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SAMPRIAN PTY LTD

Remediation Action Plan

757-763 GEORGE STREET, HAYMARKET
NSW

E22293 AB_Rev2
7 October 2020

REPORT DISTRIBUTION

Remediation Action Plan
757-763 George Street, Haymarket NSW

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Date: 7 September 2020

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Revision	Details	Date	Amended By
-	Original	23 March 2015	-
1	Proposed Redevelopment Plans Included	13 January 2017	LX / MD
2	Updated Development Plans	7 October 2020	LW/BA/MD

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EXECUTIVE SUMMARY

Samprian Pty Ltd engaged EI Australia (EI) to prepare a Remediation Action Plan for the property located at 757-763 George Street, Haymarket NSW (herein referred to as 'the site'). This remediation action plan (RAP) was completed as part of a development application process to allow site development for a proposed multi-storey hotel and retail building. The purpose of this RAP is to establish a sequential process of remediation and validation works for the site which was in use as a mixed commercial and residential property with historic uses including retail shops and restaurants as well as a small scale cloth manufacturing.

The proposed development will involve partial demolition of the existing buildings, followed by construction of a multi-storey hotel and retail building, overlying a two-level basement.

EI undertook a Detailed Site Investigation in December 2014 (Ref. EI, 2014). Council records indicated two underground storage systems (UPSSs) being likely present with underground storage tanks (USTs) likely underneath the footpath of Valentine Street. Heavy metals nickel and zinc were identified in two locations in exceedance of the criteria for ecological terrestrial environments. Groundwater impacts were also identified with contaminants including heavy metals nickel and zinc, total recoverable hydrocarbons, polycyclic aromatic hydrocarbons and volatile organic compounds in the ranges that are indicative of refined petrol and diesel fuels and concentration in exceedance of the adopted groundwater investigation levels.

The objectives of the RAP were to inform the site remediation and validation assessment process by providing a strategy and work plan outline for:

- Further investigations to quantify several data gaps due to accessibility restrictions;
- UPSS removal and remediation of impacted fill/soil materials; and
- Validation of remediated areas to a standard that is acceptable for the intended land use (residential with minimal soil access, including hotels).

Measures are also described in this RAP outlining site work practices required to minimising impacts to human health and the environmental and protecting the safety of site workers and the general public.

1 INTRODUCTION

1.1 BACKGROUND

Mitchell Favaloro of Samprian Pty Ltd (the Client) engaged EI Australia (EI) to prepare a Remediation Action Plan (RAP) for a property previously used for commercial purposes at 757-763 George Street, Haymarket NSW ('the site').

The site is located within the Sydney central business district, approximately 200m west of the Central Railway Station (see **Figure 1**) and is situated within the Local Government Area (LGA) of Sydney City Council. Cadastral information identifies the site as Lot 1 in DP 1031645 and Lot 11 in DP 70261, covering a total area of approximately 1,030.7 m^2 and is shown in **Figure 2**. The site is currently occupied by two, 2-to-3-storey, brick buildings used for mixed commercial and residential purposes, with no basement levels. The north-western corner of the site comprises hardstand parking. The site was previously assessed to be potentially contaminated from past land-use practices.

The purpose of this RAP is to outline the required additional work at the site to address the remaining data gaps from the previous investigation and establish a sequential process for remediation of the site contamination and validation works to mitigate or reduce the risk at the site to enable redevelopment for residential land uses with minimum soil access (including hotels). This RAP has been prepared in support of a future development application to Sydney City Council.

1.2 PROPOSED DEVELOPMENT

Based on the proposed development plans attached in **Appendix A** (Ref. Grimshaw Architects, 2020), it is understood that the development will involve partial demolition of the existing buildings, followed by construction of a multi-storey hotel and retail building, overlying a two-level basement. The existing brick façade fronting George Street and Valentine Street will be retained. The proposed basements would cover the whole site area, with the lowest basement (B2) having a finished floor level (FFL) at 3.0m Australian Height Datum (AHD). No deep soil areas are proposed for landscaping.

1.3 PROJECT OBJECTIVES

The main objective of this RAP is to inform the site remediation and validation assessment process by providing a strategy and work plan outline for:

- Further investigations to quantify several data gaps due to accessibility restrictions;
- Identification of the exact location of the underground storage tanks (USTs) by the use of a ground penetrating radar (GPR) and removal of USTs;
- Remediation of impacted fill/soil materials; and
- Validation of remediated areas to a standard that is acceptable for the intended land uses.

Measures are also described in this RAP outlining site work practices required to minimising impacts to human health and the environmental and protecting the safety of site workers and the general public.

1.4 SCOPE OF WORKS

In order to achieve the above objectives and in keeping the project cost-effective while generally complying with the EPA (2020) Consultants Reporting on Contaminated Land: Contaminated Land Guidelines, the scope of works was as follows:

- Development of a sampling and analytical strategy for further investigations to close outstanding data gaps due to accessibility restrictions;
- Definition of remediation goals and soil and groundwater criteria;
- Evaluation of available remediation options and selection of the most appropriate remedial strategy or combination of strategies;
- Guidance on approvals and licences under current legislation required for remedial works (e.g. SEPP 55);
- Development of a site remediation strategy for the safe removal of underground petroleum storage systems (UPSS) including USTs and other infrastructure;
- Site validation sampling and analysis to confirm that identified contaminated materials have been effectively remediated, with respect to this RAP;
- Additional groundwater monitoring post-remediation to confirm groundwater concentrations and evaluate groundwater quality trends;
- Provision of a framework to enable contractor preparation of a Work Health and Safety Plan and other site management/planning documents.

The RAP also outlines measures for the excavation, stockpiling, management and disposal of spoil, water and sediment controls, as well as a contingency plan to handle any additional contamination that may be identified during the data gap closure investigations and/or site remedial works.

1.5 REGULATORY FRAMEWORK

The following regulatory framework and guidelines that applies to the preparation of this RAP and implementation of the remedial works includes but not limited to:

Acts, Policy and Regulations

- *Contaminated Land Management Act* (1997);
- *Protection of the Environment Operations (Underground Petroleum Storage Systems)* Regulation 2019;
- *Protection of the Environment Operations (Waste)* Regulation 2014;
- *State Environment Protection Policy 55 – Remediation of Land (SEPP 55)* under the Environmental Planning and Assessment Act (1997);
- *Work Health and Safety Act* 2011; and
- *Work Health and Safety Regulations* 2011.

