{10}	mg/kg	<25
vTPH C_6 - C_{10} 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
Total +ve Xylenes	mg/kg	<1
Surrogate aaa-Trifluorotoluene	%	94

svTRH (C10-C40) in Soil		
Our Reference		180739-1
Your Reference	UNITS	12950-SR1
Date Sampled		16/11/2017
Type of sample		SOIL
Date extracted	-	27/11/2017
Date analysed	-	28/11/2017
TRH C_{10} - C_{14}	mg/kg	<50
TRH C_{15} - C_{28}	mg/kg	<100
TRH C_{29} - C_{36}	mg/kg	<100
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	<100
TRH >C_{34} -C_{40}	mg/kg	<100
Total +ve TRH (>C10-C40)	mg/kg	<50
Surrogate o-Terphenyl	%	98

PAHs in Soil		
Our Reference		180739-1
Your Reference	UNITS	12950-SR1
Date Sampled		16/11/2017
Type of sample		SOIL
Date extracted	-	27/11/2017
Date analysed	-	28/11/2017
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	<0.1
Pyrene	mg/kg	<0.1
Benzo(a)anthracene	mg/kg	<0.1
Chrysene	mg/kg	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2
Benzo(a)pyrene	mg/kg	<0.05
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
Total +ve PAH's	mg/kg	<0.05
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
Surrogate p-Terphenyl-d14	%	101

Organochlorine Pesticides in soil		
Our Reference		180739-1
Your Reference	UNITS	12950-SR1
Date Sampled		16/11/2017
Type of sample		SOIL
Date extracted	-	27/11/2017
Date analysed	-	27/11/2017
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
Total +ve DDT+DDD+DDE	mg/kg	<0.1
Surrogate TCMX	%	84

Organophosphorus Pesticides		
Our Reference		180739-1
Your Reference	UNITS	12950-SR1
Date Sampled		16/11/2017
Type of sample		SOIL
Date extracted	-	27/11/2017
Date analysed	-	27/11/2017
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	%	84

PCBs in Soil		
Our Reference		180739-1
Your Reference	UNITS	12950-SR1
Date Sampled		16/11/2017
Type of sample		SOIL
Date extracted	-	27/11/2017
Date analysed	-	27/11/2017
Aroclor 1016	mg/kg	<0.1
Aroclor 1221	mg/kg	<0.1
Aroclor 1232	mg/kg	<0.1
Aroclor 1242	mg/kg	<0.1
Aroclor 1248	mg/kg	<0.1
Aroclor 1254	mg/kg	<0.1
Aroclor 1260	mg/kg	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1
Surrogate TCLMX	%	84

Acid Extractable metals in soil		
Our Reference		180739-1
Your Reference	UNITS	12950-SR1
Date Sampled		16/11/2017
Type of sample		SOIL
Date prepared	-	27/11/2017
Date analysed	-	27/11/2017
Arsenic	mg/kg	<4
Cadmium	mg/kg	<0.4
Chromium	mg/kg	1
Copper	mg/kg	<1
Lead	mg/kg	<1
Mercury	mg/kg	<0.1
Nickel	mg/kg	<1
Zinc	mg/kg	10

Acid Extractable Cations in Soil		
Our Reference		180739-1
Your Reference	UNITS	12950-SR1
Date Sampled		16/11/2017
Type of sample		SOIL
Date prepared	-	27/11/2017
Date analysed	-	27/11/2017
Calcium	mg/kg	40
Potassium	mg/kg	30
Magnesium	mg/kg	40
Sodium	mg/kg	10

Miscellaneous Inorg - soil		
Our Reference		180739-1
Your Reference	UNITS	12950-SR1
Date Sampled		16/11/2017
Type of sample		SOIL
Date prepared	-	28/11/2017
Date analysed	-	28/11/2017
Chloride, Cl 1:5 soil:water	mg/kg	<10
Sulphate, SO4 1:5 soil:water	mg/kg	<10

Moisture		
Our Reference		180739-1
Your Reference	UNITS	12950-SR1
Date Sampled		16/11/2017
Type of sample		SOIL
Date prepared	-	27/11/2017
Date analysed	-	28/11/2017
Moisture	%	3.0

sTRH in water leach		
Our Reference		180739-2
Your Reference	UNITS	12950-ASLP
Date Sampled		16/11/2017
Type of sample		WATER
Date extracted	-	29/11/2017
Date analysed	-	29/11/2017
TRH C_{10} - C_{14}	µg/L	<50
TRH C_{15} - C_{28}	µg/L	<100
TRH C_{29} - C_{36}	µg/L	<100
TRH >C_{10} - C_{16}	µg/L	<50
TRH >C_{16} - C_{34}	µg/L	<100
TRH >C_{34} - C_{40}	µg/L	<100
Surrogate o-Terphenyl	%	108

Metals-ASLP Neutral (ICP-MS)		
Our Reference	UNITS	180739-2
Your Reference		12950-ASLP
Date Sampled		16/11/2017
Type of sample		WATER
Date extracted	-	29/11/2017
Date analysed	-	29/11/2017
pH of final Leachate	pH units	6.8
Arsenic in ASLP	µg/L	<1
Cadmium in ASLP	µg/L	<0.1
Chromium in ASLP	µg/L	<1
Copper in ASLP	µg/L	<1
Lead in ASLP	µg/L	<1
Mercury in ASLP	µg/L	<0.05
Nickel in ASLP	µg/L	<1
Zinc in ASLP	µg/L	9

Miscellaneous Inorganics		
Our Reference		180739-2
Your Reference	UNITS	12950-ASLP
Date Sampled		16/11/2017
Type of sample		WATER
Date prepared	-	29/11/2017
Date analysed	-	29/11/2017
Total Alkalinity as $CaCO_3$ in ASLP	mg/L	9

Method ID	Methodology Summary
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.
Inorg-006	Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Alternatively determined by colourimetry/turbidity using Discrete Analyer.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Metals-021 ASLP	Determination of Mercury by Cold Vapour AAS following neutral water leaching by AS 4439.3 - 1997.
Metals-022	Determination of various metals by ICP-MS following leaching using neutralised deionised water by AS 4439.3 - 1997.
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-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. Note, the Total +ve TRH PQL is reflective of the lowest individual PQL and is therefore "Total +ve TRH" is simply a sum of the positive individual TRH fractions (>C10-C40).
Org-003_NEUTRAL	Leachates are extracted with Dichloromethane and analysed by GC-FID.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's. Note, the Total +ve reported DDD+DDE+DDT PQL is reflective of the lowest individual PQL and is therefore simply a sum of the positive individually report DDD+DDE+DDT.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD. Note, the Total +ve PCBs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PCBs" is simply a sum of the positive individual PCBs.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.

Method ID	Methodology Summary
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. 'EQ 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. 'EQ 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. 'EQ 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-014	Soil samples are extracted with methanol and spiked into water prior to analysing 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-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. Note, the Total +ve Xylene PQL is reflective of the lowest individual PQL and is therefore "Total +ve Xylenes" is simply a sum of the positive individual Xylenes.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-10	[NT]
Date extracted	-			27/11/2017	[NT]	[NT]	[NT]	[NT]	27/11/2017	[NT]
Date analysed	-			28/11/2017	[NT]	[NT]	[NT]	[NT]	28/11/2017	[NT]
TRH C_6 - C_9	mg/kg	25	Org-016	<25	[NT]	[NT]	[NT]	[NT]	90	[NT]
TRH C_6 - C_{10}	mg/kg	25	Org-016	<25	[NT]	[NT]	[NT]	[NT]	90	[NT]
Benzene	mg/kg	0.2	Org-016	<0.2	[NT]	[NT]	[NT]	[NT]	75	[NT]
Toluene	mg/kg	0.5	Org-016	<0.5	[NT]	[NT]	[NT]	[NT]	93	[NT]
Ethylbenzene	mg/kg	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	100	[NT]
m+p-xylene	mg/kg	2	Org-016	<2	[NT]	[NT]	[NT]	[NT]	91	[NT]
o-Xylene	mg/kg	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	108	[NT]
naphthalene	mg/kg	1	Org-014	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	99	[NT]	[NT]	[NT]	[NT]	94	[NT]

QUALITY CONTROL: svTRH (C10-C40) in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-10	[NT]
Date extracted	-			27/11/2017	[NT]	[NT]	[NT]	[NT]	27/11/2017	[NT]
Date analysed	-			28/11/2017	[NT]	[NT]	[NT]	[NT]	28/11/2017	[NT]
TRH C_{10} - C_{14}	mg/kg	50	Org-003	<50	[NT]	[NT]	[NT]	[NT]	94	[NT]
TRH C_{15} - C_{28}	mg/kg	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	102	[NT]
TRH C_{29} - C_{36}	mg/kg	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	91	[NT]
TRH $>C_{10}$ - C_{16}	mg/kg	50	Org-003	<50	[NT]	[NT]	[NT]	[NT]	94	[NT]
TRH $>C_{16}$ - C_{34}	mg/kg	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	102	[NT]
TRH $>C_{34}$ - C_{40}	mg/kg	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	91	[NT]
Surrogate o-Terphenyl	%		Org-003	103	[NT]	[NT]	[NT]	[NT]	87	[NT]

QUALITY CONTROL: PAHs in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-10	[NT]
Date extracted	-			27/11/2017	[NT]	[NT]	[NT]	[NT]	27/11/2017	[NT]
Date analysed	-			28/11/2017	[NT]	[NT]	[NT]	[NT]	28/11/2017	[NT]
Naphthalene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	92	[NT]
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	96	[NT]
Phenanthrene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	90	[NT]
Anthracene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	90	[NT]
Pyrene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	97	[NT]
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	103	[NT]
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	[NT]	[NT]	[NT]	[NT]	100	[NT]
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	99	[NT]	[NT]	[NT]	[NT]	96	[NT]

QUALITY CONTROL: Organochlorine Pesticides in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-10	[NT]
Date extracted	-			27/11/2017	[NT]	[NT]	[NT]	[NT]	27/11/2017	[NT]
Date analysed	-			27/11/2017	[NT]	[NT]	[NT]	[NT]	27/11/2017	[NT]
HCB	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	92	[NT]
gamma-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	93	[NT]
Heptachlor	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	90	[NT]
delta-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	88	[NT]
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	91	[NT]
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	98	[NT]
Dieldrin	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	97	[NT]
Endrin	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	90	[NT]
pp-DDD	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	95	[NT]
Endosulfan II	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	84	[NT]
Methoxychlor	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate TCMX	%		Org-005	86	[NT]	[NT]	[NT]	[NT]	100	[NT]

QUALITY CONTROL: Organophosphorus Pesticides					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-10	180739-1
Date extracted	-			27/11/2017	1	27/11/2017	27/11/2017		27/11/2017	27/11/2017
Date analysed	-			27/11/2017	1	27/11/2017	27/11/2017		27/11/2017	27/11/2017
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	100	123
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Diazinon	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	91	110
Dimethoate	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Ethion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	113	116
Fenitrothion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	117	116
Malathion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	118	69
Parathion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	105	96
Ronnel	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	115	132
Surrogate TCMX	%		Org-008	86	1	84	81	4	88	88

QUALITY CONTROL: PCBs in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-10	[NT]
Date extracted	-			27/11/2017	[NT]	[NT]	[NT]	[NT]	27/11/2017	[NT]
Date analysed	-			27/11/2017	[NT]	[NT]	[NT]	[NT]	27/11/2017	[NT]
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	113	[NT]
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate TCLMX	%		Org-006	86	[NT]	[NT]	[NT]	[NT]	82	[NT]

QUALITY CONTROL: Acid Extractable metals in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-10	[NT]
Date prepared	-			27/11/2017	[NT]	[NT]	[NT]	[NT]	27/11/2017	[NT]
Date analysed	-			27/11/2017	[NT]	[NT]	[NT]	[NT]	27/11/2017	[NT]
Arsenic	mg/kg	4	Metals-020	<4	[NT]	[NT]	[NT]	[NT]	108	[NT]
Cadmium	mg/kg	0.4	Metals-020	<0.4	[NT]	[NT]	[NT]	[NT]	101	[NT]
Chromium	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	105	[NT]
Copper	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	107	[NT]
Lead	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	103	[NT]
Mercury	mg/kg	0.1	Metals-021	<0.1	[NT]	[NT]	[NT]	[NT]	102	[NT]
Nickel	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	101	[NT]
Zinc	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	103	[NT]

QUALITY CONTROL: Acid Extractable Cations in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-10	[NT]
Date prepared	-			27/11/2017	[NT]	[NT]	[NT]	[NT]	27/11/2017	[NT]
Date analysed	-			27/11/2017	[NT]	[NT]	[NT]	[NT]	27/11/2017	[NT]
Calcium	mg/kg	5	Metals-020	<5	[NT]	[NT]	[NT]	[NT]	101	[NT]
Potassium	mg/kg	10	Metals-020	<10	[NT]	[NT]	[NT]	[NT]	107	[NT]
Magnesium	mg/kg	5	Metals-020	<5	[NT]	[NT]	[NT]	[NT]	97	[NT]
Sodium	mg/kg	10	Metals-020	<10	[NT]	[NT]	[NT]	[NT]	98	[NT]

QUALITY CONTROL: Miscellaneous Inorg - soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-10	[NT]
Date prepared	-			28/11/2017	[NT]	[NT]	[NT]	[NT]	28/11/2017	[NT]
Date analysed	-			28/11/2017	[NT]	[NT]	[NT]	[NT]	28/11/2017	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	100	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	100	[NT]

QUALITY CONTROL: sTRH in water leach					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	
Date extracted	-			29/11/2017	[NT]	[NT]	[NT]	[NT]	29/11/2017	[NT]
Date analysed	-			29/11/2017	[NT]	[NT]	[NT]	[NT]	29/11/2017	[NT]
TRH C_{10} - C_{14}	µg/L	50	Org-003	<50	[NT]	[NT]	[NT]	[NT]	93	[NT]
TRH C_{15} - C_{28}	µg/L	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	70	[NT]
TRH C_{29} - C_{36}	µg/L	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	90	[NT]
TRH >C_{10} - C_{16}	µg/L	50	Org-003	<50	[NT]	[NT]	[NT]	[NT]	93	[NT]
TRH >C_{16} - C_{34}	µg/L	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	70	[NT]
TRH >C_{34} - C_{40}	µg/L	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	90	[NT]
Surrogate o-Terphenyl	%		Org-003_NEUTRAL	70	[NT]	[NT]	[NT]	[NT]	83	[NT]

QUALITY CONTROL: Metals-ASLP Neutral (ICP-MS)					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	
Date extracted	-			29/11/2017	[NT]	[NT]	[NT]	[NT]	29/11/2017	[NT]
Date analysed	-			29/11/2017	[NT]	[NT]	[NT]	[NT]	29/11/2017	[NT]
Arsenic in ASLP	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	100	[NT]
Cadmium in ASLP	µg/L	0.1	Metals-022	<0.1	[NT]	[NT]	[NT]	[NT]	102	[NT]
Chromium in ASLP	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	98	[NT]
Copper in ASLP	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	102	[NT]
Lead in ASLP	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	99	[NT]
Mercury in ASLP	µg/L	0.05	Metals-021 ASLP	<0.05	[NT]	[NT]	[NT]	[NT]	100	[NT]
Nickel in ASLP	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	100	[NT]
Zinc in ASLP	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	102	[NT]

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			29/11/2017	[NT]	[NT]	[NT]	[NT]	29/11/2017	[NT]
Date analysed	-			29/11/2017	[NT]	[NT]	[NT]	[NT]	29/11/2017	[NT]
Total Alkalinity as $CaCO_3$ in ASLP	mg/L	5	Inorg-006	<5	[NT]	[NT]	[NT]	[NT]	100	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

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.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

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.

Report Comments

ASLP was prepared using the water supplied by the client

Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1728988**	Page	: 1 of 77
Amendment	: **1**		
Client	: **ADE Consulting Group Pty Ltd**	Laboratory	: Environmental Division Sydney
Contact	: MRKA .	Contact	: Customer Services ES
Oddress	: NIV5 MLERM5 CA, 3T SMGE3 HOTE3 RSH Y1YW	Oddress	: YVVUYW H ood2ar- 3oad Smit8field RSH Oustralia Y1N9
Tele28one	: pN1 0YI 900VV11	Tele28one	: pN1UYUWV9 Wkk
Pro8ect	: C4LUYWUIYI k0	Date Sam2les 3eceived	: 1NURovUY01V 1I:Y0
Arder number	: UUU	Date Onalysis Commenced	: Y0URovUY01V
CUAUC number	: UUU	Msue Date	: 0kUDecUY01V 1V:70
Sam2ler	: RMC4ALOS +E3RO3DMRM		
Site	: UUU		
j uote number	: SJIkVI I1V		
Ro. of sam2les received	: 1Y		
Ro. of sam2les analysed	: 11		

Accreditation No. 825
Accredited for compliance with ISO/IEC 17025 - Testing

T8is re2ort su2ersedes any 2revious re2ort(s) /it8 t8is reference. 3esults a22ly to t8e sam2le(s) as submitted. T8is document s8all not be re2roduced(e)ce2t in full.

T8is Certificate of Onalysis contains t8e follo/ing information:

- x eneral Comments
- Onalytical 3esults
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

T8is document 8as been electronically signed by t8e aut8orized signatories belo/. Electronic signing is carried out in com2liance /it8 2rocedures s2ecified in Y1 CK3 Part 11.

Signatories	*Position*	*Accreditation Category*
Ole) 3ossi	Arganic C8emist	Sydney Arganics(Smit8field(RSH
Os8es8 Patel	Morganic C8emist	Sydney Morganics(Smit8field(RSH
Celine Conceicao	Senior S2ectrosco2ist	Sydney Morganics(Smit8field(RSH
Dian Dao		Sydney Morganics(Smit8field(RSH
Ed/andy Kad8ar	Arganic Coordinator	Sydney Morganics(Smit8field(RSH
Ed/andy Kad8ar	Arganic Coordinator	Sydney Arganics(Smit8field(RSH
3aymond Commodore	Mstrument C8emist	Sydney Morganics(Smit8field(RSH
San8es8ni Fyoti	Senior C8emist Golatiles	Sydney Arganics(Smit8field(RSH
Tony DeSouza	Senior 5icrobiologist	Sydney 5icrobiology(Smit8field(RSH

General Comments

T8e analytical 2rocedures used by t8e Environmental Division 8ave been develo2ed from establis8ed internationally recognized 2rocedures suc8 as t8ose 2ublis8ed by t8e , SEPO(OP4O(OS and REP5 . M 8ouse develo2ed 2rocedures are em2loyed in t8e absence of documented standards or by client request.