Guidelines

- ANZECC & ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*;
- DECCW (2009) *Guidelines for Implementing the Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008*, (UPSS Guidelines) (UPSS Regs now 2019);

- DEC (2007) *Guidelines for the Assessment and Management of Groundwater Contamination*;
- EPA (2017) *Guidelines for the NSW Site Auditor Scheme*;
- EPA (1995) *Sampling Design Guidelines*;
- EPA (2014) Waste Classification Guidelines;
- EPA (2014) Technical Note*: Investigation of Service Station Sites*;
- EPA (2010) UPSS Technical Note: *Site Validation Reporting*;
- NEPC (2013) Schedule B(1) *Guideline on Investigation Levels for Soil and Groundwater*;
- NEPC (2013) Schedule B(2) *Guideline on Site Characterisation*; and
- EPA (2020) Consultants Reporting on Contaminated Land: Contaminated Land Guidelines.

2 SITE DESCRIPTION

2.1 PROPERTY IDENTIFICATION AND LOCATION

The site identification details and associated information are presented in **Table 2-1**, while the location of the site in relation to surrounding areas is shown in **Figure 1**.

Table 2-1 Site Identification, Location and Zoning

Attribute	Description
Street Address	757-763 George Street, Haymarket NSW
Location Description	The site is located within the Sydney CBD. It is bounded by Valentine Street (south), George Street (east), commercial buildings followed by Thomas Street (west) and commercial buildings (north). Coordinates (Southwest corner): GDA94-MGA56 Easting: 333898.129, Northing: 6249500.634 (Source: http://maps.six.nsw.gov.au)
Site Area	1.030.7 m^2 (Ref. Survey Plan, Lawrence Group, 2014)
Site Owner	Samprian Pty Ltd
Lot and Deposited Plan (DP)	Lot 1 in DP 1031645 and Lot 11 in DP 70261
State Survey Marks	One Permanent Survey Mark PM150230 is situated south of the site across Valentine Street. (Source: http://maps.six.nsw.gov.au)
Local Government Authority	Sydney City Council
Parish	St Andrew
County	Cumberland
Current Zoning	B8 – Metropolitan Centre (Sydney Local Environment Plan, 2012) The site lies partially within an area noted on the State Environmental Planning Policy (Infrastructure) 2007 as 'Interim Rail Corridor – CBD Rail Link Zone B Tunnel'. Refer to Interim Rail Corridor CBD Rail Link & CBD Metro Map 7 of 9.

2.2 SURROUNDING LAND USE

The surrounding land and the nearest sensitive receptors are described in **Table 2-2**. The site is generally located in an area of mixed use.

Table 2-2 Local Land Use

Direction	Land Use/Nearest Receptors
North	A nine to twelve-storey mixed commercial and residential brick building with six levels of basement car parking, with commercial buildings beyond.
South	Valentine Street, with two to four-storey mix use brick buildings beyond.

Direction	Land Use/Nearest Receptors
East	George Street, with three-storey commercial brick buildings with two basement levels and Christ Church St. Laurence beyond.
West	A ten-storey mix use brick building (UTS facility) with a two-level basement car park adjacent to the building.
Groundwater	The eastern half of the site is mapped within the influence zone of the CBD Rail Link Tunnel. The potential support zone for tunnels is typically 10m vertically above and 5m vertically below or horizontally from the finished internal surfaces of the tunnel. No cross sections were provided to EI for further consideration, therefore it has been considered that the tunnel lies 10m BGL and is centred underneath George Street.

3 SITE CHARACTERISATION

3.1 DOCUMENTATION

In preparing this RAP, EI has considered the following documents:

- EI, Preliminary Geotechnical Investigation 757-763 George Street, Haymarket NSW (Ref: E222933 GA, dated 7 October 2014);
- EI, Detailed Site Investigation Report 757-763 George Street, Haymarket NSW (Ref: E222933 AA_Rev0, dated 3 December 2014).

3.2 REGIONAL SETTING

Local topography, geology, soil landscape and hydrogeological information are summarised in **Table 3-1**.

Table 3-1 Topographical, Geological, Soil Landscape and Hydrogeological Information

Attribute	Description	Source
Topography/Drainage	Local ground topography is generally sloping gently to the northeast across the site. RLs at the site range between 12.74 m AHD to 11.10 m AHD. All stormwater runoff is expected to be collected by either the onsite drainage or the municipal stormwater inlets on George Street both discharging to the municipal stormwater system.	Ref. Survey Plan, Lawrence Group, 2014
Regional Geology	The area is underlain by Hawkesbury Sandstone typically comprising medium to coarse-grained quartz sandstone with very minor shale and laminite lenses. The Pittman LVII dyke, trending south east to north west. The Martin Place Joint Swarm is approximately 50m north west of the site, which trends north east to south west. In addition a 'clay dyke' is located trending north west to south east through the basement of 743-755 George Street.	Department of Mineral Resources Geological Map Sydney 1:100,000 Geological Series Sheet 9130 (DMR, 1983) Pells, Braybrooke and Och, Map and Selected Details of Near Vertical Structural Details in the Sydney CBD (2004)
Soil Landscapes	The site is situated near the borderline of residual soil landscape Blacktown (bt) and erosional soil landscape Gymea (gy). Soils typically include generally shallow to moderately deep (<1m) red/brown podzolic soils on upper slopes and yellow podzolic soils and soloths on lower slopes of the Blacktown landscape as well as shallow to moderately deep yellow earths/earthy sands on crests, shallow siliceous sands on leading edges of benches, localised gleyed podzolic soils and yellow podzolic soils on shale lenses, shallow to moderately deep siliceous sands and leached sands along the drainage lines of the Gymea Landscape.	Soil Conservation Service of NSW Soil Landscapes of the Penrith 1:100,000 Sheet (Chapman and Murphy, 1989)
Acid Sulfate Soil Risk	The site falls within a Class 5 "No Known	Sydney Local Environmental Plan 2012