H 8ere moisture determination 8as been 2erformed(results are re2orted on a dry / eig8t basis.

H 8ere a re2orted less t8an w<Q result is 8ig8er t8an t8e LA3 (t8is may be due to 2rimary sam2le e) tractUdigestate dilution andUor insufficient sam2le for analysis.

H 8ere t8e LA3 of a re2orted result differs from standard LA3 (t8is may be due to 8ig8 moisture content(insufficient sam2le wreduced / eig8t em2loyedQ or matri) interference.

H 8en sam2ling time information is not 2rovided by t8e client(sam2ling dates are s8o/ n / it8out a time com2onent. M t8ese instances(t8e time com2onent 8as been assumed by t8e laboratory for 2rocessing 2ur2oses.

H 8ere a result is required to meet com2liance limits t8e associated uncertainty must be considered. 3 efer to t8e OLS Contact for details.

Bey : COS Rumber = COS registry number from database maintained by C8emical Obstracts Services. T8e C8emical Obstracts Service is a division of t8e Omerican C8emical Society.
LA3 = Limit of re2orting
^ = T8is result is com2uted from individual analyte detections at or above t8e level of re2orting
ø = OLS is not ROTO accredited for t8ese tests.
~ = Mdicates an estimated value.

- 5 K = membrane filtration
- CK, = colony forming unit
- EB0V1x (EB0NVx : M 8as been noted t8at 3 eactive P8os28orus is greater t8an Total P for sam2le 1Y(8o/ ever t8is difference is / it8in t8e limits of e) 2erimental variation.
- 5 icrobiological Comment: M accordance / it8 OLS / or- instruction j H M5 MCh09(membrane filtration result is re2orted an a22ro) imate w~Q / 8en t8e count of colonies on t8e filtered membrane is outside t8e range of 10 U100cfu.
- Omendment w09h1YhY01VQ T8is re2ort 8as been amended and reUreleased to allo/ t8e re2orting of additional leac8abe metals analytical data.
- Occording to OLS / or- instruction for membrane filtration(t8e suggested volume for filtration of non treated hnonUdrin- ing / ater starts from 10mL or k0mL if t8e sam2le is turbid. O result of <10 or <Ycfuh100mL is re2orted / 8en t8ere is no target organism gro/ t8 from a volume of 10 or k0mL res2ectively.
- 5 embrane filtration results for 5 H 00V are re2orted as an estimate w~Q due to t8e 2resence of many nonUtarget organism colonies t8at may 8ave in8ibited t8e gro/ t8 of t8e target organisms on t8e filter membrane. M may be informative to record t8is fact.
- 5 H 00N is OLS& internal code and is equivalent to OS9YVN.V.
- 5 H 00V is OLS& internal code and is equivalent to OS9YVN.k.
- +enzowaQ2yrene To) icity Equivalent j uotient wTEj Q is t8e sum total of t8e concentration of t8e eig8t carcinogenic PO4 s multi2lied by t8eir To) icity Equivalence Kactor wTEKQ relative to +enzowaQ2yrene. TEK values are 2rovided in brac- ets as follo/ s: +enzwaQant8racene w0.1Q(C8rysene w0.01Q(+enzowbp6Q' +enzow-Qfluorant8ene w0.1Q(+enzowaQ2yrene w1.0Q(Mdenow1.Y.7.cdQ2yrene w0.1Q(Dibenzwa.8Qant8racene w1.0Q(+enzowg.8.iQ2erylene w0.01Q. Less t8an LA3 results for &TEj Zero& are treated as zero(for &TEj 1hY LA3 & are treated as 8alf t8e re2orted LA3 (and for &TEj LA3 & are treated as being equal to t8e re2orted LA3 . Rote: TEj 1hY LA3 and TEj LA3 / ill calculate as 0.NmgUBg and 1.YmgUBg res2ectively for sam2les / it8 nonUdetects for all of t8e eig8t TEj PO4 s.
- +enzowaQ2yrene To) icity Equivalent j uotient wTEj Q is t8e sum total of t8e concentration of t8e eig8t carcinogenic PO4 s multi2lied by t8eir To) icity Equivalence Kactor wTEKQ relative to +enzowaQ2yrene. TEK values are 2rovided in brac- ets as follo/ s: +enzwaQant8racene w0.1Q(C8rysene w0.01Q(+enzowbp6Q' +enzow-Qfluorant8ene w0.1Q(+enzowaQ2yrene w1.0Q(Mdenow1.Y.7.cdQ2yrene w0.1Q(Dibenzwa.8Qant8racene w1.0Q(+enzowg.8.iQ2erylene w0.01Q. Less t8an LA3 results for &TEj Zero& are treated as zero.

Analytical Results

SubU5 atri) : ASLP LEACHATE
(5 atri) : WATER)

Compound	CAS Number	LOR	Unit	12950-Tuggerah	12950-Faulconbridge	12950-Blacktown	12950-Ashfield	12950-Glenorie
Client sample ID				12950-Tuggerah	12950-Faulconbridge	12950-Blacktown	12950-Ashfield	12950-Glenorie
Client sampling date / time				1NUROvUY01V 00:00	1NUROvUY01V 00:00	1NUROvUY01V 00:00	1NUROvUY01V 00:00	1NUROvUY01V 00:00
				ES1728988-001	ES1728988-002	ES1728988-003	ES1728988-004	ES1728988-005
				3 esult	3 esult	3 esult	3 esult	3 esult
EA005P: pH by PC Titrator								
pH Value	UUUU	0.01	24 , nit	6.67	6.16	6.38	6.04	4.86
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	UUUU	1	^Sfcm	30	36	124	58	35
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	D5 AUY10U001	1	mgIL	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	7WYU7YUN	1	mgIL	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	V1UkYU7	1	mgIL	5	3	3	<1	<1
Total Alkalinity as CaCO3	UUUU	1	mgIL	5	3	3	<1	<1
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	19V0WVI UW	1	mgIL	2	2	21	8	8
ED045G: Chloride by Discrete Analyser								
Chloride	1NWWU0UN	1	mgIL	5	8	20	10	5
ED093F: Dissolved Major Cations								
Calcium	V990UV0UY	1	mgIL	<1	<1	<1	<1	<1
Magnesium	V97I U kU9	1	mgIL	<1	<1	<1	<1	<1
Sodium	V990UY7Uk	1	mgIL	4	16	23	11	5
Potassium	V990U0I UV	1	mgIL	<1	<1	<1	<1	<1
EG020W: Water Leachable Metals by ICP-MS								
Arsenic	V990U7WUY	0.001	mgIL	<0.001	<0.001	0.001	<0.001	<0.001
Cadmium	V990U97U	0.0001	mgIL	<0.0001	0.0002	0.0004	0.0002	<0.0001
Chromium	V990U9VU7	0.001	mgIL	0.001	0.002	0.007	0.001	<0.001
Copper	V990Uk0UW	0.001	mgIL	<0.001	0.002	0.013	0.002	<0.001
Lead	V97I U YUI	0.001	mgIL	<0.001	0.003	0.010	0.004	<0.001
Nickel	V990U0YU0	0.001	mgIL	<0.001	0.001	0.006	<0.001	<0.001
Zinc	V990UNUN	0.00k	mgIL	0.030	0.074	0.484	0.054	0.043
EG035W: Water Leachable Mercury by FIMS								
Mercury	V97I U VUN	0.0001	mgIL	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	VNN9U91UV	0.01	mgIL	0.11	0.01	<0.01	<0.01	0.01
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	19VI VUNkU0	0.01	mgIL	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	19VI VUkkUW	0.01	mgIL	0.01	0.02	2.35	0.02	0.02

Analytical Results

SubU5 atri) : ASLP LEACHATE (5 atri) : WATER)			Client sample ID	12950-Tuggerah	12950-Faulconbridge	12950-Blacktown	12950-Ashfield	12950-Glenorie
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
Compound	CAS Number	LOR	Unit	ES1728988-001	ES1728988-002	ES1728988-003	ES1728988-004	ES1728988-005
				3 esult	3 esult	3 esult	3 esult	3 esult
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	ШШШ	0.01	mgłL	**0.01**	**0.02**	**2.35**	**0.02**	**0.02**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	ШШШ	0.1	mgłL	**0.4**	**0.2**	**0.6**	<0.1	**0.1**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
µ Total Nitrogen as N	ШШШ	0.1	mgłL	**0.4**	**0.2**	**3.0**	<0.1	**0.1**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	ШШШ	0.01	mgłL	**0.04**	<0.01	**0.08**	<0.01	<0.01
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	19YNkU99UY	0.01	mgłL	<0.01	<0.01	<0.01	<0.01	**0.01**
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	ШШШ	1	^głL	<1	<1	<1	<1	<1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	71I UW9UN	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
Hexachlorobenzene (HCB)	11WUV9U1	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
beta-BHC	71I UWkUV	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
gamma-BHC	kWUW U	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
delta-BHC	71I UWNUV	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
Heptachlor	VNU99UV	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
Aldrin	70I U0UY	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
Heptachlor epoxide	10Y9UkVU7	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
trans-Chlordane	k107UV9UY	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
alpha-Endosulfan	I kI U WUV	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
cis-Chlordane	k107UV1U	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
Dieldrin	N0UkVU1	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
4.4`-DDE	VYUkkU	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
Endrin	VYUY0UV	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
beta-Endosulfan	77Y17UNkU	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
4.4`-DDD	VYUk9UV	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
Endrin aldehyde	V9Y1U 7U9	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
Endosulfan sulfate	1071U0VUV	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
4.4`-DDT	k0UYI U7	Y.0	^głL	<Y.0	<Y.0	<Y.0	<Y.0	<Y.0
Endrin ketone	k79I 9UV0Uk	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k
Methoxychlor	VYU97Uk	Y.0	^głL	<Y.0	<Y.0	<Y.0	<Y.0	<Y.0
µ Total Chlordane (sum)	ШШШ	0.k	^głL	<0.k	<0.k	<0.k	<0.k	<0.k

Analytical Results

SubU5 atri) : ASLP LEACHATE (5 atri) : WATER)			Client sample ID	12950-Tuggerah	12950-Faulconbridge	12950-Blacktown	12950-Ashfield	12950-Glenorie
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
Compound	CAS Number	LOR	Unit	ES1728988-001	ES1728988-002	ES1728988-003	ES1728988-004	ES1728988-005
				3 esult	3 esult	3 esult	3 esult	3 esult
EP068A: Organochlorine Pesticides (OC) - Continued								
µ **Sum of DDD + DDE + DDT**	VYUk9UWVYUkkUIk 0UY	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
µ **Sum of Aldrin + Dieldrin**	70I U0UYN0UkVU1	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	NYUY7UY	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Demeton-S-methyl	I 1I UWNUW	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Monocrotophos	NI Y7UYY9	Y.0	^g/L	<Y.0	<Y.0	<Y.0	<Y.0	<Y.0
Dimethoate	N0Uk1Uk	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Diazinon	777U91Uk	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Chlorpyrifos-methyl	kkI WU17U0	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Parathion-methyl	YI WU00U0	Y.0	^g/L	<Y.0	<Y.0	<Y.0	<Y.0	<Y.0
Malathion	1Y1UVkUk	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Fenthion	kkU7WU	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Chlorpyrifos	YI Y1UWWY	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Parathion	kNU7WY	Y.0	^g/L	<Y.0	<Y.0	<Y.0	<Y.0	<Y.0
Pirimphos-ethyl	Y7k0kU91UI	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Chlorfenvinphos	9V0UI 0UN	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Bromophos-ethyl	9WY9UWWN	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Fenamiphos	YYYY9UI YUN	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Prothiofos	79N97U9NU9	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Ethion	kN7UI YUY	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Carbophenothion	VWNUI I UN	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Azinphos Methyl	WNUk0U0	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	I 1UY0U7	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	Y0WUI NUW	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	W7UYU	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	WNUY7UY	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	WkU01UW	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	1Y0UI YUY	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	Y0NU99U0	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	1YI U0U0	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	kNUkkU7	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	Y1WU01U	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	Y0kUI I UY Y0kUWYU7	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0

Analytical Results

Sub5 atri) : ASLP LEACHATE
(5 atri) : WATER)

Compound	CAS Number	LOR	Unit	12950-Tuggerah	12950-Faulconbridge	12950-Blacktown	12950-Ashfield	12950-Glenorie
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
				ES1728988-001	ES1728988-002	ES1728988-003	ES1728988-004	ES1728988-005
				3 esult	3 esult	3 esult	3 esult	3 esult
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benzo(k)fluoranthene	Y0VU0WU	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	k0U7YUW	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Indeno(1.2.3.cd)pyrene	1I 7U7I Uk	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	k7UV0U7	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	1I 1UY9UY	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
μ Sum of polycyclic aromatic hydrocarbons	UUU	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
μ Benzo(a)pyrene TEQ (zero)	UUU	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
EP080/071: Total Petroleum Hydrocarbons								
C10 - C14 Fraction	UUU	k0	^g/L	<k0	<k0	<k0	<k0	<k0
C15 - C28 Fraction	UUU	100	^g/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	UUU	k0	^g/L	<k0	<k0	<k0	<k0	<k0
μ C10 - C36 Fraction (sum)	UUU	k0	^g/L	<k0	<k0	<k0	<k0	<k0
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	UUU	100	^g/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	UUU	100	^g/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	UUU	100	^g/L	<100	<100	<100	<100	<100
μ >C10 - C40 Fraction (sum)	UUU	100	^g/L	<100	<100	<100	<100	<100
μ >C10 - C16 Fraction minus Naphthalene (F2)	UUU	100	^g/L	<100	<100	<100	<100	<100
MW006: Faecal Coliforms & E.coli by MF								
Escherichia coli	UUU	1	CK, /100mL	<Y	<1	<Y	<1	<1
MW007: Coliforms by MF								
Coliforms	UUU	1	CK, /100mL	**2600**	<1	<Y	<1	<1
EP066S: PCB Surrogate								
Decachlorobiphenyl	Y0k1UY9U7	1	_	**102**	**92.9**	**94.4**	**95.7**	**101**
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	Y1NkkU7UY	0.k	_	**97.2**	**97.9**	**107**	**107**	**96.6**
EP068T: Organophosphorus Pesticide Surrogate								
DEF	VV9VWV	0.k	_	**84.6**	**84.0**	**95.7**	**82.5**	**85.6**
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	171YVUWU7	1.0	_	**16.2**	**17.3**	**22.0**	**16.8**	**16.2**
2-Chlorophenol-D4	I 7I k1UV7UN	1.0	_	**62.3**	**56.5**	**57.9**	**44.1**	**52.4**
2.4.6-Tribromophenol	11VWI UN	1.0	_	**49.8**	**61.1**	**64.0**	**53.8**	**52.2**

Analytical Results

SubU5 atri) : **ASLP LEACHATE** (5 atri) : **WATER)**			Client sample ID	**12950-Tuggerah**	**12950-Faulconbridge**	**12950-Blacktown**	**12950-Ashfield**	**12950-Glenorie**
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES1728988-001**	**ES1728988-002**	**ES1728988-003**	**ES1728988-004**	**ES1728988-005**
				3 esult	3 esult	3 esult	3 esult	3 esult
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	7Y1UN0UW	1.0	_	**72.1**	**74.5**	**82.1**	**72.3**	**73.3**
Anthracene-d10	1V1I U0NUW	1.0	_	**92.7**	**96.9**	**78.0**	**95.8**	**98.0**
4-Terphenyl-d14	1V1WUk1U0	1.0	_	**71.8**	**73.3**	**77.4**	**76.1**	**75.6**

Analytical Results

SubU5 atri) : ASLP LEACHATE (5 atri) : WATER)			Client sample ID	12950-Lucas Heights	12950-Hawkesbury	12950-South Creek	12950-Disturbed Terrain	12950-BR1
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
Compound	CAS Number	LOR	Unit	ES1728988-006	ES1728988-007	ES1728988-008	ES1728988-009	ES1728988-010
				3 esult	3 esult	3 esult	3 esult	3 esult
EA005P: pH by PC Titrator								
pH Value	UUUU	0.01	24 , nit	**5.28**	**5.76**	**6.42**	**6.42**	**6.65**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	UUUU	1	^Shcm	**33**	**31**	**248**	**43**	**31**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	D5 AUY10U001	1	mghL	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	7WI YU7YUN	1	mghL	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	V1UkYU7	1	mghL	<1	<1	**4**	**4**	**6**
Total Alkalinity as CaCO3	UUUU	1	mghL	<1	<1	**4**	**4**	**6**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	19V0WUVI UW	1	mghL	**6**	**5**	**21**	**2**	**2**
ED045G: Chloride by Discrete Analyser								
Chloride	1NWWU00UN	1	mghL	**5**	**5**	**48**	**9**	**5**
ED093F: Dissolved Major Cations								
Calcium	V990UW0UY	1	mghL	<1	<1	<1	<1	<1
Magnesium	V97I U kU9	1	mghL	<1	<1	<1	<1	<1
Sodium	V990UY7Uk	1	mghL	**4**	**6**	**43**	**8**	**5**
Potassium	V990U0I UV	1	mghL	**2**	<1	<1	<1	<1
EG020W: Water Leachable Metals by ICP-MS								
Arsenic	V990U7WUY	0.001	mghL	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	V990U97U	0.0001	mghL	<0.0001	<0.0001	**0.0003**	**0.0002**	<0.0001
Chromium	V990U9VU7	0.001	mghL	<0.001	<0.001	**0.007**	<0.001	**0.014**
Copper	V990Uk0UW	0.001	mghL	<0.001	<0.001	**0.007**	**0.001**	**0.005**
Lead	V97I U YUI	0.001	mghL	<0.001	<0.001	**0.007**	<0.001	**0.002**
Nickel	V990U0YU0	0.001	mghL	**0.006**	<0.001	**0.004**	**0.002**	**0.007**
Zinc	V990UNNUN	0.00k	mghL	**0.135**	**0.042**	**0.064**	**0.160**	**0.022**
EG035W: Water Leachable Mercury by FIMS								
Mercury	V97I U VUN	0.0001	mghL	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	VNN9U91UV	0.01	mghL	<0.01	<0.01	<0.01	**0.01**	**0.08**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	19VI VUNkU0	0.01	mghL	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	19VI VUkkUW	0.01	mghL	**0.03**	<0.01	**0.04**	**0.13**	**0.02**

Analytical Results

Sub(5 atri) : ASLP LEACHATE
(5 atri) : WATER)

Compound	CAS Number	LOR	Unit	12950-Lucas Heights	12950-Hawkesbury	12950-South Creek	12950-Disturbed Terrain	12950-BR1
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
				ES1728988-006	ES1728988-007	ES1728988-008	ES1728988-009	ES1728988-010
				3 esult	3 esult	3 esult	3 esult	3 esult
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	UUUU	0.01	mg/L	**0.03**	<0.01	**0.04**	**0.13**	**0.02**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	UUUU	0.1	mg/L	<0.1	**0.1**	<0.1	**0.2**	**0.2**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
µ Total Nitrogen as N	UUUU	0.1	mg/L	<0.1	**0.1**	<0.1	**0.3**	**0.2**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	UUUU	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	19YNkU99UY	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	**0.02**
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	UUUU	1	^g/L	<1	<1	<1	<1	<1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	71I U9UN	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Hexachlorobenzene (HCB)	11WU9UI	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
beta-BHC	71I UKUY	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
gamma-BHC	kWWW U	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
delta-BHC	71I UNUV	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Heptachlor	VNU99UV	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Aldrin	70I U0UY	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Heptachlor epoxide	10Y9UkVU7	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
trans-Chlordane	k107UY9UY	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
alpha-Endosulfan	I kI U WUV	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
cis-Chlordane	k107UV1U	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Dieldrin	N0UkVU	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
4.4`-DDE	VYUkkU	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Endrin	VYUY0UV	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
beta-Endosulfan	77Y17UNkU	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
4.4`-DDD	VYUk9UV	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Endrin aldehyde	V9Y1U 7U9	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Endosulfan sulfate	1071U0VUV	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
4.4`-DDT	k0UYI U7	Y.0	^g/L	<Y.0	<Y.0	<Y.0	<Y.0	<Y.0
Endrin ketone	k79I 9UV0Uk	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Methoxychlor	VYU97Uk	Y.0	^g/L	<Y.0	<Y.0	<Y.0	<Y.0	<Y.0
µ Total Chlordane (sum)	UUUU	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k

Analytical Results

Sub(5 atri) : ASLP LEACHATE
(5 atri) : WATER)

Compound	CAS Number	LOR	Unit	12950-Lucas Heights	12950-Hawkesbury	12950-South Creek	12950-Disturbed Terrain	12950-BR1
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
				ES1728988-006	ES1728988-007	ES1728988-008	ES1728988-009	ES1728988-010
				3 esult	3 esult	3 esult	3 esult	3 esult
EP068A: Organochlorine Pesticides (OC) - Continued								
μ Sum of DDD + DDE + DDT	VYUk9UWVYUkkUlk 0UY	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
μ Sum of Aldrin + Dieldrin	70I U00UYNOUkVU	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	NYUV7UV	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Demeton-S-methyl	I 1I UWNUW	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Monocrotophos	N Y7UYYU9	Y.0	^g/L	<Y.0	<Y.0	<Y.0	<Y.0	<Y.0
Dimethoate	NOUk1Uk	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Diazinon	777U91Uk	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Chlorpyrifos-methyl	kkI WU17U0	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Parathion-methyl	YI WU00U0	Y.0	^g/L	<Y.0	<Y.0	<Y.0	<Y.0	<Y.0
Malathion	1Y1UVkUk	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Fenthion	kkU7WU	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Chlorpyrifos	YI Y1UWWY	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Parathion	kNU7WUY	Y.0	^g/L	<Y.0	<Y.0	<Y.0	<Y.0	<Y.0
Pirimphos-ethyl	Y7k0kU91UI	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Chlorfenvinphos	9V0UI 0UN	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Bromophos-ethyl	9WY9UWWUN	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Fenamiphos	YYYY9UI YUN	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Prothiofos	79N97U9NU9	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Ethion	kN7UI YUY	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Carbophenothion	WWNUI I UN	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
Azinphos Methyl	WNUk0U0	0.k	^g/L	<0.k	<0.k	<0.k	<0.k	<0.k
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	I 1UY0U7	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	Y0WU NUW	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	W7U7YU	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	WNUV7UV	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	VkU01UW	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	1Y0UI YUV	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	Y0NU99U0	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	1YI U00U0	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	kNUkkU7	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	Y1WU01U	1.0	^g/L	<1.0	<1.0	<1.0	<1.0	<1.0

Analytical Results

SubU5 atri) : ASLP LEACHATE (5 atri) : WATER)			Client sample ID	12950-Lucas Heights	12950-Hawkesbury	12950-South Creek	12950-Disturbed Terrain	12950-BR1
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
Compound	CAS Number	LOR	Unit	ES1728988-006	ES1728988-007	ES1728988-008	ES1728988-009	ES1728988-010
				3 esult	3 esult	3 esult	3 esult	3 esult
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benzo(b+j)fluoranthene	Y0kUI I UY Y0kUYYU7	1.0	^gIL	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	Y0VU0WU	1.0	^gIL	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	k0U7YUW	0.k	^gIL	<0.k	<0.k	<0.k	<0.k	<0.k
Indeno(1.2.3.cd)pyrene	1I 7U7I Uk	1.0	^gIL	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	k7UV0U7	1.0	^gIL	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	1I 1UY9UY	1.0	^gIL	<1.0	<1.0	<1.0	<1.0	<1.0
µ Sum of polycyclic aromatic hydrocarbons	UUUU	0.k	^gIL	<0.k	<0.k	<0.k	<0.k	<0.k
µ Benzo(a)pyrene TEQ (zero)	UUUU	0.k	^gIL	<0.k	<0.k	<0.k	<0.k	<0.k
EP080/071: Total Petroleum Hydrocarbons								
C10 - C14 Fraction	UUUU	k0	^gIL	<k0	<k0	<k0	<k0	<k0
C15 - C28 Fraction	UUUU	100	^gIL	<100	<100	<100	<100	<100
C29 - C36 Fraction	UUUU	k0	^gIL	<k0	<k0	<k0	<k0	<k0
µ C10 - C36 Fraction (sum)	UUUU	k0	^gIL	<k0	<k0	<k0	<k0	<k0
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	UUUU	100	^gIL	<100	<100	<100	<100	<100
>C16 - C34 Fraction	UUUU	100	^gIL	<100	<100	<100	<100	<100
>C34 - C40 Fraction	UUUU	100	^gIL	<100	<100	<100	<100	<100
µ >C10 - C40 Fraction (sum)	UUUU	100	^gIL	<100	<100	<100	<100	<100
µ >C10 - C16 Fraction minus Naphthalene (F2)	UUUU	100	^gIL	<100	<100	<100	<100	<100
MW006: Faecal Coliforms & E.coli by MF								
Escherichia coli	UUUU	1	CK, h100mL	<1	<1	<Y	<1	<1
MW007: Coliforms by MF								
Coliforms	UUUU	1	CK, h100mL	<1	<1	~<2	~<1	~3
EP066S: PCB Surrogate								
Decachlorobiphenyl	Y0k1UY9U7	1	_	109	103	106	92.5	95.4
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	Y1NkkU7UY	0.k	_	120	116	117	102	104
EP068T: Organophosphorus Pesticide Surrogate								
DEF	VW9WUW	0.k	_	102	100	110	87.4	91.4
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	171YVUWW7	1.0	_	23.4	21.9	29.0	19.3	17.3
2-Chlorophenol-D4	I 7I k1UV7UN	1.0	_	51.4	57.6	60.6	50.8	56.4

Analytical Results

SubU5 atri) : ASLP LEACHATE (5 atri) : WATER)			Client sample ID	12950-Lucas Heights	12950-Hawkesbury	12950-South Creek	12950-Disturbed Terrain	12950-BR1
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
Compound	CAS Number	LOR	Unit	ES1728988-006	ES1728988-007	ES1728988-008	ES1728988-009	ES1728988-010
				3 esult	3 esult	3 esult	3 esult	3 esult
EP075(SIM)S: Phenolic Compound Surrogates - Continued								
2.4.6-Tribromophenol	11WUVI UN	1.0	_	67.6	65.0	83.8	49.4	63.1
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	7Y1UN0UW	1.0	_	84.5	82.1	90.1	65.8	60.3
Anthracene-d10	1V1I U0NUW	1.0	_	87.8	87.2	76.7	93.3	93.5
4-Terphenyl-d14	1V1WUk1U0	1.0	_	81.3	80.0	86.9	72.0	73.9

Analytical Results

SubU5 atri) : ASLP ZHE LEACHATE (5 atri) : WATER)			Client sample ID	12950-Tuggerah	12950-Faulconbridge	12950-Blacktown	12950-Ashfield	12950-Glenorie
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
Compound	CAS Number	LOR	Unit	ES1728988-001	ES1728988-002	ES1728988-003	ES1728988-004	ES1728988-005
				3 esult	3 esult	3 esult	3 esult	3 esult
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	UUUU	Y0	^g!L	<Y0	<Y0	<Y0	<Y0	<Y0
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	CNXC10	Y0	^g!L	<Y0	<Y0	<Y0	<Y0	<Y0
µ C6 - C10 Fraction minus BTEX (F1)	CNXC10U-TE%	Y0	^g!L	<Y0	<Y0	<Y0	<Y0	<Y0
EP080: BTEXN								
Benzene	V1U97UY	1	^g!L	<1	<1	<1	<1	<1
Toluene	10WWWU7	Y	^g!L	<Y	<Y	<Y	<Y	<Y
Ethylbenzene	100U91U9	Y	^g!L	<Y	<Y	<Y	<Y	<Y
meta- & para-Xylene	10WU7WU7 10NU9YU7	Y	^g!L	<Y	<Y	<Y	<Y	<Y
ortho-Xylene	I kU9VUN	Y	^g!L	<Y	<Y	<Y	<Y	<Y
µ Total Xylenes	1770UY0UV	Y	^g!L	<Y	<Y	<Y	<Y	<Y
µ Sum of BTEX	UUUU	1	^g!L	<1	<1	<1	<1	<1
Naphthalene	I 1UY0U7	k	^g!L	<k	<k	<k	<k	<k
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	1V0N0U0VU0	Y	_	94.9	85.9	108	107	106
Toluene-D8	Y07VUYNUk	Y	_	108	96.8	99.4	96.2	98.7
4-Bromofluorobenzene	9N0U00U9	Y	_	104	95.0	98.2	93.0	97.1

Analytical Results

SubU5 atri) : ASLP ZHE LEACHATE
(5 atri) : WATER)

Compound	CAS Number	LOR	Unit	12950-Lucas Heights	12950-Hawkesbury	12950-South Creek	12950-Disturbed Terrain	12950-BR1
Client sampling date / time				1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
				ES1728988-006	ES1728988-007	ES1728988-008	ES1728988-009	ES1728988-010
				3 esult	3 esult	3 esult	3 esult	3 esult
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	UUU	Y0	^g/L	<Y0	<Y0	<Y0	<Y0	<Y0
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	CNXC10	Y0	^g/L	<Y0	<Y0	<Y0	<Y0	<Y0
µ C6 - C10 Fraction minus BTEX (F1)	CNXC10U-TE%	Y0	^g/L	<Y0	<Y0	<Y0	<Y0	<Y0
EP080: BTEXN								
Benzene	V1U97UY	1	^g/L	<1	<1	<1	<1	<1
Toluene	10WWWU7	Y	^g/L	<Y	<Y	<Y	<Y	<Y
Ethylbenzene	100U91U9	Y	^g/L	<Y	<Y	<Y	<Y	<Y
meta- & para-Xylene	10WU7WU7 10NU9YU7	Y	^g/L	<Y	<Y	<Y	<Y	<Y
ortho-Xylene	I kU9VUN	Y	^g/L	<Y	<Y	<Y	<Y	<Y
µ Total Xylenes	1770UY0UV	Y	^g/L	<Y	<Y	<Y	<Y	<Y
µ Sum of BTEX	UUU	1	^g/L	<1	<1	<1	<1	<1
Naphthalene	I 1UY0U7	k	^g/L	<k	<k	<k	<k	<k
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	1V0N0U0VU0	Y	_	105	106	112	119	113
Toluene-D8	Y07VUYNUk	Y	_	99.2	115	103	115	118
4-Bromofluorobenzene	9N0U00U9	Y	_	95.2	108	100	108	113

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)			Client sample ID	12950-Tuggerah DI WATER	----	----	----	----
			Client sampling date / time	1NURovUY01V 00:00	UUUU	UUUU	UUUU	UUUU
Compound	CAS Number	LOR	Unit	ES1728988-012	--------	--------	--------	--------
				3 esult	UUUU	UUUU	UUUU	UUUU
EA005P: pH by PC Titrator								
pH Value	UUUU	0.01	24 , nit	**5.93**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	UUUU	1	^S/cm	**4**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	D5 AUY10U001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	7WIYU7YUN	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	V1UkYU7	1	mg/L	<1	----	----	----	----
Total Alkalinity as CaCO3	UUUU	1	mg/L	<1	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	19V0VWI UW	1	mg/L	<1	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	1NWWU00UN	1	mg/L	<1	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	V990UV0UY	1	mg/L	<1	----	----	----	----
Magnesium	V97I U kU9	1	mg/L	<1	----	----	----	----
Sodium	V990UY7Uk	1	mg/L	<1	----	----	----	----
Potassium	V990U0I UV	1	mg/L	<1	----	----	----	----
EG020W: Water Leachable Metals by ICP-MS								
Arsenic	V990U7WUY	0.001	mg/L	<0.001	----	----	----	----
Cadmium	V990U97U	0.0001	mg/L	**0.0003**	----	----	----	----
Chromium	V990U9VU7	0.001	mg/L	**0.015**	----	----	----	----
Copper	V990Uk0UW	0.001	mg/L	**0.003**	----	----	----	----
Lead	V97I U YUI	0.001	mg/L	**0.002**	----	----	----	----
Nickel	V990U0YU0	0.001	mg/L	**0.006**	----	----	----	----
Zinc	V990UNUN	0.00k	mg/L	**0.528**	----	----	----	----
EG035W: Water Leachable Mercury by FIMS								
Mercury	V97I U VUN	0.0001	mg/L	<0.0001	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	VNN9U91UV	0.01	mg/L	<0.01	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	19VI VUNkU0	0.01	mg/L	<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	19VI VUkkUW	0.01	mg/L	<0.01	----	----	----	----

Analytical Results

Sub(5 atri) : DI WATER LEACHATE (5 atri) : WATER)			Client sample ID	12950-Tuggerah DI WATER	----	----	----	----
			Client sampling date / time	1NURovUY01V 00:00	ШШШ	ШШШ	ШШШ	ШШШ
Compound	CAS Number	LOR	Unit	ES1728988-012	--------	--------	--------	--------
				3 esult	ШШШ	ШШШ	ШШШ	ШШШ
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	ШШШ	0.01	mg/L	<0.01	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	ШШШ	0.1	mg/L	**0.4**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
µ Total Nitrogen as N	ШШШ	0.1	mg/L	**0.4**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	ШШШ	0.01	mg/L	**0.02**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	19YNkU99UY	0.01	mg/L	**0.03**	----	----	----	----
EN055: Ionic Balance								
Total Anions	ШШШ	0.01	meq/L	<0.01	----	----	----	----
Total Cations	ШШШ	0.01	meq/L	<0.01	----	----	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	ШШШ	1	^g/L	<1	----	----	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	71I UY9UN	0.k	^g/L	<0.k	----	----	----	----
Hexachlorobenzene (HCB)	11WUY9U1	0.k	^g/L	<0.k	----	----	----	----
beta-BHC	71I UYkUV	0.k	^g/L	<0.k	----	----	----	----
gamma-BHC	kVWW U	0.k	^g/L	<0.k	----	----	----	----
delta-BHC	71I UYNUV	0.k	^g/L	<0.k	----	----	----	----
Heptachlor	VNU99UV	0.k	^g/L	<0.k	----	----	----	----
Aldrin	70I U00UY	0.k	^g/L	<0.k	----	----	----	----
Heptachlor epoxide	10Y9UkVU7	0.k	^g/L	<0.k	----	----	----	----
trans-Chlordane	k107UY9UY	0.k	^g/L	<0.k	----	----	----	----
alpha-Endosulfan	I kI U WUV	0.k	^g/L	<0.k	----	----	----	----
cis-Chlordane	k107UY1U	0.k	^g/L	<0.k	----	----	----	----
Dieldrin	N0UkVU1	0.k	^g/L	<0.k	----	----	----	----
4.4`-DDE	VYUkkU	0.k	^g/L	<0.k	----	----	----	----
Endrin	VYUY0UV	0.k	^g/L	<0.k	----	----	----	----
beta-Endosulfan	77Y17UNkU	0.k	^g/L	<0.k	----	----	----	----
4.4`-DDD	VYUk9UV	0.k	^g/L	<0.k	----	----	----	----
Endrin aldehyde	V9Y1U 7U9	0.k	^g/L	<0.k	----	----	----	----
Endosulfan sulfate	1071U0VUV	0.k	^g/L	<0.k	----	----	----	----
4.4`-DDT	k0UY1 U7	Y.0	^g/L	<Y.0	----	----	----	----

Analytical Results

Sub(5 atri) : DI WATER LEACHATE
(5 atri) : WATER)