Attribute	Description	Source
	Occurrence" of Acid Sulfate Soils classification. In accordance with the local environmental plan however, Council consent is required for development works within 500 m of adjacent Class 1, 2, 3 or 4 lands that is below 5 m AHD, and the works are likely to lower the water table to below 1 m AHD on adjacent Class 1, 2, 3 or 4 land.	Acid Sulfate Soils (ASS) Map – Sheet ASS_015
Regional Hydrogeology	Based EI, 2014 report (E22293AA), standing water level was measured at 6m BGL Groundwater likely comprises intermittent seepage zones that may be present in the fill layer and deeper groundwater expected to move through the joints and fractures within the underlying sandstone bedrock. Groundwater flow direction in the vicinity of the site is anticipated to be northwest of the site towards Cockle Bay (1km northwest).	
Registered Groundwater Bores	An online search of registered groundwater bores was conducted by EI, 2014 (Ref E22293AA). Seven registered groundwater bores were identified from which all were indicated to have been authorised for monitoring purposes and no beneficiary uses were indicated.	NSW Natural Resource Atlas database (Ref. http://www.nratlas.nsw.gov.au)

3.3 SITE HISTORY OVERVIEW

Site history summarised by EI was sourced from the previous investigation conducted at the site by EI (Ref: E22293AA, dated 3 December 2014).

The site historically was used for commercial purposes as retail shops and restaurants since at least the 1950's. Small scale cloth manufacturing likely occurred at the north-eastern part of the site (757-759 George Street) during the mid-1950's to late 1980's. Buildings in the northern portion of the site were demolished by the mid-1980's and that area has likely been used as car parking until present. Two fire incidents were recorded; one in 1946 at the southern building (761-763 George Street) and the other in the early 1970's at the north-eastern part of the site (757-759 George Street).

In addition council records revealed a series of permissions to install an underground petroleum storage system (UPSS) in the early 1938 believed to be pertaining to a UST installed on site and its associated infrastructures underneath the footpath of Valentine Street near Quay Street, as well as another permission in 1943 relating to the installation of a UPSS under Valentine Street near 761 George Street. Evidence was not identified during the previous investigation to confirm the locations of these two USTs. It is therefore assumed that the two USTs are present on site.

3.4 PREVIOUS INVESTIGATIONS

A summary of EI's works and key findings is outlined in **Table 3-2**. Where necessary, the findings were reviewed against the NEPM (2013) Residential B Health-based Investigation Levels (HILs) and Commercial/industrial D Health-based Screening Levels (HSLs) soil criteria, and the ANZECC (2000) Groundwater Investigation Levels for Marine Waters groundwater criteria.

Table 3-2 Summary of Previous Investigation Works and Findings

Details	EI Project Tasks and Findings (EI, 2014)
Previous scope	• Soil samples were collected from 4 borehole locations around the site in order to characterise the nature and extent of soil contamination; • One on-site groundwater monitoring well was installed at the centre of the site to a depth of 12m BGL. On review of previous report Figure 2 (E22293AA), the site boundary at the northeast part of the site has been shifted to comply with the site boundary indicated on the survey plan (see **Figure 2** of this report).
Results	• Two UPSSs are considered likely to be abandoned onsite, with USTs likely to be located underneath the footpath of Valentine Street; • The site was covered by concrete hardstand followed by grey/brown to red/orange silty sand fill and sandy clay fill down to 0.70-0.80m BGL, fine to coarse grained of low plasticity, including brick, concrete, shale and sandstone. A brick layer was encountered at 0.10 to 0.15m BGL at sampling locations BH3 and BH5 respectively with another deeper brick layer encountered at 6.0m BGL at sampling location BH2. These locations were found within the footprint of former buildings present onsite and it was hence inferred that the deep fill in BH2 is associated with infilling of former structures. Fill material was followed by residual soils comprising brown/grey with red mottling stiff clay down to 3m BGL, of high plasticity with trace of fine to medium grained sand, becoming stiff silty clay of medium plasticity with trace of rootlets. Bedrock was encountered at 3.0m BGL comprising grey to dark grey extremely to slightly weathered sandstone, fine to medium grained; • Soil results for heavy metals, TRHs, BTEX, PAHs, OC/OP Pesticides, PCBs and asbestos were reported below the Health Investigation Levels and Health Screening Levels; • Exceedances of the ecological criteria were reported for zinc of 81mg/kg within the fill layer of BH3 (0.8-1.0m BGL) and nickel of 39mg/kg within the fill layer of BH4 (0.05-0.3m BGL) • Odours and sheen were observed during purging and sampling of groundwater; • Groundwater reported concentrations of heavy metals nickel (58µg/L) and zinc (72µg/L) in exceedance of the Groundwater Investigation Levels for marine water. • The presence of BTEX and TRH was detected in the collected groundwater sample. The detected benzene concentration was found to be under the adopted criteria, however TRH fractions F1 (7800 µg/L) and F2 (2100 µg/L) concentrations were above the health based screening levels. Toluene, Ethylbenzene, xylenes and TRH fraction F3 were also detected, however there are no currently available NEPM 2013 criteria for these parameters. • Groundwater concentration of semi-volatile naphthalene was reported below the adopted criteria. PAH compounds 2-methylnaphthalene (3.8 µg/L) and 1-methylnaphthalene (2.6 µg/L) were detected within the collected sample, however there are no current published criteria; • Three VOC exceedances of the adopted criteria were reported within the groundwater samples, being VOC compound isopropyl-benzene (cumene) of 18 µg/L, 1,3,5-trimethylbenzene of 98 µg/L and 1,2,4-trimethylbenzene of 170 µg/L. • Phase separated hydrocarbon (PSH) / light non-aqueous phase liquid (LNAPL) was considered possible to exist in groundwater.
Recommendations	• Preparation of a Remedial Action Plan (RAP) to outline the methodology and requirements for locating, decommissioning and off-site removal of USTs and associated infrastructure, with appropriate remediation of contaminated soils and groundwater; • The RAP should also provide a Sampling, Analysis and Quality Plan for the data gap

Details	EI Project Tasks and Findings (EI, 2014)
	closure investigations, including supplementary soil and groundwater sampling for the delineation of the identified contamination plume; and • EI also has no knowledge on whether a Hazardous Materials Survey (HMS) has been conducted for the site. A HMS should be completed prior to demolition of existing structures, to ensure that hazardous materials that may have been used within the existing buildings are adequately managed during demolition to prevent the spreading of contamination, if present.

The approximate borehole locations and soil contamination exceedances (against the adopted SILs and GILs) is presented on **Figure 2** and the extracted tables of contaminant concentrations are provided in **Appendix B**.

3.5 CONCEPTUAL SITE MODEL

In accordance with NEPM (2013) Schedule B2 – Guideline on Site Characterisation and to aid in the assessment of data collection for the site, EI developed a preliminary conceptual site model (CSM) assessing plausible pollutant linkages between potential contamination sources, migration pathways and receptors. The CSM provides a framework for the review of the reliability and useability of the data collected and to identify data gaps in the existing site characterisation.

3.5.1 Subsurface Conditions

The general site geology encountered during the Detailed Site Investigation (EI, 2014) may be described as a layer of anthropogenic filling overlying residual clays and sandstone. The geological information obtained during the DSI investigation is summarised in **Table 3-3** with the borehole logs provided in **Appendix C**.

Table 3-3 Generalised Subsurface Profile

Material	Depth (m BGL)+	General Description
Concrete or Bitumen	0.0 to 0.15	Concrete slab Bitumen (0.05m at BH4)
Fill	min 0.15 to 0.8 (max 7.25 at BH2)	Silty SAND / Sandy CLAY, grey/brown to red/orange, fine to coarse, low plasticity, with brick, concrete, shale and sandstone.
Natural Residual Soil	0.8 to 3.0	CLAY, brown/grey with red mottling, trace fine to medium grained sand, becoming stiff, medium plasticity Silty CLAY with trace rootlets.
Bedrock	3.0 to max 14.95	SANDSTONE, extremely to slightly weathered, grey – dark grey, fine to medium grained.

Notes:
+ Approximate depth shown as metres below ground level (m BGL). Refer to borehole logs in **Appendix C** for specific information at individual test bore locations.

3.5.2 Contamination Sources

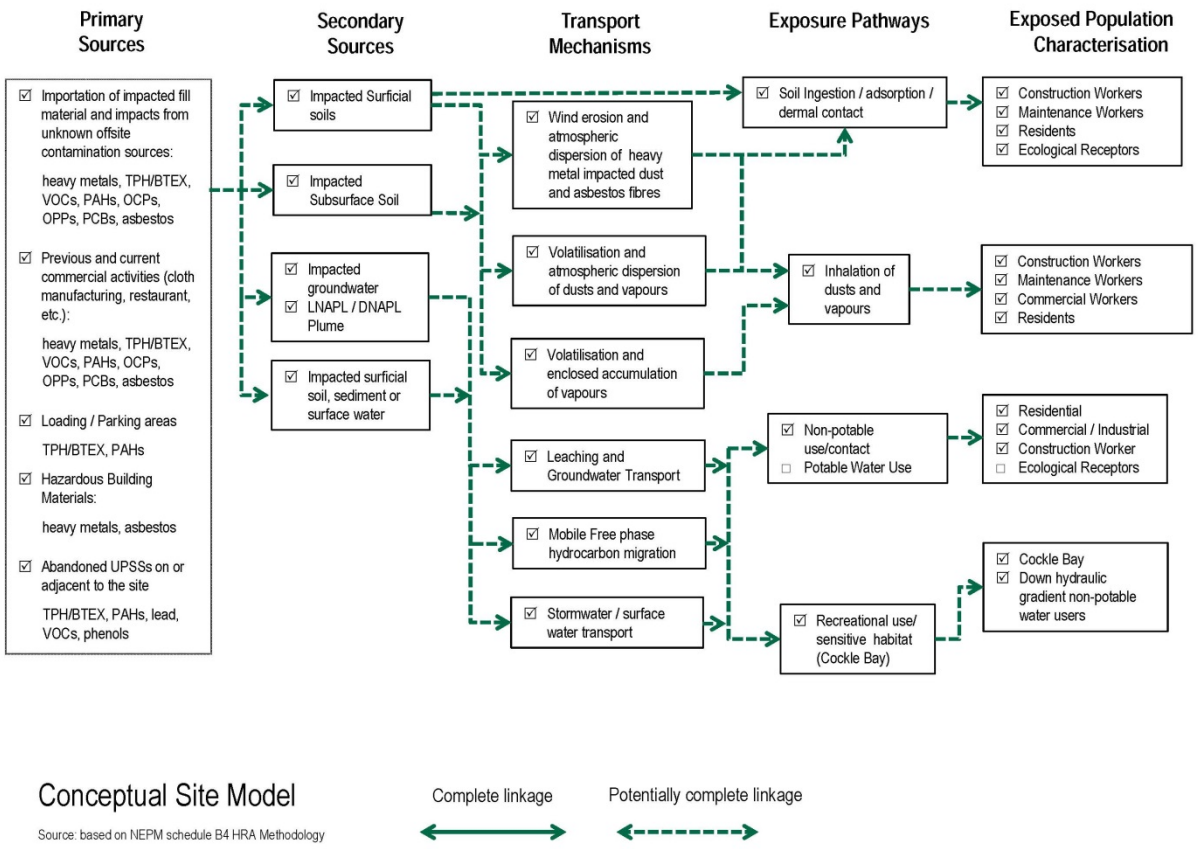
On the basis of site history and review of the detailed assessment (EI, 2014), EI considers potential chemical hazards and onsite contamination sources to be as follows:

- Imported fill soils of unknown origin distributed across the site;
- Historical and current commercial activities on site;
- Demolition of previous site buildings;
- Weathering of painted structural surfaces (buildings), historically and currently;
- Hazardous materials, including identified asbestos and potential asbestos-containing materials (ACM) from building products;
- Abandoned underground petroleum storage systems (UPSS) on/adjacent to the site;
- Deeper, natural soils containing residual impacts, representing potential secondary sources of contamination;
- Potential presence of light and dense non aqueous phase liquids (LNAPL & DNAPL) that may spilled onto the ground surface and infiltrated the soil profile, or that may have leaked from the UPSS; and
- Impacts from unknown onsite/offsite contamination sources.