Compound	CAS Number	LOR	Unit	12950-Tuggerah DI WATER	----	----	----	----
			Client sampling date / time	1NURovUY01V 00:00	UUUU	UUUU	UUUU	UUUU
				ES1728988-012	--------	--------	--------	--------
				3 esult	UUUU	UUUU	UUUU	UUUU
EP068A: Organochlorine Pesticides (OC) - Continued								
Endrin ketone	k79l 9UY0Uk	0.k	^g/L	<0.k	----	----	----	----
Methoxychlor	VYU97Uk	Y.0	^g/L	<Y.0	----	----	----	----
µ Total Chlordane (sum)	UUUU	0.k	^g/L	<0.k	----	----	----	----
µ Sum of DDD + DDE + DDT	VYUk9UWVYUkkUl k 0UY	0.k	^g/L	<0.k	----	----	----	----
µ Sum of Aldrin + Dieldrin	70l U00UYhN0UkVUl	0.k	^g/L	<0.k	----	----	----	----
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	NYUV7UV	0.k	^g/L	<0.k	----	----	----	----
Demeton-S-methyl	l 1l UWNUV	0.k	^g/L	<0.k	----	----	----	----
Monocrotophos	Nl Y7UYYU9	Y.0	^g/L	<Y.0	----	----	----	----
Dimethoate	N0Uk1Uk	0.k	^g/L	<0.k	----	----	----	----
Diazinon	777U91Uk	0.k	^g/L	<0.k	----	----	----	----
Chlorpyrifos-methyl	kkl WU17U0	0.k	^g/L	<0.k	----	----	----	----
Parathion-methyl	Yl WU00U0	Y.0	^g/L	<Y.0	----	----	----	----
Malathion	1Y1UVkUk	0.k	^g/L	<0.k	----	----	----	----
Fenthion	kkU7WU	0.k	^g/L	<0.k	----	----	----	----
Chlorpyrifos	Yl Y1UWWUY	0.k	^g/L	<0.k	----	----	----	----
Parathion	kNU7WUY	Y.0	^g/L	<Y.0	----	----	----	----
Pirimphos-ethyl	Y7k0kU91Ul	0.k	^g/L	<0.k	----	----	----	----
Chlorfenvinphos	9V0Ul 0UN	0.k	^g/L	<0.k	----	----	----	----
Bromophos-ethyl	9WY9UWWUN	0.k	^g/L	<0.k	----	----	----	----
Fenamiphos	YYYY9Ul YUN	0.k	^g/L	<0.k	----	----	----	----
Prothiofos	79N97U9NU9	0.k	^g/L	<0.k	----	----	----	----
Ethion	kN7Ul YUY	0.k	^g/L	<0.k	----	----	----	----
Carbophenothion	VWNUl l UN	0.k	^g/L	<0.k	----	----	----	----
Azinphos Methyl	VWNUk0U0	0.k	^g/L	<0.k	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	l 1UY0U7	1.0	^g/L	<1.0	----	----	----	----
Acenaphthylene	Y0WUl NUV	1.0	^g/L	<1.0	----	----	----	----
Acenaphthene	W7U7YU	1.0	^g/L	<1.0	----	----	----	----
Fluorene	WNUV7UV	1.0	^g/L	<1.0	----	----	----	----
Phenanthrene	WkU01UV	1.0	^g/L	<1.0	----	----	----	----
Anthracene	1Y0UlYUV	1.0	^g/L	<1.0	----	----	----	----
Fluoranthene	Y0NU99U0	1.0	^g/L	<1.0	----	----	----	----

Analytical Results

SubU5 atri) : **DI WATER LEACHATE**
(5 atri) : **WATER)**

Compound	CAS Number	LOR	Unit	12950-Tuggerah DI WATER	----	----	----	----
			Client sampling date / time	1NURovUY01V 00:00	UUUU	UUUU	UUUU	UUUU
				ES1728988-012	--------	--------	--------	--------
				3 esult	UUUU	UUUU	UUUU	UUUU
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Pyrene	1YI U0U0	1.0	^g/L	<1.0	----	----	----	----
Benz(a)anthracene	kNUkkU7	1.0	^g/L	<1.0	----	----	----	----
Chrysene	Y1WU01U	1.0	^g/L	<1.0	----	----	----	----
Benzo(b+j)fluoranthene	Y0kUI I UY Y0kUWYU7	1.0	^g/L	<1.0	----	----	----	----
Benzo(k)fluoranthene	Y0VU0WU	1.0	^g/L	<1.0	----	----	----	----
Benzo(a)pyrene	k0U7YUW	0.k	^g/L	<0.k	----	----	----	----
Indeno(1.2.3.cd)pyrene	1I 7U7I Uk	1.0	^g/L	<1.0	----	----	----	----
Dibenz(a.h)anthracene	k7UW0U7	1.0	^g/L	<1.0	----	----	----	----
Benzo(g.h.i)perylene	1I 1UY9UY	1.0	^g/L	<1.0	----	----	----	----
µ Sum of polycyclic aromatic hydrocarbons	UUUU	0.k	^g/L	<0.k	----	----	----	----
µ Benzo(a)pyrene TEQ (zero)	UUUU	0.k	^g/L	<0.k	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C10 - C14 Fraction	UUUU	k0	^g/L	<k0	----	----	----	----
C15 - C28 Fraction	UUUU	100	^g/L	<100	----	----	----	----
C29 - C36 Fraction	UUUU	k0	^g/L	<k0	----	----	----	----
µ C10 - C36 Fraction (sum)	UUUU	k0	^g/L	<k0	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	UUUU	100	^g/L	<100	----	----	----	----
>C16 - C34 Fraction	UUUU	100	^g/L	<100	----	----	----	----
>C34 - C40 Fraction	UUUU	100	^g/L	<100	----	----	----	----
µ >C10 - C40 Fraction (sum)	UUUU	100	^g/L	<100	----	----	----	----
µ >C10 - C16 Fraction minus Naphthalene (F2)	UUUU	100	^g/L	<100	----	----	----	----
MW006: Faecal Coliforms & E.coli by MF								
Escherichia coli	UUUU	1	CK, I100mL	<Y	----	----	----	----
MW007: Coliforms by MF								
Coliforms	UUUU	1	CK, I100mL	**~32**	----	----	----	----
EP066S: PCB Surrogate								
Decachlorobiphenyl	Y0k1UY9U7	1	_	**104**	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	Y1NkkU7UY	0.k	_	**104**	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	WU9WUW	0.k	_	**95.4**	----	----	----	----

Analytical Results

Sub(5 atri) : DI WATER LEACHATE
(5 atri) : WATER)

			Client sample ID	12950-Tuggerah DI WATER	----	----	----	----
			Client sampling date / time	1NURovUY01V 00:00	UUUU	UUUU	UUUU	UUUU
Compound	CAS Number	LOR	Unit	ES1728988-012	--------	--------	--------	--------
				3 esult	UUUU	UUUU	UUUU	UUUU
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	171YVUWW7	1.0	_	**21.1**	----	----	----	----
2-Chlorophenol-D4	I 7I k1UY7UN	1.0	_	**61.1**	----	----	----	----
2.4.6-Tribromophenol	11WUVI UN	1.0	_	**52.2**	----	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	7Y1UN0UW	1.0	_	**65.7**	----	----	----	----
Anthracene-d10	1V1I U0NUW	1.0	_	**95.5**	----	----	----	----
4-Terphenyl-d14	1V1WUk1U0	1.0	_	**77.7**	----	----	----	----

Analytical Results

SubU5 atri) : SOIL (5 atri) : SOIL)			Client sample ID	12950-Tuggerah	12950-Faulconbridge	12950-Blacktown	12950-Ashfield	12950-Glenorie
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
Compound	CAS Number	LOR	Unit	ES1728988-001	ES1728988-002	ES1728988-003	ES1728988-004	ES1728988-005
				3 esult	3 esult	3 esult	3 esult	3 esult
EA002 : pH (Soils)								
pH Value	UUUU	0.1	24 , nit	6.1	5.8	5.7	5.3	4.9
EA010: Conductivity								
Electrical Conductivity @ 25°C	UUUU	1	^Shcm	13	14	224	29	53
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	UUUU	1.0	_	2.0	3.1	23.4	8.8	15.9
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	19V0WVI UV	10	mghg	<10	<10	210	10	50
ED045G: Chloride by Discrete Analyser								
Chloride	1NVWV00UN	10	mghg	<10	<10	210	20	<10
ED093S: Soluble Major Cations								
Calcium	V990UV0UY	10	mghg	<10	<10	<10	<10	<10
Magnesium	V97I U kU9	10	mghg	<10	<10	30	<10	<10
Sodium	V990UY7Uk	10	mghg	<10	<10	240	20	20
Potassium	V990U0I UV	10	mghg	<10	10	40	10	<10
EG005T: Total Metals by ICP-AES								
Arsenic	V990U7WUY	k	mghg	<k	<k	11	8	18
Cadmium	V990U97U	1	mghg	<1	<1	<1	<1	<1
Chromium	V990U9VU7	Y	mghg	<Y	8	17	4	23
Copper	V990Uk0UW	k	mghg	<k	5	32	13	18
Lead	V97I U YUI	k	mghg	<k	24	19	15	21
Nickel	V990U0YU0	Y	mghg	<Y	<Y	10	<Y	<Y
Zinc	V990UNNUN	k	mghg	9	18	43	<k	6
EG035T: Total Recoverable Mercury by FIMS								
Mercury	V97I U VUN	0.1	mghg	<0.1	<0.1	<0.1	<0.1	<0.1
EN60: ASLP Leaching Procedure								
Final pH	UUUU	0.1	24 , nit	7.4	6.8	7.3	6.7	5.4
EN60Z: ASLP Leachate - ZHE								
Extraction Fluid pH	UUUU	0.1	24 , nit	7.4	6.8	7.3	6.7	5.4
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	UUUU	0.1	mghg	<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	71I UI9UN	0.0k	mghg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Hexachlorobenzene (HCB)	11VWU9UI	0.0k	mghg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k

Analytical Results

Sub|5 atri) : SOIL (5 atri) : SOIL)			Client sample ID	12950-Tuggerah	12950-Faulconbridge	12950-Blacktown	12950-Ashfield	12950-Glenorie
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
Compound	CAS Number	LOR	Unit	ES1728988-001	ES1728988-002	ES1728988-003	ES1728988-004	ES1728988-005
				3 esult	3 esult	3 esult	3 esult	3 esult
EP068A: Organochlorine Pesticides (OC) - Continued								
beta-BHC	71I UWkUV	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
gamma-BHC	kVWW U	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
delta-BHC	71I UWNUW	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Heptachlor	VNU99UW	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Aldrin	70I U00UY	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Heptachlor epoxide	10Y9UkVU7	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
µ Total Chlordane (sum)	UUUU	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
trans-Chlordane	k107UV9UY	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
alpha-Endosulfan	I kI U WWV	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
cis-Chlordane	k107UV1U	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Dieldrin	N0UkVU1	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
4.4`-DDE	VYUkkU	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Endrin	VYUY0UW	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
beta-Endosulfan	77Y17UNkU	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
µ Endosulfan (sum)	11kUYI UV	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
4.4`-DDD	VYUk9UW	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Endrin aldehyde	V9Y1U 7U9	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Endosulfan sulfate	1071U0VUW	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
4.4`-DDT	k0UYI U7	0.Y	mg/kg	<0.Y	<0.Y	<0.Y	<0.Y	<0.Y
Endrin ketone	k79I 9UV0Uk	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Methoxychlor	VYU97Uk	0.Y	mg/kg	<0.Y	<0.Y	<0.Y	<0.Y	<0.Y
µ Sum of Aldrin + Dieldrin	70I U00UYHN0UkVU1	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
µ Sum of DDD + DDE + DDT	VYUk9UWHVYUkkUHk 0UY	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	NYUV7UV	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Demeton-S-methyl	I 1I UWNUW	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Monocrotophos	NI Y7UYYU9	0.Y	mg/kg	<0.Y	<0.Y	<0.Y	<0.Y	<0.Y
Dimethoate	N0Uk1Uk	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Diazinon	777U91Uk	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Chlorpyrifos-methyl	kkI WU17U0	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Parathion-methyl	YI WU00U0	0.Y	mg/kg	<0.Y	<0.Y	<0.Y	<0.Y	<0.Y
Malathion	1Y1UVkUk	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Fenthion	kkU7WU	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Chlorpyrifos	YI Y1UWWY	0.0k	mg/kg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k

Analytical Results

SubU5 atri) : SOIL (5 atri) : SOIL)			Client sample ID	12950-Tuggerah	12950-Faulconbridge	12950-Blacktown	12950-Ashfield	12950-Glenorie
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
Compound	CAS Number	LOR	Unit	ES1728988-001	ES1728988-002	ES1728988-003	ES1728988-004	ES1728988-005
				3 esult	3 esult	3 esult	3 esult	3 esult
EP068B: Organophosphorus Pesticides (OP) - Continued								
Parathion	kNU7WUY	0.Y	mgħg	<0.Y	<0.Y	<0.Y	<0.Y	<0.Y
Pirimphos-ethyl	Y7k0kU91U	0.0k	mgħg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Chlorfenvinphos	9V0U 0UN	0.0k	mgħg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Bromophos-ethyl	9VY9UVWUN	0.0k	mgħg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Fenamiphos	YYYY9U YUN	0.0k	mgħg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Prothiofos	79N97U9NU9	0.0k	mgħg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Ethion	kN7UYUY	0.0k	mgħg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Carbophenothion	VWNUI UN	0.0k	mgħg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Azinphos Methyl	VWUk0U0	0.0k	mgħg	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
EP071 SG: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Silica gel cleanup								
>C10 - C16 Fraction	UUU	k0	mgħg	<k0	<k0	<k0	<k0	<k0
>C16 - C34 Fraction	UUU	100	mgħg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	UUU	100	mgħg	<100	<100	<100	<100	<100
µ **>C10 - C40 Fraction (sum)**	UUU	k0	mgħg	<k0	<k0	<k0	<k0	<k0
µ **>C10 - C16 Fraction minus Naphthalene (F2)**	UUU	k0	mgħg	<k0	<k0	<k0	<k0	<k0
EP071 SG-S: Total Petroleum Hydrocarbons in Soil - Silica gel cleanup								
C10 - C14 Fraction	UUU	k0	mgħg	<k0	<k0	<k0	<k0	<k0
C15 - C28 Fraction	UUU	100	mgħg	<100	<100	<100	<100	<100
C29 - C36 Fraction	UUU	100	mgħg	<100	<100	<100	<100	<100
µ **C10 - C36 Fraction (sum)**	UUU	k0	mgħg	<k0	<k0	<k0	<k0	<k0
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	I 1UY0U7	0.k	mgħg	<0.k	<0.k	<0.k	<0.k	<0.k
Acenaphthylene	Y0WU NUV	0.k	mgħg	<0.k	<0.k	<0.k	<0.k	<0.k
Acenaphthene	W7U7YU	0.k	mgħg	<0.k	<0.k	<0.k	<0.k	<0.k
Fluorene	WNUY7UY	0.k	mgħg	<0.k	<0.k	<0.k	<0.k	<0.k
Phenanthrene	WkU01UV	0.k	mgħg	<0.k	<0.k	<0.k	<0.k	<0.k
Anthracene	1Y0UI YUY	0.k	mgħg	<0.k	<0.k	<0.k	<0.k	<0.k
Fluoranthene	Y0NU99U0	0.k	mgħg	<0.k	<0.k	<0.k	<0.k	<0.k
Pyrene	1YI U00U0	0.k	mgħg	<0.k	<0.k	<0.k	<0.k	<0.k
Benz(a)anthracene	kNUkkU7	0.k	mgħg	<0.k	<0.k	<0.k	<0.k	<0.k
Chrysene	Y1WU01U	0.k	mgħg	<0.k	<0.k	<0.k	<0.k	<0.k
Benzo(b+j)fluoranthene	Y0kUI I UY Y0kUWYU7	0.k	mgħg	<0.k	<0.k	<0.k	<0.k	<0.k
Benzo(k)fluoranthene	Y0VU0WU	0.k	mgħg	<0.k	<0.k	<0.k	<0.k	<0.k

Analytical Results

Sub5 atri) : SOIL (5 atri) : SOIL)			Client sample ID	12950-Tuggerah	12950-Faulconbridge	12950-Blacktown	12950-Ashfield	12950-Glenorie
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
Compound	CAS Number	LOR	Unit	ES1728988-001	ES1728988-002	ES1728988-003	ES1728988-004	ES1728988-005
				3 esult	3 esult	3 esult	3 esult	3 esult
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benzo(a)pyrene	k0U7YUW	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Indeno(1.2.3.cd)pyrene	1I 7U7I Uk	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Dibenz(a.h)anthracene	k7UV0U7	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Benzo(g.h.i)perylene	1I 1UY9UY	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
µ Sum of polycyclic aromatic hydrocarbons	ШШ	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
µ Benzo(a)pyrene TEQ (zero)	ШШ	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
µ Benzo(a)pyrene TEQ (half LOR)	ШШ	0.k	mgh g	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**
µ Benzo(a)pyrene TEQ (LOR)	ШШ	0.k	mgh g	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	ШШ	10	mgh g	<10	<10	<10	<10	<10
C10 - C14 Fraction	ШШ	k0	mgh g	<k0	<k0	<k0	<k0	<k0
C15 - C28 Fraction	ШШ	100	mgh g	<100	<100	<100	<100	<100
C29 - C36 Fraction	ШШ	100	mgh g	<100	<100	<100	<100	<100
µ C10 - C36 Fraction (sum)	ШШ	k0	mgh g	<k0	<k0	<k0	<k0	<k0
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	CNXC10	10	mgh g	<10	<10	<10	<10	<10
µ C6 - C10 Fraction minus BTEX (F1)	CNXC10U-TE%	10	mgh g	<10	<10	<10	<10	<10
>C10 - C16 Fraction	ШШ	k0	mgh g	<k0	<k0	<k0	<k0	<k0
>C16 - C34 Fraction	ШШ	100	mgh g	<100	<100	<100	<100	<100
>C34 - C40 Fraction	ШШ	100	mgh g	<100	<100	<100	<100	<100
µ >C10 - C40 Fraction (sum)	ШШ	k0	mgh g	<k0	<k0	<k0	<k0	<k0
µ >C10 - C16 Fraction minus Naphthalene (F2)	ШШ	k0	mgh g	<k0	<k0	<k0	<k0	<k0
EP080: BTEXN								
Benzene	V1U97UY	0.Y	mgh g	<0.Y	<0.Y	<0.Y	<0.Y	<0.Y
Toluene	10WWW7	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Ethylbenzene	100U91U9	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
meta- & para-Xylene	10W7W7 10NU9YU7	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
ortho-Xylene	I kU9VUN	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
µ Sum of BTEX	ШШ	0.Y	mgh g	<0.Y	<0.Y	<0.Y	<0.Y	<0.Y
µ Total Xylenes	1770UY0UV	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Naphthalene	I 1UY0U7	1	mgh g	<1	<1	<1	<1	<1
EP066S: PCB Surrogate								