3.5.3 Chemicals of Concern

Based on the findings of the site history and contamination appraisal the chemicals of concern at the site are considered to be:

- Soil – heavy metals (HMs), total recoverable hydrocarbons (TRH), polycyclic aromatic hydrocarbons (PAH), the monocyclic aromatic hydrocarbon compounds benzene, toluene, ethyl benzene and xylenes (BTEX), volatile organic compounds (VOC), organochlorine and organophosphate pesticides (OCP/ OPP), polychlorinated biphenyls (PCB), phenols and asbestos.
- Groundwater – HMs, TPH, BTEX, PAH, VOC including chlorinated VOC (VOCC) such as trichloroethylene (TCE).



Drawing 1 Conceptual Site Model for 757-763 George Street, Haymarket NSW

3.6 SUMMARY OF CONTAMINATION REQUIRING REMEDIATION

Based on the previous investigations the primary sources of contamination that require remediation include:

- Remaining in-situ Underground Petroleum Storage Systems;
- Nickel, zinc, TRH fraction F1, F2 and F3, as wells as VOCs impacted groundwater.

Further discussion on the extent of remediation is provided in **Section 5.4**.

3.7 DATA AND INFORMATION GAPS

Based on the conceptual site model derived for the site, the following data gaps were identified:

- Unknown quality of fill and natural soils directly under the existing building footprints and to depth of basements;
- Unknown quality of lower units of fill soils in the vicinity of sampling location BH2 (filling depth down to 7.25m BGL) identified during the previous investigation (EI, 2014);
- Unknown quality of natural soils across the site

- Unknown location of possible abandoned UPSSs identified during the previous investigation (EI, 2014);
- Limited groundwater quality data and direction of flow underneath the site, as one monitoring well (MW1) was installed onsite;
- Unknown migration of impacted groundwater identified during the previous investigation (EI, 2014);
- Unknown potential for vapour risk from identified VOCs in groundwater (EI, 2014);
- Unknown presence of hazardous materials within the buildings present onsite.

These data gaps are due to accessibility restrictions at the site to be addressed post demolition.

4 REMEDIATION GOALS AND CRITERIA

4.1 REMEDIATION GOALS

The main goal of the remediation program is to remove primary and secondary contamination sources so as to render the site suitable for the proposed land use (residential with minimal soil access including hotels).

This will require the decommissioning and removal for off-site disposal of underground tanks and associated infrastructure (i.e. filling lines) and to remediate impacted soil and groundwater, where necessary.

4.2 EXTENT OF REMEDIATION REQUIRED

Investigations to date have identified the following areas of the site requiring remediation:

- The removal and appropriate off-site disposal of the possible two, underground tanks and associated facilities after appropriate collection of residual liquids and any contaminated soils and UPSS backfill materials; and
- Soil validation and groundwater sampling and laboratory testing, following the remediation works at the site to allow the site to be used for a hotel in accordance with the concept plan approval.

It should be noted that impacted groundwater will require remediation subject to the further groundwater investigations discussed in **Section 5.5**.

Table 4-1 Approximate Excavation Volumes

Area/Tanks	Approximate Volume	Excavation Area- Approximate Dimensions	
	(m^3)	Area (m^2)	Depth (m)
UST (size subject to further investigation)	TBA	-	-
Filling points and lines (area subject to further investigation)	-	-	-
Fill within the basement bulk excavation	2060	1030	2
Natural soils within the basement bulk excavation	7210	1030	7

4.3 SOIL REMEDIATION OPTIONS

In considering the remedial options available for the site, the surrounding lands and the geological and hydrogeological limitations, the following issues have been considered:

- Prioritisation of works;
- Ability of remedial method to mitigate contamination with respect to the proposed development and receptors;
- Remedial timetable and cost effectiveness;
- Defensible method to ensure the site is remediated to appropriate levels / validation criteria;
- Monitoring and status of remedial works including risk based performance objectives; and

- Regulatory compliance.

4.4 SOIL CRITERIA

It is understood that the proposed development comprises a multi-storey hotel and retail building, overlying a two-level basement. Soil remediation criteria adopted to be used as clean up levels are based on NEPM (2013):

- *Residential B Health Investigation Levels* (HIL B) for residential settings with minimal opportunities for soil access. HIL B also encompasses more sensitive commercial land uses such as childcare facilities, hotels and hostels (Ref. NEPM 2013, Schedule B7, Section 3.2.4).
- Soil Health Screening Levels (HSLs) D thresholds for vapour intrusion at commercial and industrial sites were applied due to the proposed basements.

The proposed criteria with respect to the potential contaminants of concern in soils are detailed in **Table 4-2**.

Table 4-2 Soil Remediation Criteria

Chemical	Unit	PQL	HILs/HSLs Residential B	HSLs Commercial/Industrial D [1]
Metals				
Arsenic – As	mg / kg	3	500	-
Cadmium - Cd	mg / kg	0.3	150	-
Chromium(VI) – Cr(VI)	mg / kg	0.3	500	-
Copper – Cu	mg / kg	0.5	30,000	-
Lead – Pb	mg / kg	1	1,200	-
Mercury – Hg (inorganic)	mg / kg	0.01	120	-
Nickel – Ni	mg / kg	0.5	1,200	-
Zinc – Zn	mg / kg	0.5	60,000	-
Petroleum Hydrocarbons				
F1*	mg / kg	25	45 (0m - <1m)[2] 70 (1m - <2m) 110 (2m - <4m) 200 (4m+)	260 (0m - <1m) 370 (1m - <2m) 630 (2m - <4m) NL (4m+)
F2**	mg / kg	25	110 (0m - <1m)[2] 240 (1m - <2m) 440 (2m - <4m) NL (4m+)	NL
F3 (>C16-C34)	mg / kg	90	2,500	-