Analytical Results

Sub(5 atri) : SOIL (5 atri) : SOIL)			Client sample ID	12950-Tuggerah	12950-Faulconbridge	12950-Blacktown	12950-Ashfield	12950-Glenorie
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
Compound	CAS Number	LOR	Unit	ES1728988-001	ES1728988-002	ES1728988-003	ES1728988-004	ES1728988-005
				3 esult	3 esult	3 esult	3 esult	3 esult
EP066S: PCB Surrogate - Continued								
Decachlorobiphenyl	Y0k1UY9U7	0.1	_	114	102	86.2	120	119
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	Y1NkkUY7UY	0.0k	_	98.5	85.5	76.2	91.0	89.7
EP068T: Organophosphorus Pesticide Surrogate								
DEF	VWU9WUV	0.0k	_	90.9	78.4	70.1	62.0	65.1
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	171YVUWW7	0.k	_	79.0	79.2	75.6	80.3	75.8
2-Chlorophenol-D4	I 7I k1UY7UN	0.k	_	82.6	81.0	73.0	82.0	81.7
2.4.6-Tribromophenol	11WUVI UN	0.k	_	49.9	77.9	68.9	66.3	65.4
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	7Y1UN0UW	0.k	_	93.4	90.8	86.1	91.9	91.8
Anthracene-d10	1V1I U0NUW	0.k	_	96.4	92.5	91.5	95.2	96.0
4-Terphenyl-d14	1V1WUk1U0	0.k	_	90.4	87.7	85.9	89.2	90.9
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	1V0N0U0VU0	0.Y	_	114	97.8	103	107	103
Toluene-D8	Y07VUYNUk	0.Y	_	116	96.7	102	116	99.4
4-Bromofluorobenzene	9N0U00U9	0.Y	_	110	91.3	97.3	108	93.8

Analytical Results

SubU5 atri) : SOIL
(5 atri) : SOIL)

Compound	CAS Number	LOR	Unit	12950-Lucas Heights	12950-Hawkesbury	12950-South Creek	12950-Disturbed Terrain	12950-BR1
Client sampling date / time				1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
				ES1728988-006	ES1728988-007	ES1728988-008	ES1728988-009	ES1728988-010
				3 esult	3 esult	3 esult	3 esult	3 esult
EA002 : pH (Soils)								
pH Value	UUUU	0.1	24 , nit	4.7	5.8	5.6	6.3	7.3
EA010: Conductivity								
Electrical Conductivity @ 25°C	UUUU	1	^Shcm	43	33	712	21	15
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	UUUU	1.0	_	13.0	2.0	17.6	6.2	2.4
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	19V0VWI UW	10	mgh g	40	40	200	<10	<10
ED045G: Chloride by Discrete Analyser								
Chloride	1NVWU00UN	10	mgh g	<10	<10	1180	<10	<10
ED093S: Soluble Major Cations								
Calcium	V990UV0UY	10	mgh g	<10	<10	<10	<10	<10
Magnesium	V97I U kU9	10	mgh g	<10	<10	20	<10	<10
Sodium	V990UY7Uk	10	mgh g	20	20	770	<10	<10
Potassium	V990U0I UV	10	mgh g	10	<10	<10	<10	<10
EG005T: Total Metals by ICP-AES								
Arsenic	V990U7WUY	k	mgh g	7	<k	13	<k	<k
Cadmium	V990U97U	1	mgh g	<1	<1	<1	<1	<1
Chromium	V990U9VU7	Y	mgh g	14	7	28	<Y	<Y
Copper	V990Uk0UW	k	mgh g	<k	6	28	<k	<k
Lead	V97I U YUI	k	mgh g	24	16	17	<k	<k
Nickel	V990U0YU0	Y	mgh g	2	<Y	7	3	<Y
Zinc	V990UNNUN	k	mgh g	<k	<k	23	<k	9
EG035T: Total Recoverable Mercury by FIMS								
Mercury	V97I U VUN	0.1	mgh g	<0.1	<0.1	<0.1	<0.1	<0.1
EN60: ASLP Leaching Procedure								
Final pH	UUUU	0.1	24 , nit	6.4	6.3	7.1	7.1	7.5
EN60Z: ASLP Leachate - ZHE								
Extraction Fluid pH	UUUU	0.1	24 , nit	6.4	6.3	7.1	7.1	7.5
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	UUUU	0.1	mgh g	<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	71I UV9UN	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Hexachlorobenzene (HCB)	11VUV9UI	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k

Analytical Results

SubU5 atri) : SOIL (5 atri) : SOIL)			Client sample ID	12950-Lucas Heights	12950-Hawkesbury	12950-South Creek	12950-Disturbed Terrain	12950-BR1
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
Compound	CAS Number	LOR	Unit	ES1728988-006	ES1728988-007	ES1728988-008	ES1728988-009	ES1728988-010
				3 esult	3 esult	3 esult	3 esult	3 esult
EP068A: Organochlorine Pesticides (OC) - Continued								
beta-BHC	71I UWkUV	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
gamma-BHC	kWWW U	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
delta-BHC	71I UWNUV	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Heptachlor	VNU99UW	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Aldrin	70I U00UY	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Heptachlor epoxide	10Y9UkVU7	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
μ Total Chlordane (sum)	UUUU	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
trans-Chlordane	k107UV9UY	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
alpha-Endosulfan	I kI U WUV	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
cis-Chlordane	k107UV1U	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Dieldrin	N0UkVU1	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
4.4`-DDE	VYUkkU	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Endrin	VYUY0UW	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
beta-Endosulfan	77Y17UNkU	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
μ Endosulfan (sum)	11kUYI UV	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
4.4`-DDD	VYUk9UW	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Endrin aldehyde	V9Y1U 7U9	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Endosulfan sulfate	1071U0VUW	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
4.4`-DDT	k0UYI U7	0.Y	mgh g	<0.Y	<0.Y	<0.Y	<0.Y	<0.Y
Endrin ketone	k79I 9UV0Uk	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Methoxychlor	VYU97Uk	0.Y	mgh g	<0.Y	<0.Y	<0.Y	<0.Y	<0.Y
μ Sum of Aldrin + Dieldrin	70I U00UYhN0UkVU1	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
μ Sum of DDD + DDE + DDT	VYUk9UWhVYUkkUhk 0UY	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	NYUV7UV	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Demeton-S-methyl	I 1I UWNUV	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Monocrotophos	N Y7UYYU9	0.Y	mgh g	<0.Y	<0.Y	<0.Y	<0.Y	<0.Y
Dimethoate	N0Uk1Uk	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Diazinon	777U91Uk	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Chlorpyrifos-methyl	kkI WU17U0	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Parathion-methyl	YI WU00U0	0.Y	mgh g	<0.Y	<0.Y	<0.Y	<0.Y	<0.Y
Malathion	1Y1UVkUk	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Fenthion	kkU7WU	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k

Analytical Results

Sub-5 atri) : SOIL
(5 atri) : SOIL)

Compound	CAS Number	LOR	Unit	12950-Lucas Heights	12950-Hawkesbury	12950-South Creek	12950-Disturbed Terrain	12950-BR1
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
			Client sample ID	ES1728988-006	ES1728988-007	ES1728988-008	ES1728988-009	ES1728988-010
				3 esult	3 esult	3 esult	3 esult	3 esult
EP068B: Organophosphorus Pesticides (OP) - Continued								
Chlorpyrifos	YI Y1UWWY	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Parathion	kNU7WY	0.Y	mgh g	<0.Y	<0.Y	<0.Y	<0.Y	<0.Y
Pirimphos-ethyl	Y7k0kU91U	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Chlorfenvinphos	9V0U 0UN	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Bromophos-ethyl	9VW9UWUN	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Fenamiphos	YYYY9U YUN	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Prothiofos	79N97U9NU9	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Ethion	kN7UI YUY	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Carbophenothion	VWNUI I UN	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
Azinphos Methyl	VNUk0U0	0.0k	mgh g	<0.0k	<0.0k	<0.0k	<0.0k	<0.0k
EP071 SG: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Silica gel cleanup								
>C10 - C16 Fraction	UUUU	k0	mgh g	<k0	<k0	<k0	<k0	<k0
>C16 - C34 Fraction	UUUU	100	mgh g	<100	<100	<100	<100	<100
>C34 - C40 Fraction	UUUU	100	mgh g	<100	<100	<100	<100	<100
µ >C10 - C40 Fraction (sum)	UUUU	k0	mgh g	<k0	<k0	<k0	<k0	<k0
µ >C10 - C16 Fraction minus Naphthalene (F2)	UUUU	k0	mgh g	<k0	<k0	<k0	<k0	<k0
EP071 SG-S: Total Petroleum Hydrocarbons in Soil - Silica gel cleanup								
C10 - C14 Fraction	UUUU	k0	mgh g	<k0	<k0	<k0	<k0	<k0
C15 - C28 Fraction	UUUU	100	mgh g	<100	<100	<100	<100	<100
C29 - C36 Fraction	UUUU	100	mgh g	<100	<100	<100	<100	<100
µ C10 - C36 Fraction (sum)	UUUU	k0	mgh g	<k0	<k0	<k0	<k0	<k0
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	I 1UY0U7	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Acenaphthylene	Y0WU NUW	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Acenaphthene	W7U7YU	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Fluorene	WNU7UV	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Phenanthrene	VkU01UW	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Anthracene	1Y0UI YUV	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Fluoranthene	Y0NU99U0	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Pyrene	1YI U00U0	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Benz(a)anthracene	kNUkkU7	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Chrysene	Y1WU01U	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Benzo(b+j)fluoranthene	Y0kUI I UY Y0kUWU7	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k

Analytical Results

Sub(5 atri) : SOIL
(5 atri) : SOIL)

Compound	CAS Number	LOR	Unit	12950-Lucas Heights	12950-Hawkesbury	12950-South Creek	12950-Disturbed Terrain	12950-BR1
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
				ES1728988-006	ES1728988-007	ES1728988-008	ES1728988-009	ES1728988-010
				3 esult	3 esult	3 esult	3 esult	3 esult
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benzo(k)fluoranthene	YOVU0WU	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Benzo(a)pyrene	k0U7YUW	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Indeno(1.2.3.cd)pyrene	1I 7U7I Uk	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Dibenz(a.h)anthracene	k7UU0U7	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Benzo(g.h.i)perylene	1I 1UY9UY	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
µ Sum of polycyclic aromatic hydrocarbons	UUUU	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
µ Benzo(a)pyrene TEQ (zero)	UUUU	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
µ Benzo(a)pyrene TEQ (half LOR)	UUUU	0.k	mgh g	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**
µ Benzo(a)pyrene TEQ (LOR)	UUUU	0.k	mgh g	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	UUUU	10	mgh g	<10	<10	<10	<10	<10
C10 - C14 Fraction	UUUU	k0	mgh g	<k0	<k0	<k0	<k0	<k0
C15 - C28 Fraction	UUUU	100	mgh g	<100	<100	<100	<100	<100
C29 - C36 Fraction	UUUU	100	mgh g	<100	<100	<100	<100	<100
µ C10 - C36 Fraction (sum)	UUUU	k0	mgh g	<k0	<k0	<k0	<k0	<k0
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	CNXC10	10	mgh g	<10	<10	<10	<10	<10
µ C6 - C10 Fraction minus BTEX (F1)	CNXC10U-TE%	10	mgh g	<10	<10	<10	<10	<10
>C10 - C16 Fraction	UUUU	k0	mgh g	<k0	<k0	<k0	<k0	<k0
>C16 - C34 Fraction	UUUU	100	mgh g	<100	<100	<100	<100	<100
>C34 - C40 Fraction	UUUU	100	mgh g	<100	<100	<100	<100	<100
µ >C10 - C40 Fraction (sum)	UUUU	k0	mgh g	<k0	<k0	<k0	<k0	<k0
µ >C10 - C16 Fraction minus Naphthalene (F2)	UUUU	k0	mgh g	<k0	<k0	<k0	<k0	<k0
EP080: BTEXN								
Benzene	V1U97UY	0.Y	mgh g	<0.Y	<0.Y	<0.Y	<0.Y	<0.Y
Toluene	10WUWU7	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Ethylbenzene	100U91U9	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
meta- & para-Xylene	10WU7WU7 10NU9YU7	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
ortho-Xylene	I kU9VUN	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
µ Sum of BTEX	UUUU	0.Y	mgh g	<0.Y	<0.Y	<0.Y	<0.Y	<0.Y
µ Total Xylenes	1770UY0UV	0.k	mgh g	<0.k	<0.k	<0.k	<0.k	<0.k
Naphthalene	I 1UY0U7	1	mgh g	<1	<1	<1	<1	<1

Analytical Results

Sub(5 atri) : SOIL
(5 atri) : SOIL)

Compound	CAS Number	LOR	Unit	12950-Lucas Heights	12950-Hawkesbury	12950-South Creek	12950-Disturbed Terrain	12950-BR1
			Client sampling date / time	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00	1NURovUY01V 00:00
				ES1728988-006	ES1728988-007	ES1728988-008	ES1728988-009	ES1728988-010
				3 esult	3 esult	3 esult	3 esult	3 esult
EP066S: PCB Surrogate								
Decachlorobiphenyl	Y0k1UY9U7	0.1	_	91.8	112	104	97.1	102
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	Y1NkkUY7UY	0.0k	_	79.7	91.7	94.5	89.5	100
EP068T: Organophosphorus Pesticide Surrogate								
DEF	VWl9WUWV	0.0k	_	63.0	78.5	68.8	62.8	62.4
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	171YVUWWU7	0.k	_	78.2	79.3	78.4	72.6	77.2
2-Chlorophenol-D4	l 7l k1UY7UN	0.k	_	83.7	81.7	77.3	77.4	81.9
2.4.6-Tribromophenol	11WUVl UN	0.k	_	62.4	65.0	60.5	49.7	33.5
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	7Y1UN0UW	0.k	_	94.2	90.6	88.7	88.2	92.5
Anthracene-d10	1V1l U0NUW	0.k	_	98.6	91.6	95.3	92.7	96.2
4-Terphenyl-d14	1V1WUk1U0	0.k	_	92.6	87.9	89.4	87.2	90.3
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	1V0N0U0VU0	0.Y	_	102	107	112	110	112
Toluene-D8	Y07VUYNUk	0.Y	_	99.3	106	112	108	118
4-Bromofluorobenzene	9N0U00U9	0.Y	_	94.1	101	105	103	107

Analytical Results

SubU5 atri) : SOIL (5 atri) : SOIL)			Client sample ID	12950-Tuggerah DI WATER	----	----	----	----
			Client sampling date / time	1NURovUY01V 00:00	UUUU	UUUU	UUUU	UUUU
Compound	CAS Number	LOR	Unit	ES1728988-012	--------	--------	--------	--------
				3 esult	UUUU	UUUU	UUUU	UUUU
EN60: Bottle Leaching Procedure								
Final pH	UUUU	0.1	24 , nit	**7.0**	----	----	----	----
EN60Z-DI: Deionised Water Leach (Zero Headspace Extraction)								
Final pH	UUUU	0.1	24 , nit	**6.5**	----	----	----	----

Analytical Results

Sub(5 atri) : ZHE LEACHATE
(5 atri) : WATER)

Compound	CAS Number	LOR	Unit	12950-Tuggerah DI WATER	----	----	----	----
Client sampling date / time				1NURovUY01V 00:00	UUU	UUU	UUU	UUU
				ES1728988-012	--------	--------	--------	--------
				3 esult	UUU	UUU	UUU	UUU
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	UUU	Y0	^g/L	<Y0	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	CNXC10	Y0	^g/L	<Y0	----	----	----	----
µ **C6 - C10 Fraction minus BTEX (F1)**	CNXC10U-TE%	Y0	^g/L	<Y0	----	----	----	----
EP080: BTEXN								
Benzene	V1U97UY	1	^g/L	<1	----	----	----	----
Toluene	10WUWW7	Y	^g/L	<Y	----	----	----	----
Ethylbenzene	100U91U9	Y	^g/L	<Y	----	----	----	----
meta- & para-Xylene	10WU7WU7 10NU9YU7	Y	^g/L	<Y	----	----	----	----
ortho-Xylene	I kU9VUN	Y	^g/L	<Y	----	----	----	----
µ **Total Xylenes**	1770UY0UV	Y	^g/L	<Y	----	----	----	----
µ **Sum of BTEX**	UUU	1	^g/L	<1	----	----	----	----
Naphthalene	I 1UY0U7	k	^g/L	<k	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	1V0N0U0VU0	Y	_	**123**	----	----	----	----
Toluene-D8	Y07VUYNUk	Y	_	**122**	----	----	----	----
4-Bromofluorobenzene	9N0U00U9	Y	_	**110**	----	----	----	----

Surrogate Control Limits

SubU5 atri) : **ASLP LEACHATE**

Compound	CAS Number	Recovery Limits (%) Low	High
EP066S: PCB Surrogate			
Decachlorobiphenyl	Y0k1UY9U7	YI	1YI
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	Y1NkkUY7UY	NV	111
EP068T: Organophosphorus Pesticide Surrogate			
DEF	VWU9WUWV	NV	111
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	171YVUWWU7	10	99
2-Chlorophenol-D4	I 7I k1UY7UN	19	I 9
2.4.6-Tribromophenol	11WUWI UN	1V	1Yk
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	7Y1UN0UWV	Y0	109
Anthracene-d10	1V1I U0NUWV	YV	117
4-Terphenyl-d14	1V1WUk1U0	7Y	11Y

SubU5 atri) : **ASLP ZHE LEACHATE**

Compound	CAS Number	Recovery Limits (%) Low	High
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	1V0N0U0VU0	V1	17V
Toluene-D8	Y07VUYNUk	VI	171
4-Bromofluorobenzene	9N0U00U9	V0	1YW

SubU5 atri) : **DI WATER LEACHATE**

Compound	CAS Number	Recovery Limits (%) Low	High
EP066S: PCB Surrogate			
Decachlorobiphenyl	Y0k1UY9U7	YI	1YI
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	Y1NkkUY7UY	NV	111
EP068T: Organophosphorus Pesticide Surrogate			
DEF	VWU9WUWV	NV	111
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	171YVUWWU7	10	99
2-Chlorophenol-D4	I 7I k1UY7UN	19	I 9
2.4.6-Tribromophenol	11WUWI UN	1V	1Yk
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	7Y1UN0UWV	Y0	109
Anthracene-d10	1V1I U0NUWV	YV	117
4-Terphenyl-d14	1V1WUk1U0	7Y	11Y

SubU5 atri) : **SOIL**

	Recovery Limits (%)

Sub𝕃5 atri) : **SOIL**

Compound	CAS Number	Recovery Limits (%) Low	High
EP066S: PCB Surrogate			
Decachlorobiphenyl	Y0k1UY9U7	7I	19I
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	Y1NkkUY7UY	9I	19V
EP068T: Organophosphorus Pesticide Surrogate			
DEF	VWU9WUWV	7k	197
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	171YVUWWU7	N7	1Y7
2-Chlorophenol-D4	I 7I k1UY7UN	NN	1YY
2.4.6-Tribromophenol	11WUVI UN	90	17W
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	7Y1UN0UWV	V0	1YY
Anthracene-d10	1V1I U0NUWV	NN	1YW
4-Terphenyl-d14	1V1WUk1U0	Nk	1YI
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	1V0N0U0VU0	V7	177
Toluene-D8	Y07VUYNUk	V9	17Y
4-Bromofluorobenzene	9N0U00U9	VY	170

Sub𝕃5 atri) : **ZHE LEACHATE**

Compound	CAS Number	Recovery Limits (%) Low	High
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	1V0N0U0VU0	V1	17V
Toluene-D8	Y07VUYNUk	VI	171
4-Bromofluorobenzene	9N0U00U9	V0	1YW

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1728721**	Page	: 1 of 8
Client	: **ADE Consulting Group Pty Ltd**	Laboratory	: Environmental Division Sydney
Contact	: INFO .	Contact	: Customer Services ES
Address	: 6/7 MILLENIUM COURT SILVERWATER NSW 2128	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 94007711	Telephone	: +61-2-8784 8555
Project	: CHL-28-12950	Date Samples Received	: 15-Nov-2017 19:25
Order number	: ----	Date Analysis Commenced	: 15-Nov-2017
C-O-C number	: ----	Issue Date	: 21-Nov-2017 18:57
Sampler	: Nicholas Bernardini		
Site	: ----		
Quote number	: EN/097/17		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ashesh Patel	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Raymond Commodore	Instrument Chemist	Sydney Inorganics, Smithfield, NSW
Tony DeSouza	Senior Microbiologist	Sydney Microbiology, Smithfield, NSW

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.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

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.
~ = Indicates an estimated value.

- MF = membrane filtration
- CFU = colony forming unit
- Microbiological Comment: In accordance with ALS work instruction QWI-MIC/04, membrane filtration result is reported an approximate (~) when the count of colonies on the filtered membrane is outside the range of 10 - 100cfu.
- MW006 is ALS's internal code and is equivalent to AS4276.7.
- MW007 is ALS's internal code and is equivalent to AS4276.5.
- 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	12950-ASLP	----	----	----	----
			Client sampling date / time	15-Nov-2017 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1728721-001	--------	--------	--------	--------
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	6.60	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	7	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	4	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	4	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	2	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	5	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
Sodium	7440-23-5	1	mg/L	4	----	----	----	----
Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.001	----	----	----	----
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	<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
EG035T: Total Recoverable 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	<0.01	----	----	----	----
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	<0.01	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	12950-ASLP	----	----	----	----
			Client sampling date / time	15-Nov-2017 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1728721-001	--------	--------	--------	--------
				Result	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.2**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**0.2**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.01	----	----	----	----
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**0.26**	----	----	----	----
Total Cations	----	0.01	meq/L	**0.17**	----	----	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	1	µg/L	<1	----	----	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.5	µg/L	<0.5	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L	<0.5	----	----	----	----
beta-BHC	319-85-7	0.5	µg/L	<0.5	----	----	----	----
gamma-BHC	58-89-9	0.5	µg/L	<0.5	----	----	----	----
delta-BHC	319-86-8	0.5	µg/L	<0.5	----	----	----	----
Heptachlor	76-44-8	0.5	µg/L	<0.5	----	----	----	----
Aldrin	309-00-2	0.5	µg/L	<0.5	----	----	----	----
Heptachlor epoxide	1024-57-3	0.5	µg/L	<0.5	----	----	----	----
trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	----	----	----	----
alpha-Endosulfan	959-98-8	0.5	µg/L	<0.5	----	----	----	----
cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	----	----	----	----
Dieldrin	60-57-1	0.5	µg/L	<0.5	----	----	----	----
4.4`-DDE	72-55-9	0.5	µg/L	<0.5	----	----	----	----
Endrin	72-20-8	0.5	µg/L	<0.5	----	----	----	----
beta-Endosulfan	33213-65-9	0.5	µg/L	<0.5	----	----	----	----
4.4`-DDD	72-54-8	0.5	µg/L	<0.5	----	----	----	----
Endrin aldehyde	7421-93-4	0.5	µg/L	<0.5	----	----	----	----
Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	----	----	----	----
4.4`-DDT	50-29-3	2.0	µg/L	<2.0	----	----	----	----
Endrin ketone	53494-70-5	0.5	µg/L	<0.5	----	----	----	----
Methoxychlor	72-43-5	2.0	µg/L	<2.0	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	12950-ASLP	----	----	----	----
			Client sampling date / time	15-Nov-2017 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1728721-001	--------	--------	--------	--------
				Result	----	----	----	----
EP068A: Organochlorine Pesticides (OC) - Continued								
^ Total Chlordane (sum)	----	0.5	µg/L	<0.5	----	----	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.5	µg/L	<0.5	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L	<0.5	----	----	----	----
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.5	µg/L	<0.5	----	----	----	----
Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	----	----	----	----
Monocrotophos	6923-22-4	2.0	µg/L	<2.0	----	----	----	----
Dimethoate	60-51-5	0.5	µg/L	<0.5	----	----	----	----
Diazinon	333-41-5	0.5	µg/L	<0.5	----	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	----	----	----	----
Parathion-methyl	298-00-0	2.0	µg/L	<2.0	----	----	----	----
Malathion	121-75-5	0.5	µg/L	<0.5	----	----	----	----
Fenthion	55-38-9	0.5	µg/L	<0.5	----	----	----	----
Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	----	----	----	----
Parathion	56-38-2	2.0	µg/L	<2.0	----	----	----	----
Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	----	----	----	----
Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	----	----	----	----
Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	----	----	----	----
Fenamiphos	22224-92-6	0.5	µg/L	<0.5	----	----	----	----
Prothiofos	34643-46-4	0.5	µg/L	<0.5	----	----	----	----
Ethion	563-12-2	0.5	µg/L	<0.5	----	----	----	----
Carbophenothion	786-19-6	0.5	µg/L	<0.5	----	----	----	----
Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	----	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	----	----	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	----	----	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	----	----	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	----	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	----	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	----	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	----	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	----	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	----	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**12950-ASLP**	----	----	----	----
			Client sampling date / time	15-Nov-2017 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1728721-001**	--------	--------	--------	--------
				Result	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	----	----	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	µg/L	<0.5	----	----	----	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	µg/L	<0.5	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
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	----	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	----	----	----	----
MW006: Faecal Coliforms & E.coli by MF								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	12950-ASLP	----	----	----	----
			Client sampling date / time	15-Nov-2017 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1728721-001	--------	--------	--------	--------
				Result	----	----	----	----
MW006: Faecal Coliforms & E.coli by MF - Continued								
Escherichia coli	----	1	CFU/100mL	**~4**	----	----	----	----
MW007: Coliforms by MF								
Coliforms	----	1	CFU/100mL	**5300**	----	----	----	----
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	1	%	**94.1**	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.5	%	**96.2**	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.5	%	**90.7**	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	**20.2**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	**47.4**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%	**41.7**	----	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	**75.1**	----	----	----	----
Anthracene-d10	1719-06-8	1.0	%	**80.0**	----	----	----	----
4-Terphenyl-d14	1718-51-0	1.0	%	**96.0**	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**112**	----	----	----	----
Toluene-D8	2037-26-5	2	%	**85.2**	----	----	----	----
4-Bromofluorobenzene	460-00-4	2	%	**80.4**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	Recovery Limits (%) High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	29	129
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	67	111
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	67	111
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

Environmental and OHS Laboratory

CLIENT / PROJECT:	Chalouhi	LABORATORY REFERENCE NO. (Lab use ONLY)	12950 - 1
CLIENT CODE - PROJECT NUMBER - INVOICE NUMBER	CHL-28-12950		
SAMPLES DELIVERED BY:	ADE Consulting Group	RECEIVED BY:	[illegible]
SAMPLERS:	NB	SAMPLES: CHILLED: ☑	PRESERVED: N/A
TURNAROUND:	24h: ☐ 48h: ☐ 72h: ☐ 5 WORKING DAYS: X	MINIMAL HEADSPACE: ☑	WITHIN HOLDING TIME: ☑
SAMPLING DATE:	09.11.2017 to 16.11.2017	DATE: 17/11/17	TIME: 4.pm
AFTER TEST STORAGE:	ROOM TEMP: ☐ FRIDGE: X FREEZER: ☐ > 4 WEEKS: ☐ OTHER: ☐	SIGNATURE: [illegible]	
REPORT FORMAT:	DISK: ☐ E-MAIL: X		
SIGNATURE: [illegible]	JOB CONTACT E-MAIL: n.bernardini@adenvirotech.com.au;		

ANALYSIS REQUIRED

Sample ID (Lab Use)	Invoice Number	Sample number	MATRIX	DELIVERY DATE	DELIVERY TIME	TYPE & PRESERVATIVE	NO.	6 Metal Suite	8 Metal Suite	BTEX	PAH	OCP/OPP	PCB	vTRH (C6-C10)	TRH (C10-C40)		pH/pH fox	TCLP: Trip spike and blank analysis	TCLP: TCLP PAH B(a)P PQL<0.2 ug/L	TCLP: TCLP PAH B(a)P PQL<5.0 ug/L	TCLP: TCLP Metals (SPECIFY METALS WHICH NEED TO BE ANALYSED)	NOTES
C1	12950	Trip Blank - Hawkesbury	Vial	17.11.2017	16:00	Glass Vial	1			X												
C2	12950	Trip Spike - Hawkesbury	Vial	17.11.2017	16:00	Glass Vial	2			X												
C3	12950	Trip Blank - Tuggarah	Vial	17.11.2017	16:00	Glass Vial	3			X												
C4	12950	Trip Spike - Tuggarah	Vial	17.11.2017	16:00	Glass Vial	4			X												
C5	12950	Trip Blank - Blacktown	Vial	17.11.2017	16:00	Glass Vial	5			X												
C6	12950	Trip Spike - Blacktown	Vial	17.11.2017	16:00	Glass Vial	6			X												
C7	12950	Trip Blank - Ashfield	Vial	17.11.2017	16:00	Glass Vial	7			X												
C8	12950	Trip Spike - Ashfield	Vial	17.11.2017	16:00	Glass Vial	8			X												
C9	12950	Trip Blank - Disturbed	Vial	17.11.2017	16:00	Glass Vial	9			X												
C10	12950	Trip Spike - Disturbed	Vial	17.11.2017	16:00	Glass Vial	10			X												
C11	12950	Trip Blank - Faulconbridge	Vial	17.11.2017	16:00	Glass Vial	11			X												
C12	12950	Trip Spike - Faulconbridge	Vial	17.11.2017	16:00	Glass Vial	12			X												
C13	12950	Trip Blank - Glenorie	Vial	17.11.2017	16:00	Glass Vial	13			X												
C14	12950	Trip Spike - Glenorie	Vial	17.11.2017	16:00	Glass Vial	14			X												
C15	12950	Trip Blank - Lucas Heights	Vial	17.11.2017	16:00	Glass Vial	15			X												
C16	12950	Trip Spike - Lucas Heights	Vial	17.11.2017	16:00	Glass Vial	16			X												
C17	12950	Trip Blank - South Creek	Vial	17.11.2017	16:00	Glass Vial	17			X												
C18	12950	Trip Spike - South Creek	Vial	17.11.2017	16:00	Glass Vial	18			X												

Job Number: CHL-28-12950

Ove 21/11/17

From: ADE Consulting Group Pty Ltd
Unit 6/7 Millennium Court,
Silverwater NSW 2128
Phone: (02) 8541 7214
Email: info@adenvirotech.com.au

To: ALS Global
Sydney
277-289 Woodpark Road
Smithfield NSW 2164
Attention:

ADE CONSULTING GROUP

QUOTE NUMBER: EN/097/17
ALS ACCOUNT ID: ADENVT

HT

Sampler: Nicholas Bernardini (print name) — signature — Date: 15/11/2017

Delivery: (print name) — signature — Date:

Received for Laboratory: (print name) — ALS (signature) — Date: 15/11/17 1925 14.8°C

DETAILS OF SAMPLE				ANALYSIS REQUIRED							
Laboratory Sample ID	ADE Sample ID	Sample Type	Container & Preservation	W16	NT-08A	MW007	MW006(EC)	EA005P	EA010P	NT-01	NT-02
	12950-ASLP	Water	1 x 500 ml plastic, no preservatives					x	x	x	x
	12950-ASLP	Water	3 x 60 ml plastic, sulphuric acid		x						
	12950-ASLP	Water	1 x 250 ml plastic, sodium thiosulphate			x	x				
	12950-ASLP	Water	1 x 60 ml plastic, nitric acid	x							
	12950-ASLP	Water	1 x 100 ml glass, no preservative	x							
	12950-ASLP	Water	2 x 40 ml glass, sulphuric acid	x	x						

Environmental Division
Sydney
Work Order Reference
ES1728721

Telephone : + 61-2-8784 8655

Job Number: CHL-28-12950

From: ADE Consulting Group Pty Ltd
Unit 6/7 Millennium Court,
Silverwater NSW 2128
Phone: (02) 8541 7214
Email: info@adenvirotech.com.au

To: ALS Global
Sydney
277-289 Woodpark Road
Smithfield NSW 2164
Attention:

Environmental Division
Sydney
Work Order Reference
ES1728988

Telephone : + 61-2-8784 8555

QUOTE NUMBER: EN/097/17
ALS ACCOUNT ID: ADENVT

Sampler: Nicholas Bernardini (print name) — signature — Date: 15/11/2017

Delivery: (print name) (signature) Date:

Received for Laboratory: J Crealy (print name) ALS (signature) Date: 16/11/17
19:20 4.5°C

DETAILS OF SAMPLE				ANALYSIS REQUIRED					
Laboratory Sample ID	ADE Sample ID	Sample Type	Container & Preservation	EA055	S-16	EP071SG-S	NT-1S	NT-2S	IN-4S
1	12950-Tuggerah	Soil	Glass, no preservatives	X	X	X	X	X	X
2	12950-Faulconbridge	Soil	Glass, no preservatives	X	X	X	X	X	X
3	12950-Blacktown	Soil	Glass, no preservatives	X	X	X	X	X	X
4	12950-Ashfield	Soil	Glass, no preservatives	X	X	X	X	X	X
5	12950-Glenorie	Soil	Glass, no preservatives	X	X	X	X	X	X
6	12950-Lucas Heights	Soil	Glass, no preservatives	X	X	X	X	X	X

Job Number: CHL-28-12950

DETAILS OF SAMPLE				ANALYSIS REQUIRED					
Laboratory Sample ID	ADE Sample ID	Sample Type	Container & Preservation	EA055	S-16	EP071SG-S	NT-1S	NT-2S	IN-4S
7	12950-Hawkesbury	Soil	Glass, no preservatives	X	X	X	X	X	X
8	12950- South Creek	Soil	Glass, no preservatives	X	X	X	X	X	X
9	12950- Disturbed Terrain	Soil	Glass, no preservatives	X	X	X	X	X	X
10	12950-BR1	Soil	Glass, no preservatives	X	X	X	X	X	X

FURTHER INFORMATION: ASLP ANALYSIS – PLEASE REFER TO ALS QUOTATION # SY/579/17

Further instructions:

1. Invoices are required to be sent to **accounts@adenvirotech.com.au** instead of sending them to your contact person. ADE Consulting Group Pty Ltd will not be processing any invoices going forward unless they are emailed to this address.

2. Please analyse all samples on **5 DAY turnaround time** and report results to **info@adenvirotech.com.au** and n.bernardini@adenvirotech.com.au.

3. Please keep soil samples in refrigerated condition for 2 months following reporting.

4. Please keep water samples in refrigerated condition for 2 weeks following reporting.

Job Number: **CHL-28-12950**

- **Further instructions:**

1. Invoices are required to be sent to **accounts@adenvirotech.com.au** instead of sending them to your contact person. ADE Consulting Group Pty Ltd will not be processing any invoices going forward unless they are emailed to this address.

2. Please analyse all samples on **5 DAY turnaround time** and report results to **info@adenvirotech.com.au**, n.bernardini@adenvirotech.com.au and j.eccles@adenvirotech.com.au.

3. Please keep soil samples in refrigerated condition for 2 months following reporting.

4. Please keep water samples in refrigerated condition for 2 weeks following reporting.

Job Number: CHL-28-12950

From: ADE Consulting Group Pty Ltd
Unit 6/7 Millennium Court,
Silverwater NSW 2128
Phone: (02) 8541 7214
Email: info@adenvirotech.com.au

To: ALS Global
Sydney
277-289 Woodpark Road
Smithfield NSW 2164
Attention:

ADE CONSULTING GROUP

QUOTE NUMBER: EN/097/17
ALS ACCOUNT ID: ADENVT

Sampler: Nicholas Bernardini (print name) — signature — Date: 15/11/2017

Delivery: print name — signature — Date:

Received for Laboratory: print name — signature — Date:

DETAILS OF SAMPLE				ANALYSIS REQUIRED											
Laboratory Sample ID	ADE Sample ID	Sample Type	Container & Preservation	EN60a	EN60Za	W-07	W-13	NT-08A	MW007	MW006 (Ec)	EA005P	EA01 0P	NT-01	NT-02	W-02 ASLP
	12950-ASLP	Water	60 x 500 ml glass, no preservatives	X	X	X	X	X	X	X	X	X	X	X	X
One Leachate Analysis per soil sample (In total 10)															

FURTHER INFORMATION: ASLP ANALYSIS – PLEASE REFER TO ALS QUOTATION # SY/579/17

Job Number: CHL-28-12950

Further instructions:

1. Invoices are required to be sent to **accounts@adenvirotech.com.au** instead of sending them to your contact person. ADE Consulting Group Pty Ltd will not be processing any invoices going forward unless they are emailed to this address.