Chemical	Unit	PQL	HILs/HSLs Residential B	HSLs Commercial/Industrial D [1]
F4 (>C34-C40)	mg / kg	120	10,000	-
Polycyclic Aromatic Hydrocarbons				
Naphthalene	mg / kg	0.1	3 (0m - <1m)[2] NL	NL
Benzo(α)pyrene	mg / kg	0.1	-	-
Carcinogenic PAHs (as B(α)P TEQ)***	TEQ	0.2	4	-
Total PAHs	mg / kg	0.8	400	-
Monocyclic Aromatic Hydrocarbons (BTEX) [4]				
Benzene	mg / kg	0.1	0.5 (0m – 4m+)[2]	3 (0m – 4m+)[2]
Toluene	mg / kg	0.1	160 (0m - <1m)[2] 220 (1m - <2m) 310 (2m - <4m) 540 (4m+)	NL
Ethylbenzene	mg / kg	0.1	55 (0m - <1m)[2] NL (1m – 4m+)	NL
Xylenes (total)	mg / kg	0.3	40 (0m - <1m)[2] 60 (1m - <2m) 95 (2m - <4m) 170 (4m+)	230 (0m - <1m)[2] NL (1m – 4m+)
Asbestos HSLs [4]				
Bonded Asbestos	w / w		0.04%	0.05%
Friable Asbestos (FA & AF) [3]			0.001%	-
All forms of Asbestos			No visible in surface soils	

Notes:

Residential B = NEPM 2013, HILs / HSLs Residential with Minimal Access to Soil

Commercial / Industrial D = NEPM 2013, HSLs Commercial / Industrial

* = To obtain F1 subtract the sum of BTEX concentrations from the C_6-C_{10} fraction.

** = To obtain F2 subtract Naphthalene from the >C_{10}-C_{16} fraction.

*** = Carcinogenic PAHs HIL is based on the 8 carcinogenic PAHs and their TEFs (potency relative to Benzo(α)pyrene) – ref. footnote (6) of NEPC (2013) *Schedule (B1)* Table 1A(1) for further details.

[1] = Health Screening Levels (HSLs) for sand, ref. NEPC (2013) Schedule B1 Table 1A(3). Relevant HSLsRAC values will be adopted based on site specific aspects and conditions.

[2] = Soil Health Screening Levels (HSLs) developed for selected petroleum compounds and fractions, applicable to assessing human health risk via the inhalation and direct contact pathways, ref. NEPC (2013) *Schedule B1* Table 1A(3).

[3] = FA – Fibrous Asbestos, AF – Asbestos Fines (Ref. NEPM 2013, Schedule B1, Table 7).

[4] = Health Screening Levels (HSLs) for asbestos contamination in soil, ref. NEPC (2013) *Schedule B1* Table 7.

Relevant HSLs values will be adopted based on site specific aspects and conditions.

NR = no registered criteria value. NL – Not limiting

Conformance with the criteria will be deemed to have been attained when either all validation samples show contaminant concentrations that are below the specified criteria, or, as a minimum, the 95% upper confidence limit (UCL) mean concentration values of each contaminant in the remediated area (i.e. across the excavated surface), are below the respective remediation criteria.

4.5 WASTE CRITERIA

Prior to being removed from the site, excavated soils must be classified in accordance with the EPA (2014) *Waste Classification Guidelines* (the 'Waste Guidelines'). Under these guidelines, fill/soils may be classified into the following groups: *General Solid Waste, Restricted Solid Waste* or *Hazardous Waste*, subject to laboratory test results for total and leachable contaminant levels, the later involving the *Toxicity Characteristics Leaching Procedure* (TCLP). The total contaminant concentrations and TCLP results for each parameter will then be interpreted against the respective EPA (2014) thresholds (*Ref*. **Table 4-3** and **Table 4-4**), in order to classify the waste. Soils containing asbestos may also be classified as *Special Waste (Asbestos Waste)*, assuming no other contaminant is present at such a level as to render the material *Restricted Solid Waste* or *Hazardous Waste*.

Table 4-3 Waste Classification without Leachate Testing

Contaminant	Maximum Values of *Specific Contaminant Concentration* for Classification without TCLP	
	General Solid Waste CT1 (mg/kg)	Restricted Solid Waste CT2 (mg/kg)
Arsenic	100	400
Benzene	10	40
Benzo(a)pyrene	0.8	3.2
Cadmium	20	80
Chromium (VI)	100	400
Ethylbenzene	600	2,400
Lead	100	400
Mercury	4	16
Nickel	40	160
Toluene	288	1,152
Xylenes (total)	1,000	4,000
TRH C6-C9	650	2,600
TRH C_{10}-C_{36}	10,000	40,000
PAHs (total)	200	800
Xylenes	1,000	4,000

Table 4-4 Waste Classification using TCLP and SCC Values

Contaminant	Maximum Values for *Leachable Concentration* and Specific Contaminant Concentration when used together			
	General Solid Waste		***Restricted Solid Waste***	
	Leachable Concentration	**Specific Contaminant Concentration**	**Leachable Concentration**	**Specific Contaminant Concentration**
	TCLP1 (mg/L)	**SCC1 (mg/kg)**	**TCLP2 (mg/L)**	**SCC2 (mg/kg)**
Arsenic	5.0	500	20	2,000
Benzene	0.5	18	2	72
Benzo(a)pyrene	0.04	10	0.16	23
Cadmium	1.0	100	4	400
Chromium (VI)	5	1,900	20	7,600
Ethylbenzene	30	1,080	120	4,320
Lead	5	1,500	20	6,000
Mercury	0.2	50	0.8	200
Nickel	2	1,050	8	4,200
TRH C_6-C_9	N/A	650	N/A	2,600
TRH C_{10}-C_{36}	N/A	10,000	N/A	40,000
PAHs (total)	N/A	200	N/A	800
Xylenes	50	1,800	200	7,200

Note: N/A = not applicable (assessed using SCC1 and SCC2 values, only)

Should the analytical results exceed the SCC2 and/or TCLP2 thresholds, then the materials will be classified as *Hazardous Waste*. In such cases, material stabilisation treatment with EPA approval may be required for offsite disposal. This approach is discussed in more detail under the contingency plan in **Section 7.3**.

Unexpected material may need to be segregated depending on the source of the waste.

4.6 GROUNDWATER CRITERIA

For the further investigation of groundwater at the site and given the proximity of the site to Cockle Bay, analytical results for groundwater will be assessed against the following criteria:

- NEPM (2013) Groundwater Investigation Levels for the protection of Marine Waters;
- NEPM (2013) Groundwater Investigation Levels for the protection of Fresh Waters (where NEPM 2013 does not provide Marine water criteria); and
- NEPM (2013) Groundwater Investigation Levels for the protection of Drinking Water (where NEPM 2013 does not provide Marine or Fresh water criteria).

Table 4-5 Groundwater Remediation Criteria

Chemical	Unit	PQL	Marine Water	Fresh Water	Drinking Water	HSL D
Metals						
Arsenic – As	µg / L	1	NR	24 (AsIII) 13 (AsV)	100	NR
Cadmium - Cd	µg / L	0.1	0.7	0.2	20	NR
Chromium(VI) – Cr(VI)	µg / L	1	27	NR (Cr III)	NR	NR
Copper – Cu	µg / L	1	1.3	1.4	20,000	NR
Lead – Pb	µg / L	1	4.4	3.4	100	NR
Mercury – Hg (inorganic)	µg / L	0.1	0.1	0.06	10	NR
Nickel – Ni	µg / L	1	7	11	200	NR
Zinc – Zn	µg / L	5	15	8	NR	NR
Petroleum Hydrocarbons						
F1*	µg / L	50	NR	NR	NR	6,000 (2m - <8m)
F2**	µg / L	60	NR	NR	NR	NL
F3 (>C16-C34)*	µg / L	500	NR	NR	NR	NR
F4 (>C34-C40)**	µg / L	500	NR	NR	NR	NR
Polycyclic Aromatic Hydrocarbons						
Naphthalene	µg / L	0.1	50	16	NR	NL
Benzo(α)pyrene	µg / L	0.1	NR	NR	0.1	NR
Monocyclic Aromatic Hydrocarbons (BTEX) [4]						
Benzene	µg / L	0.5	500	950	10	5,000 (0m – 8m+)
Toluene	µg / L	0.5	NR	NR	8,000	NL
Ethyl benzene	µg / L	0.5	NR	NR	3,000	NL
Xylenes (total)	µg / L	1.5	NR	550	6,000	NL
VOCs						
Vinyl Chloride (Chloroethene)	µg / L	0.3	NR	NR	3	NR
1,1-Dichloroethene	µg / L	0.5	NR	NR	300	NR

Chemical	Unit	PQL	Marine Water	Fresh Water	Drinking Water	HSL D
1,1-Dichloroethane	µg / L	0.5	NR	90	NR	NR
Cis-1,2-Dichloroethene	µg / L	0.5	NR	NR	600	NR
Chloroform (THM)	µg / L	0.5	NR	NR	30	NR
1,2-Dichloroethane	µg / L	0.5	NR	1,900	30	NR
1,1,1-Trichloroethane	µg / L	0.5	NR	270	NR	NR
Trichloroethene (TCE)	µg / L	0.5	NR	330	NR	NR
1,1,2-Trichloroethane	µg / L	0.5	1,900	6,500	NR	NR
Tetrachloroethane (PCE)	µg / L	0.5	NR	NR	500	NR
1,1,2,2-Tetrachloroethane	µg / L	0.5	NR	400	NR	NR

Notes:

* = To obtain F1 subtract the sum of BTEX concentrations from the C_6-C_{10} fraction.

** = To obtain F2 subtract Naphthalene from the >C_{10}-C_{16} fraction.

[1] = Groundwater Health Screening Levels (HSLs) developed for selected petroleum compounds and fractions, applicable to assessing human health risk via the inhalation and direct contact pathways, ref. NEPC (2013) *Schedule B1* Table 1A(4).

[2] = Health Screening Levels (HSLs) for sand, ref. NEPC (2013) Schedule B1 Table 1A(4) for commercial / industrial land uses. Selection of HSL D land use has been made based on the proposed commercial uses on ground floor, ref. NEPC (2013) and *Technical Report No. 10 - Health screening levels for petroleum hydrocarbons in soil and groundwater published by the CRC for Contamination Assessment and Remediation of the Environment (E Friebel and P. Nadebaum, 2011)*. Relevant HSLs RAC values will be adopted based on site specific aspects and conditions.

NR = no registered criteria value. NL – Not limiting

5 REMEDIATION WORKS

5.1 REVIEW OF REMEDIAL TECHNOLOGY

Selection and implementation of any remedial method depends initially on the proposed land use criteria to ensure protection of human health and the environment. Remedial options are then chosen by assessing the feasibility of each option to reach the clean-up goal and evaluating the costs and acceptability of the option. Risk driven remediation can also be considered depending on acceptance of materials being left on site. Remediation should also consider the concepts of ecologically sustainable development (ESD), which attempts to balance acceptable environmental risk/outcomes to the social and economic costs while protecting the biodiversity and heritage.

Readily available remediation techniques were considered for the site, which were then either accepted or rejected based upon their applicability to the contaminants of concern, site setting and cost/technology issues.

As bulk excavation of the site is required for basement construction, classification and offsite disposal would be the likely preferred approach.

Groundwater impacts in the form of elevated heavy metals, hydrocarbons and chlorinates were identified during previous groundwater investigations at the site. The review of remediation technologies focuses on soil remediation methods at this stage. This technology comparison may be updated subject to further groundwater investigation results as part of the data gap closure post-demolition.

Advantages, disadvantages and suitability of available soil remedial technologies are summarised in **Table 5-1**