2. Please analyse all samples on **5 DAY turnaround time** and report results to **info@adenvirotech.com.au** and n.bernardini@adenvirotech.com.au.

3. Please keep soil samples in refrigerated condition for 2 months following reporting.

4. Please keep water samples in refrigerated condition for 2 weeks following reporting.

Job Number: CHL-28-12950

ADE CONSULTING GROUP

From:	To: Envirolab
Unit 4, 10-11 Millennium Court,	Sydney
Silverwater NSW 2128	12 Ashley Street,
Phone: (02) 9648 6669	Chatswood NSW 2067
Email: info@ADenviro.com.au	Attention:

Sampler: Nicholas Bernardini (print name) | (signature) | Date:16.11.2017

Delivery: Qu (print name) | Jack 26 (signature) | Date: 27/11 | Received for Laboratory: ELS (print name) | (signature) | Date: 27/11

I called through this morning enquiring about utilizing quarry water collected by an ADE representative for ASLP on selected soil samples. We would be looking to have the soils analysed for the following:

- Heavy Metals (arsenic, chromium, cadmium, copper, lead, mercury, nickel, zinc);
- Total Petroleum Hydrocarbons (TPH), with silica gel clean-up;
- Benzene, Toluene, Ethyl-Benzene and Xylenes (BTEX);
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Organochlorine Pesticides (OCP);
- Organphosphorus Pesticides (OPPs);
- Polychlorinated Biphenyls (PCBs); and
- Major Cations and Anions (Ca, Mg, Na, K, Cl, SO_4).

Additionally we are looking to have the ASLP leachate (ie resulting leachant solution) analysed for the following:

- Heavy Metals (arsenic, chromium, cadmium, copper, lead, mercury, nickel, zinc);
- Total Petroleum Hydrocarbons (TPH), with silica gel clean-up; and
- Alkalinity;

ENVIROLAB Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 180739
Date Received: 27/11
Time Received: 1430
Received by: PH
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Job Number: CHL-28-12950

SOILS

Laboratory Sample ID	ADE Sample ID	Sample Type	Container	Analysis Required								
				Heavy Metals	TPH	BTEX	PAHs	OCP	OPP	PCB	Ca,Mg,Na, K, Cl, SO_4	
1	12950-SR1	Soil	Glass Jar, no pres.	X	X	X	X	X	X	X	X	

Please feel free to contact myself Nicholas Bernardini on 0450603542 or Justin Eccles on 0449797659 with any questions

SAMPLE DETAILS

CHL-28-12950
Job Number: ____________

LEACHANT

Laboratory Sample ID	ADE Sample ID	Sample Type	Container	Analysis Required											
				Heavy Metals	TPH	Alkalinity									
2-	12950-ASLP	Water	Glass flask	X	X	X									

Please feel free to contact myself Nicholas Bernardini on 0450603542 or Justin Eccles on 0449797659 with any questions

Further instructions:

CHL-28-12950

Job Number: ____________

1. Invoices are required to be sent to **adenvirotech@ezzybills.com** instead of sending them to your contact person. ADEnvirotech will not be processing any invoices going forward unless they are emailed to this address.

2. Please provide PQLs below the health-based investigation levels published in NEPC Guidelines (Table 5A) for soil samples:

Analyte	PQLs, mg/kg
Heavy Metals Screen (As, Be, Cd, Cr, Pb, Hg, Mo, Ni, Se, Ag)	5 (except for Cd – 1, Hg – 0.1)
OCPs	1
PAHs individual	0.5 (except for Benzo(a)Pyrene – 0.1)
PCBs	1
Total Phenols	1
CN	1
TPH	250
BTEX	0.2, 1, 1, 3
SPOCAS - POCAS, % Sulfur oxidisable (oven dry basis)	0.3

3. Please send back COC/ORDER and SRA.

4. Please analyse all samples on **24 Hour turnaround time** and report results to info@adenviro.com.au, n.bernardini@adenvirotech.com.au and j.eccles@adenvirotech.com.au.

5. Please keep samples in refrigerated condition for 3 months.

Job Number: CHL-28-12950

From: ADE Consulting Group Pty Ltd
Unit 6/7 Millennium Court,
Silverwater NSW 2128
Phone: (02) 8541 7214
Email: info@adenvirotech.com.au

To: ALS Global
Sydney
277-289 Woodpark Road
Smithfield NSW 2164
Attention:

Environmental Division
Sydney
Work Order Reference
ES1728988

Telephone : + 61-2-8784 8555

QUOTE NUMBER: EN/097/17
ALS ACCOUNT ID: ADENVT

Sampler: Nicholas Bernardini (print name) — (signature) Date: 15/11/2017

Delivery: (print name) (signature) Date:

Received for Laboratory: J. Crealy (print name) ALS (signature) Date: 16/11/17 19:20 4.5°C

DETAILS OF SAMPLE				ANALYSIS REQUIRED					
Laboratory Sample ID	ADE Sample ID	Sample Type	Container & Preservation	EA055	S-16	EP071SG-S	NT-1S	NT-2S	IN-4S
1	12950-Tuggerah	Soil	Glass, no preservatives	X	X	X	X	X	X
2	12950-Faulconbridge	Soil	Glass, no preservatives	X	X	X	X	X	X
3	12950-Blacktown	Soil	Glass, no preservatives	X	X	X	X	X	X
4	12950-Ashfield	Soil	Glass, no preservatives	X	X	X	X	X	X
5	12950-Glenorie	Soil	Glass, no preservatives	X	X	X	X	X	X
6	12950-Lucas Heights	Soil	Glass, no preservatives	X	X	X	X	X	X

Job Number: CHL-28-12950

DETAILS OF SAMPLE				ANALYSIS REQUIRED					
Laboratory Sample ID	ADE Sample ID	Sample Type	Container & Preservation	EA055	S-16	EP071SG-S	NT-1S	NT-2S	IN-4S
7	12950-Hawkesbury	Soil	Glass, no preservatives	X	X	X	X	X	X
8	12950- South Creek	Soil	Glass, no preservatives	X	X	X	X	X	X
9	12950- Disturbed Terrain	Soil	Glass, no preservatives	X	X	X	X	X	X
10	12950-BR1	Soil	Glass, no preservatives	X	X	X	X	X	X

FURTHER INFORMATION: ASLP ANALYSIS – PLEASE REFER TO ALS QUOTATION # SY/579/17

Further instructions:

1. Invoices are required to be sent to **accounts@adenvirotech.com.au** instead of sending them to your contact person. ADE Consulting Group Pty Ltd will not be processing any invoices going forward unless they are emailed to this address.

2. Please analyse all samples on **5 DAY turnaround time** and report results to **info@adenvirotech.com.au** and n.bernardini@adenvirotech.com.au.

3. Please keep soil samples in refrigerated condition for 2 months following reporting.

4. Please keep water samples in refrigerated condition for 2 weeks following reporting.

Job Number: **CHL-28-12950**

- **Further instructions:**

1. Invoices are required to be sent to **accounts@adenvirotech.com.au** instead of sending them to your contact person. ADE Consulting Group Pty Ltd will not be processing any invoices going forward unless they are emailed to this address.

2. Please analyse all samples on **5 DAY turnaround time** and report results to **info@adenvirotech.com.au**, n.bernardini@adenvirotech.com.au and j.eccles@adenvirotech.com.au.

3. Please keep soil samples in refrigerated condition for 2 months following reporting.

4. Please keep water samples in refrigerated condition for 2 weeks following reporting.

Job Number: CHL-28-12950

From: ADE Consulting Group Pty Ltd
Unit 6/7 Millennium Court,
Silverwater NSW 2128
Phone: (02) 8541 7214
Email: info@adenvirotech.com.au

To: ALS Global
Sydney
277-289 Woodpark Road
Smithfield NSW 2164
Attention:

ADE CONSULTING GROUP

QUOTE NUMBER: EN/097/17
ALS ACCOUNT ID: ADENVT

Sampler: Nicholas Bernardini — *print name* — *signature* — Date: 15/11/2017

Delivery: *print name* — *signature* — Date:

Received for Laboratory: *print name* — *signature* — Date:

DETAILS OF SAMPLE				ANALYSIS REQUIRED											
Laboratory Sample ID	ADE Sample ID	Sample Type	Container & Preservation	EN60a	EN60Za	W-07	W-13	NT-08A	MW007	MW006 (Ec)	EA005P	EA01 0P	NT-01	NT-02	W-02 ASLP
	12950-ASLP	Water	60 x 500 ml glass, no preservatives	X	X	X	X	X	X	X	X	X	X	X	X
One Leachate Analysis per soil sample (In total 10)															

FURTHER INFORMATION: ASLP ANALYSIS – PLEASE REFER TO ALS QUOTATION # SY/579/17

APPENDIX V – QA/QC RECONCILIATION

DATA QUALITY ASSESSMENT

In order to carry out the assessment of the data acquired in the course of the investigation, the US EPA Guidelines were used.

The Guidelines provide general strategy on assessing data quality criteria and performance specifications for decision making. The following is the output from most of the steps of the Data Quality Assessment (DQA) Process provided in the Guidelines. The sub-steps recommended are given in *italic.*

Data Review

Quality control reports from the laboratories subcontracted for sample analyses were reviewed. The data included laboratory blank samples, duplicate samples, control samples, spiked samples and method blanks.

The review of the QA/QC program was conducted in accordance with the items recommended by the NSW EPA to be included in the consultants' reports. Some additional recommendations from the US EPA methodology referred to by AS 4482.1 were also followed.

Following the QA/QC assessment, the validity of the results is determined based on the assessment criteria adopted and are expressed as valid or invalid data (acceptable or unacceptable).

COC

Australian Standard AS 4482.1 defines the Chain-Of-Custody (COC) documentation as the link in the transfer of samples between the time of collection and arrival at the laboratory.

The COC utilised by ADE included the items recommended by the Standard:

- Name of person transferred the samples;
- Name of person who received the samples;
- Date the samples were collected;
- Date the samples were received at the laboratory; and
- Name and contact details of client.

Copies of the COC's completed during the course of the investigation are provided in Appendix IX – Chain of Custody.

Analytical Methods Used

Refer to Appendix VIII – Analytical Reports for the specification of analytical methods used by the laboratories.

Laboratory Accreditation for Methods Used

Refer to VIII – Analytical Reports for the details of laboratory accreditations for analytical methods used.

Detection/Practical Quantitation Limits

The smallest amount of a substance that can be detected by EOH&S Laboratory above the noise in a procedure and within a stated confidence level is the detection limit. Current practice identifies several detection limits.

These are the instrument detection limit (IDL), the lower level detection (LLD), the method detection limit (MDL) and the practical quantitation limit (PQL).

The relationship among these levels is approximately IDL: LLD: MDL: PQL = 1: 2: 4: 10. Refer to Appendix VIII – Analytical Reports for the list of PQLs provided by EOH&S Laboratory. When dilution of a sample is involved in the sample preparation, the method detection limit is adjusted by the dilution factor.

Field QA/QC

Table A - Summary of field QA/QC samples collected

Field QA/QC	Frequency	Sample details
Blind replicate samples	1 total	• 12950-BR1 is a blind replicate of sample 12950-Tuggerah collected during the characterisation sampling undertaken on 16.11.2017.
Split Replicate Sample	1 total	• 12950-SR1 is a split replicate of sample 12950-Tuggerah collected during the characterisation sampling on the 16.11.2017.
Trip Blank Sample	1 per sampling event	• 12950- Trip Blank - Hawkesbury is a blank sample kept with samples during field works for the characterisation sampling on the 16.11.2017. • 12950- Trip Blank - Tuggerah is a blank sample kept with samples during field works for the characterisation sampling on the 16.11.2017. • 12950- Trip Blank - Blacktown is a blank sample kept with samples during field works for the characterisation sampling on the 13.11.2017. • 12950- Trip Blank - Ashfield is a blank sample kept with samples during field works for the characterisation sampling on the 09.11.2017. • 12950- Trip Blank – Disturbed Terrain is a blank sample kept with samples during field works for the characterisation sampling on the 16.11.2017. • 12950- Trip Blank – Faulconbridge is a blank sample kept with samples during field works for the characterisation sampling on the 16.11.2017. • 12950- Trip Blank – Glenorie is a blank sample kept with samples during field works for the characterisation sampling on the 13.11.2017. • 12950- Trip Blank – Lucas Heights is a blank sample kept with samples during field works for the characterisation sampling on the 16.11.2017. • 12950- Trip Blank – South Creek is a blank sample kept with samples during field works for the characterisation sampling on the 15.11.2017.
Trip Spike Sample	1 per sampling event	• 12950- Trip Spike - Hawkesbury is a spike sample kept with samples during field works for the characterisation sampling on the 16.11.2017. • 12950- Trip Spike - Tuggerah is a spike sample kept with samples during field works for the characterisation sampling on the 16.11.2017. • 12950- Trip Spike - Blacktown is a spike sample kept with samples during field works for the characterisation sampling on the 13.11.2017. • 12950- Trip Spike - Ashfield is a spike sample kept with samples during field works for the characterisation sampling on the 09.11.2017. • 12950- Trip Spike – Disturbed Terrain is a spike sample kept with samples during field works for the characterisation sampling on the 16.11.2017. • 12950- Trip Spike – Faulconbridge is a spike sample kept with samples during field works for the characterisation sampling on the 16.11.2017. • 12950- Trip Spike – Glenorie is a spike sample kept with samples during field works for the characterisation sampling on the 13.11.2017. • 12950- Trip Spike – Lucas Heights is a spike sample kept with samples during field works for the characterisation sampling on the 16.11.2017. • 12950- Trip Spike – South Creek is a spike sample kept with samples during field works for the characterisation sampling on the 15.11.2017.

Summary of Data Quality Indicators

A summary of QA/QC results compared to the DQI's is provided in Table B below.

Table B - Summary of DQI's

Precision
Precision is a measure of agreement among replicate measurements of the same property, made under prescribed similar conditions. Blind Replicate Samples: • Three blind replicate samples were collected to determine the variability of the sampling process at various timelines. The blind duplicate samples were collected from the same location as the primary sample. Australian Standard 4482.1 specifies the typical RPD values for blind replicate samples to be 30% - 50%. Combining the AS acceptance criteria with the recommendations of the USEPA methodology, the control limits described below were used. 1. A control limit of 50% for the RPD for original and blind replicate sample values greater than or equal to 5x the Detection Limit (DL), 2. A control limit of ± the DL if either the sample or duplicate value is less than 5x the DL. 3. If both samples values are less than the DL, the RPD is not calculated. • Considering the heterogeneous nature of the material within the site the following criteria was considered appropriate: 4. A control limit of 50% for the RPD for original and blind replicate sample values greater than or equal to 5x the Detection Limit (DL), 5. A control limit of ± the DL if either the sample or duplicate value is less than 5x the DL. 6. If both samples values are less than the DL, the RPD is not calculated. • Appendix IV – Quality Assurance and Quality Control provides the Relative Percent Difference (RPD) values for the original and blind replicate samples collected during the soil investigations. Where condition 2 or 3 was applicable, an estimated level of agreement between the results was provided and, where appropriate, an RPD value calculated. • **QA/QC Tables 1 and 3 in Appendix V** shows the blind replicate samples in comparison to primary samples. The Blind Replicates (BR) sampled showed 39 valid values and 5 invalid values. Laboratory Split Samples: • Two split samples were analysed to measure the variability between laboratories. • Two split samples were submitted for analysis at Envirolab. The results were compared with the original sample analysed by ALS. • **QA/QC Tables 2 and 4 in Appendix V** shows the RPD between the split and the primary samples. • The assessment variability of the split samples showed 29 valid values and 4 invalid values. Overall, precision has been deemed acceptable. •

Table B – Continued...

Accuracy
• The trip blank sample analysed returned results within the adopted criteria (60-140% of the original concentration), resulting in 45 valid values and 0 invalid values. Spike and Surrogates: • According to the US EPA methodology, it is recommended to consider the following actions based on the spike recovery results for inorganic analytes: • If the spike recovery is >125% and the reported sample results are less than the Practical Quantitation Limit (< PQL), the data is acceptable for use, • If the spike recovery is >125% or <75% and the sample results are > PQL, qualify the data for these samples as "estimated", • If the spike recovery falls within the range of 30-74% and the sample results are < PQL, qualify the data for these samples as "estimated and may be inaccurate or imprecise", • If spike recovery results fall <30% and the sample results are < PQL, qualify the data for these samples as "unusable". • Surrogate limits recommended by ALS and Envirolab were used in order to validate matrix spikes and laboratory control samples. These criteria, generally, conform to the USEPA recommended standards. • **Analysis of spikes and surrogates showed 444 valid values and 8 invalid values.** Laboratory Duplicates: • Duplicate sample determinations were provided by the laboratories to demonstrate acceptable method precision at the time of analysis. Duplicates are, generally, analysed at a frequency of 1 for every 10 samples. AS 4482.1 provides an acceptable range of the Relative Percent Difference (RPD) values up to 50% for quality control samples. • **Analysis of laboratory duplicates showed 391 valid values and 0 invalid values of RPD.** Laboratory Blanks: • The assessment of blank analysis results was to determine the existence and magnitude of contamination resulting from laboratory activities. • The assessment of blank analysis results was carried out in order to determine the existence and magnitude of contamination resulting from laboratory activities. No contaminants were found in the blanks analysed by the laboratory. • **Analysis of laboratory blanks showed 409 valid values and 0 invalid values.**
Representativeness
Representativeness is a measure of the degree to which data accurately and precisely represent a characteristic of a population parameter at a sampling point or for a process condition or environmental condition. It was verified that each point in space had an equal probability of being selected for sampling. The site investigation revealed that soil samples collected were representative of the stratigraphic formations from which they were collected. It appears that measurements of the population of interest were made in such a manner that the resulting data appropriately reflect the environment investigated.

Table B – Continued...

Comparability
Comparability is the qualitative term that expresses the ability to fairly compare sample test results taken from the same site at different times. Standard ADE's environmental investigation procedures were used by the personnel in the field. No deviations from the sampling procedures were observed by the site supervisor during the fieldwork. Therefore, none or negligent bias in the data collection was expected. The spatial and temporal changes on the site during this period did not have significant influence in order to bias the data due to the environmental dynamics. Units in which the data was measured in the field and the laboratory analysis had the same metrics.
Completeness
Document Completeness In the author's opinion, the documentation used in the course of the investigation were completed to satisfactory standards, including: • Field observation logs, • Chain of Custodies, • Orders, • Laboratory accreditation, and • Laboratory reports. Data Completeness Please see the following table, providing a summary of the data validity.

QA/QC Evalutation

The qualitative and quantitative descriptors, so called Data Quality Indicators (DQIs), were used in interpreting the degree of acceptability of the data acquired in the course of the investigation.

The principles DQIs are precision, accuracy, representativeness, comparability, and completeness referred to by the acronym PARCC. Precision and accuracy are the quantitative measures, representativeness and comparability are qualitative, and completeness is a combination of both quantitative and qualitative measures. In the following, **Error! Reference source not found.** summarises the DQO reconciliation.

Table C - Summary of DQO reconciliation.

QA/QC Item	DQO Criteria	Valid Values	Not Valid Values	Completeness	Conclusion
Laboratory duplicate samples	95%	391	0	100%	Acceptable
Laboratory blank samples	100%	409	0	100%	Acceptable
Laboratory spike/surrogate recoveries	95%	444	8	98.23%	Acceptable
Laboratory control (split) sample	75%	29	4	87.88%	Acceptable
Blind replicate samples	75%	39	5	88.64%	Acceptable
Trip blank sample	95%	45	0	100%	Acceptable
Spike BTEX	75%	45	0	100%	Acceptable
Total:					
Overall Completeness:	**95%**	**1,115**	**4**	**98.80%**	**Acceptable**

The ratio of the valid data to the total number of the analyses conducted in the QA/QC program yielded 98.8%. As such, the data collected in the course of the investigation meets the target result for the completeness of the QA/QC program stated in the DQOs (95%).

QA/QC Table 1: Soil Blind replicate (duplicate) samples compared with primary samples

	DL ALS	12950-Tuggerah	12950-BR1	RPD, %
Benzene	0.2	<0.2	<0.2	V
Toluene	0.5	<0.5	<0.5	V
Ethylbenzene	0.5	<0.5	<0.5	V
Xylenes	0.5	<0.5	<0.5	V
Benzo(a)pyrene	0.5	<0.5	<0.5	V
Total PAH	0.5	<0.5	<0.5	V
Total PCBs	0.1	<0.1	<0.1	V
Chloride	10	<10	<10	V
Sulfate	10	<10	<10	V
Calcium	10	<10	<10	V
Magnesium	10	<10	<10	V
Sodium	10	<10	<10	V
Potassium	10	<10	<10	V
TPH C_{10}-C_{36}	50	<50	<50	V
Arsenic	5	<5	<5	V
Cadmium	1	<1	<1	V
Chromium	2	<2	<2	V
Copper	5	<5	<5	V
Lead	5	<5	<5	V
Mercury	0.1	<0.1	<0.1	V
Nickel	2	<2	<2	V
Zinc	5	9	9	V
			V - valid result	22
			N - not valid result	0

QA/QC Table 2: Soil Split replicate samples compared with primary samples

	DL ALS/ Envlab (mg/kg)	12950-Tuggerah	12950-SR1	RPD, %
Benzene	0.2	<0.2	<0.2	V
Toluene	0.5	<0.5	<0.5	V
Ethylbenzene	0.5 / 1	<0.5	<1	V
Xylenes	0.5 / 1	<0.5	<1	V
Benzo(a)pyrene	0.5 / 0.05	<0.5	<0.05	V
Total PAH	0.5 / 0.05	<0.5	<0.05	V
Total PCBs	0.1	<0.1	<0.1	V
Chloride	10	<10	<10	V
Sulfate	10	<10	<10	V
Calcium	10	<10	40	N
Magnesium	10	<10	30	N
Sodium	10	<10	40	N
Potassium	10	<10	10	V
TPH C_{10}-C_{36}	50 / 250	<50	<250	V
Arsenic	5 / 4	<5	<4	V
Cadmium	1 / 0.4	<1	<0.4	V
Chromium	2 / 1	<2	1.0	V
Copper	5 / 1	<5	<1	V
Lead	5 / 1	<5	<1	V
Mercury	0.1 / 0.1	<0.1	<0.1	V
Nickel	2 / 1	<2	<1	V
Zinc	5 / 5	9	10	V

V - valid result	19
N - not valid result	3

QA/QC Table 3: ALSP Blind replicate (duplicate) samples compared with primary samples

	DL ALS	12950-Tuggerah	12950-BR1	RPD, %
Benzo(a)pyrene	0.5	<0.5	<0.5	V
Napthalene	1	<1	<1	V
Anthracene	1	<1	<1	V
Arochlor 1242	1	<1	<1	V
Arochlor 1254	1	<1	<1	V
Chloride	1	5	5	V
Sulfate	1	2	2	V
Calcium	1	<1	<1	V
Magnesium	1	<1	<1	V
Sodium	1	4	1	N
Potassium	1	<1	<1	V
TRH C10-C16	100	<100	<100	V
TRH C16-C34	100	<100	<100	V
TRH C34-C40	100	<100	<100	V
Arsenic	1	<1	<1	V
Cadmium	0.1	<0.1	<0.1	V
Chromium	1	1.0	14.0	N
Copper	1	<1	5	N
Lead	1	<1	2	V
Mercury	0.1	<0.1	<0.1	V
Nickel	1	<1	7	N
Zinc	5	30	22	N
			V - valid result	17
			N - not valid result	5

QA/QC Table 4: ASLP Split replicate (duplicate) samples compared with primary samples

	DL ALS/ Envlab (mg/kg)	12950-Tuggerah	12950-SR1	RPD, %
TRH C10-C16	100 / 50	<100	<50	V
TRH C16-C34	100	<100	<100	V
TRH C34-C40	100	<100	<100	V
Arsenic	1	<1	<1	V
Cadmium	0.1	<0.1	<0.1	V
Chromium	1	1.0	<1	V
Copper	1	<1	<1	V
Lead	1	<1	<1	V
Mercury	0.1 / 0.05	<0.1	<0.05	V
Nickel	1	<1	<1	V
Zinc	5 / 1	30	9	N

V - valid result	10
N - not valid result	1

QA/QC Table 5: Analysis results for trip blank samples

Analyte	PQL	Trip Blank - Hawkesbury	Trip Blank - Tuggerah	Trip Blank - Blacktown	Trip Blank - Ashfield	Trip Blank - Disturbed Terrain	Trip Blank - Faulconbridge	Trip Blank - Glenorie	Trip Blank - Lucas Heights	Trip Blank - South Creek
Benzene	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethyl Benzene	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
m, p- Xylene(s)	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
o-Xylene	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
V - valid result	45									
N - not valid result	0									

QA/QC Table 6: Analysis results for trip spike samples

Analyte	Acceptable range, %	11847-TripSpike concentrations (ug/L)	Trip Spike - Hawkesbury	Trip Spike - Tuggerah	Trip Spike - Blacktown	Trip Spike - Ashfield	Trip Spike - Disturbed Terrain	Trip Spike - Faulconbridge	Trip Spike - Glenorie	Trip Spike - Lucas Heights	Trip Spike - South Creek
Benzene	60 - 140	40	94%	97%	98%	96%	98%	95%	96%	103%	101%
Toluene	60 - 140	40	96%	98%	98%	96%	99%	98%	97%	104%	103%
Ethyl Benzene	60 - 140	40	96%	98%	96%	93%	99%	98%	96%	103%	101%
m, p- Xylene(s)	60 - 140	40	97%	99%	96%	93%	99%	98%	96%	103%	100%
o-Xylene	60 - 140	40	98%	99%	99%	96%	100%	99%	97%	105%	103%
V - valid result	45										
N - not valid result	0										

Analysis Report	Spikes/Surrogates			Analysis Report	Lab Blanks			Analysis Report	Lab Duplicates		
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	9	14	-		9	5	-		9	10	-
	10	2	-		10	-	-		10	10	-
	11	14	-		11	5	-		11	10	-
	12	2	-		12	-	-		12	10	-
Total		Pass	Fail	Total		Pass	Fail	Total		Pass	Fail
		444	8			409	0			391	0

APPENDIX VI – BOREHOLE LOGS

12950-Tuggerah

CLIENT: Chalouhi
PROJECT NUMBER: CHL-28-12950 **PROJECT NAME:** Bell Quarry Rehabilitation Proje
DATE STARTED: 16.11.2017 **PROJECT LOCATION:** 18 Huntley Street, Alexan
EQUIPMENT: 20 T Excavator **COMPLETED:** 16.11.2017
HOLE SIZE: Cutting **LOCATION:** -33.907250, 151.188886

NOTES:

LOGGED BY: Nicholas Bernardini
CHECKED BY: Justin Eccles

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Test Remarks	Additional Observations
20 T Excavator					SM	(FILL) Silty SAND (SM), fine grained, well graded, light grey, dry		
			0.5		SW	(FILL) SAND (SW), fine grained, well graded, dark grey / dark brown with tar barrels, bricks and glass, moist.		
			1					
			1.5					
			2					
			2.5					
			3		SW	(RESIDUAL) SAND (SW), fine grained, well graded, light orange / light brown, moist.	Tuggerah SR1 BR1	
			3.5					
			4					
			4.5			Base of excavation reached at 4.5 m BGL		

12950-Faulconbridge

CLIENT: Chalouhi
PROJECT NUMBER: CHL-28-12950
PROJECT NAME: Bell Quarry Rehabilitation Proje
DATE STARTED: 16.11.2017
PROJECT LOCATION: 12 Tenth Street, Warragar
EQUIPMENT: Hand Auger
COMPLETED: 16.11.2017
HOLE SIZE: 10 cm
LOCATION: -33.884157, 150.605375

NOTES:
LOGGED BY: Nicholas Bernardini
CHECKED BY: Justin Eccles

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Test Remarks	Additional Observations
Hand Auger					SM	(TOPSOIL) Silty SAND (SM), fine grained, well graded, dark brown, with sub-angular-black gravels and roots, dry		
			0.5		SM	(RESIDUAL) Silty SAND (SM), medium grained, well graded, dark brown, moist.	Faulconbridge	
			1			VENM reached, Termination Depth at:1.0 m BGL		
			1.5					
			2					
			2.5					

Disclaimer This bore log is intended for environmental not geotechnical purposes.

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12950-Disturbed Terrain

CLIENT: Chalouhi
PROJECT NUMBER: CHL-28-12950
DATE STARTED: 16.11.2017
EQUIPMENT: 20 T Excavator
HOLE SIZE: >1m

PROJECT NAME: Bell Quarry Rehabilitation Proje
PROJECT LOCATION: Governor Macquarie Drive
COMPLETED: 16.11.2017
LOCATION: -33.915545, 150.950392

NOTES:

LOGGED BY: Nicholas Bernardini
CHECKED BY: Justin Eccles

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Test Remarks	Additional Observations
20 T Excavator			0.5 1 1.5 2		SM	(ENM FILL) Silty SAND (SM), medium grained, well graded, dark brown, moist.	Disturbed Terrain	
			2.5 3 3.5 4 4.5			Depth of excavation reached, Termination Depth at: 2.5m BGL		

12950-Hawkesbury Sandstone

CLIENT: Chalouhi
PROJECT NUMBER: CHL-28-12950
DATE STARTED: 16.11.2017
EQUIPMENT: 20 T Excavator
HOLE SIZE: Cutting

PROJECT NAME: Bell Quarry Rehabilitation Proje
PROJECT LOCATION: 457-459 Pacific Highway,
COMPLETED: 16.11.2017
LOCATION: -33.683561, 151.110377

NOTES:

LOGGED BY: Nicholas Bernardini
CHECKED BY: Justin Eccles

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Test Remarks	Additional Observations
20 T Excavator			0 – 0.4		SM	(TOPSOIL) Silty SAND (SM), fine grained, poorly sorted, dark brown, moist.		
			0.4 – 2.5		CH	(RESIDUAL) Silty CLAY (CH), high plasticity, dark brown mottled light grey with weathered shale fragments, moist.		
			2.5 – 5		SHAL	(RESIDUAL) Weathered SHALE, dark grey, brittle with ironstone bands, dry.		
			5 – 8		SNDS	(RESIDUAL) SANDSTONE, medium / coarse grained, well graded, light orange / dark yellow with dark red ironstone bands, dry.	Hawkesbury Sandstone	
			8			Depth of excavation reached, Termination Depth at: 8m BGL		

Depth scale: 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, 8

Disclaimer This bore log is intended for environmental not geotechnical purposes.

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12950-Lucas Heights

CLIENT: Chalouhi
PROJECT NUMBER: CHL-28-12950
DATE STARTED: 16.11.2017
EQUIPMENT: 20 T Excavator
HOLE SIZE: Cutting
PROJECT NAME: Bell Quarry Rehabilitation Proje
PROJECT LOCATION: 250 Railway Parade, Koga
COMPLETED: 16.11.2017
LOCATION: -33.968100, 151.128413

NOTES:

LOGGED BY: Nicholas Bernardini
CHECKED BY: Justin Eccles

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Test Remarks	Additional Observations
20 T Excavator			0 – 0.5		SM	(TOPSOIL) Silty SAND (SM), fine grained, poorly sorted, dark brown, moist.		
			0.5 – 3		SC	(RESIDUAL) Clayey SAND (SC), fine grained, well sorted, medium / high plasticity, dark red / light grey with sub angular iron coated gravels, moist.	Lucas Heights (at approx. 2)	
			3 – 4		SNDS	(RESIDUAL) SANDSTONE, medium / coarse grained, well graded, light orange / dark yellow with dark red ironstone bands, dry.		
			4			Depth of excavation reached, Termination Depth at: 4m BGL		

Depth scale: 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5

12950-South Creek

CLIENT: Chalouhi
PROJECT NUMBER: CHL-28-12950
DATE STARTED: 15.11.2017
EQUIPMENT: 5 T Excavator
HOLE SIZE: 0.5 m

PROJECT NAME: Bell Quarry Rehabilitation Proje
PROJECT LOCATION: 490 Twelfth Avenue, Ross
COMPLETED: 15.11.2017
LOCATION: -33.924734, 150.787932

NOTES:

LOGGED BY: Nicholas Bernardini
CHECKED BY: Justin Eccles

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Test Remarks	Additional Observations
5 T Excavator					SM	(TOPSOIL) Silty SAND (SM), fine grained, poorly sorted, dark brown, moist.		
			0.5		SM	(RESIDUAL) Silty SAND (SM), fine grained, well sorted, light brown / light orange, moist.	South Creek	
			1					
			1.5					
			2			Depth of excavation reached, Termination Depth at: 2m BGL		
			2.5					
			3					
			3.5					
			4					
			4.5					

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12950-Blacktown

CLIENT: Chalouhi
PROJECT NUMBER: CHL-28-12950
DATE STARTED: 13.11.2017
EQUIPMENT: 5 T Excavator
HOLE SIZE: 0.5 m

PROJECT NAME: Bell Quarry Rehabilitation Proje
PROJECT LOCATION: 490 Twelfth Avenue, Ross
COMPLETED: 13.11.2017
LOCATION: -33.925417, 150.788241

NOTES:

LOGGED BY: Nicholas Bernardini
CHECKED BY: Justin Eccles

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Test Remarks	Additional Observations
5 T Excavator					SM	(TOPSOIL) Silty SAND (SM), fine grained, poorly sorted, dark brown, moist.		
			0.5, 1, 1.5		CL	(RESIDUAL) Silty CLAY (CH), medium / high plasticity, medium red mottled light grey, moist.	Blacktown	
			2, 2.5, 3, 3.5, 4, 4.5			Depth of excavation reached, Termination Depth at: 2m BGL		

12950-Glenorie

CLIENT: Chalouhi
PROJECT NUMBER: CHL-28-12950 | PROJECT NAME: Bell Quarry Rehabilitation Proje
DATE STARTED: 13.11.2017 | PROJECT LOCATION: 2-4 Lodge Street, Hornsby
EQUIPMENT: 5 T Excavator | COMPLETED: 13.11.2017
HOLE SIZE: 0.5 m | LOCATION: -33.690266, 151.102363

NOTES:

LOGGED BY: Nicholas Bernardini
CHECKED BY: Justin Eccles

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Test Remarks	Additional Observations
5 T Excavator			0–0.7		SM	(TOPSOIL) Silty SAND (SM), fine grained, poorly sorted, dark brown, dry.		
			0.7–2.5		CL	(RESIDUAL) Silty CLAY (CL), medium plasticity, light grey / light brown with trace sub-angular shale fragments, moist.	Glenorie	
			2.5			Depth of excavation reached, Termination Depth at: 2.5m BGL		

ADE CONSULTING GROUP

12950-Ashfield

CLIENT: Chalouhi
PROJECT NUMBER: CHL-28-12950
DATE STARTED: 09.11.2017
EQUIPMENT: 20 T Excavator
HOLE SIZE: >1m

PROJECT NAME: Bell Quarry Rehabilitation Proje
PROJECT LOCATION: 6-14 Walker Street, Rhode
COMPLETED: 09.11.2017
LOCATION: -33.830236, 151.086460

NOTES:

LOGGED BY: Nicholas Bernardini
CHECKED BY: Justin Eccles

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Test Remarks	Additional Observations
20 T Excavator			0 – 0.5		SM	(TOPSOIL) Silty SAND (SM), fine grained, poorly sorted, dark brown, dry.		
			0.5 – 2		CH	Silty CLAY (CH), medium plasticity, medium red mottled light grey, moist.	Ashfield	
			2 – 3		SHAL	Weathered SHALE, dark grey, brittle with ironstone bands, dry.		
			3			Depth of excavation reached, Termination Depth at: 3m BGL		

Depth scale: 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5

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Document Status

Revision	Author	Reviewer		Approved for Issue		
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