Table 5-1 Remedial Technology Review – Soils

Remediation methodology	Description	Advantages	Disadvantages	Suitability
No Action	'No Action' can be considered if: • There is no measurable contamination; • Contaminant concentrations are below assessment guidelines; • Contaminants are not mobile; or • Exposure to contaminated soils is unlikely.	No remediation costs Creates minimal disturbance to the site Retains material on-site	Not applicable to the kind of contamination encountered at the site. Contamination would remain in situ allowing potential off-site migration of contamination and impacts on groundwater. Would pose limitations on land use options. Requires an Environmental Management Plan and ongoing monitoring.	Not suitable – based on the results and recommendations of previous site assessments, the "do nothing" option is not considered to be suitable.
On-site bioremediation	Excavated soils are thoroughly broken down and aerated, mixed with microorganisms and nutrients, stockpiled and aerated in above ground enclosures.	Cost effective if soils are utilised on-site. Lower disposal costs. Limited requirement to import fill material to site. Retains material on-site.	Significant area of site required to land farm material. Undefined remediation timeframe. Potential for odour problems. Uncertainty of successful results, particularly for the heavy-end hydrocarbons. Not suitable for metals contamination.	Possibly suitable – should unexpected contaminated materials be encountered. This may be more cost effective than off-site disposal; however this will be dependent on the volume of impacted material.
In-situ treatment	*In-situ* treatment of impacted soils within the smear zone and saturated zone using *in-situ* treatment methods such as SVE, steam stripping, ISCO or injection of oxygen releasing compounds.	Creates minimal disturbance to the site (no excavation). Cost effective for large scale site remediation projects of light to mid-weight petroleum hydrocarbons. Potential to simultaneously remediate dissolved phase hydrocarbons in site groundwater.	Not applicable to the kind of contamination encountered at the site. Expensive establishment costs. Potential for odour problems. Requires detailed design, pilot trials and management.	Not suitable – this method is designed for widespread hydrocarbon impacted soils. Since the present dataset does not provide evidence of widespread contamination, this is not considered to be an economically viable option.

Remediation methodology	Description	Advantages	Disadvantages	Suitability
Consolidation and/or capping	Risk minimisation approach where impacted soils are managed on-site by capping the ground surface with a clean, impermeable layer of fill material.	Effectively removes risk to human health by eliminating exposure pathways.	Importance of capping materials. Contamination would remain in situ allowing potential off-site migration of contamination and impacts on groundwater. Would pose limitations on land use options. Requires an Environmental Management Plan and ongoing monitoring.	Possibly suitable – however further soil and groundwater investigation is required to determine the extent of contamination (especially associated with the potential presence of the abandoned UPSSs).
Excavation and off-site disposal	Excavate soil materials to allow for basement construction. Transport directly to a licensed landfill facility. Re-instate site with imported clean fill material.	Fast – impacted material removed immediately, significantly reducing potential for impact to groundwater. No storage or treatment problems. Reduced vapour/odour issues as impacted materials removed from site. Minimal design and management costs.	Transfer of waste to another location (licensed waste facility). High costs associated with the disposal of waste soils and importation of clean backfill. May require some additional testing (including TCLP) to enable waste classification prior to disposal. Not in accordance of the redevelopment vision. Sustainability issues related to disposal to landfill.	Suitable – this will remove all contaminated soils. Required for basement construction.
Natural attenuation	Allowing the contaminants to biodegrade naturally following removal of the contamination source.	No remedial excavation of site. Retains materials on site. Sustainable, cost effective remediation method.	Slow process. Potential for contamination to further impact on the groundwater aquifer and nearby environmental receptors. Unlikely to improve the geotechnical characteristics of contaminated fill. Would require Environmental Management Plan and ongoing monitoring.	Possibly Suitable –the objective of the remedial works is to ensure the site is suitable for the proposed use without ongoing monitoring. However, if any organic contamination is detected at the boundary, natural attenuation may be suitable as the hydrocarbons degrade.

5.2 PREFERRED REMEDIATION STRATEGY

Based on the assessment of remedial technologies, the potential risks to human health and the environment and considering the cost effectiveness of each remedial technique, the preferred remedial strategy for the site is a staged approach involving:

- Hazardous materials assessment conducted on the remaining commercial buildings prior to any partial demolition;
- Site demolition to allow further assessment, particularly in the southern site portion;
- Removal of sources of contamination by decommissioning and appropriate off-site disposal of site infrastructure, including all underground storage systems;
- Classification and bulk excavation of soils to allow for appropriate offsite disposal during construction of the proposed basement:
  - Classification and disposal of all wastes (including contaminated soils) by licensed transport to approved/licensed, off site, waste facilities; and
  - Remediation of the impacted soils (where required) using a combination of the following:
    - Excavation and disposal of impacted soils to a licensed landfill facility;
    - Excavation and on-site separation of highly impacted soils (where concentrations exceed criteria for classification as restricted solid waste) for additional waste classification prior to disposal; and
    - Program of monitored natural attenuation for low level soil and groundwater contamination, which may remain due to design issues.

Material derived from the site, including contaminated soil, rock and fill would be removed by truck to a suitable licenced disposal facility or recycled where classified as virgin excavated natural material (VENM) or excavated natural material (ENM) in accordance with the general waste exemptions (EPA, 2014). The potential environmental impacts relating to the demolition, remediation and offsite disposal are discussed further in **Section 5.7**.

As groundwater impacts require further groundwater assessment, remedial action for groundwater at the site is not proposed at this stage, but may be considered at a later stage if warranted.

Details on the methodology to be employed for the key work tasks are described below. They will not necessarily be conducted in the indicated sequence.

5.3 APPROVALS AND LICENCES

5.3.1 State environmental planning policies

State Environmental Planning Policy No 55 (SEPP 55) – *Remediation of Land* sets the regulatory framework for contaminated land and remediation works in NSW. Remediation work which requires development consent is known as Category 1 work which refers to work:

- Classed as *designated development*;
- Proposed on land identified as critical habitat;

- Where consideration indicates remediation work is likely to have a significant effect on threatened species, populations, ecological communities or their habitats;
- Proposed in an area or zone designated as an area of environmental significance such as scenic areas, wetlands; and
- Requiring consent under another state environmental planning policy or a regional environmental plan.

All other remediation work is classified as Category 2 works, which may be carried out without development consent. EI considers the work to be classified as Category 2 works. The following notifications, licenses and approvals would be required to undertake the site remediation works:

- Council approval of the RAP document and notification for Category 2 remediation works (i.e. 30 days' notice prior to works commencement); and
- Notification of tank disposal under UPSS and SafeWork NSW regulations (once UPSS locations have been established).

5.3.2 Development Control Plans (DCPs)

No local planning instruments dealing with the management and remediation of contaminated land have been identified through Sydney City Council.

5.3.3 Other licences required

Transporters of contaminated waste are required to be licensed to transport contaminated waste to the licensed landfills. Landfills are required to be licensed for the category of waste they are scheduled to receive.

Waste receipts and evidence of disposal of classified waste fill/soils at an appropriately-licensed landfill facility should be provided for site validation purposes. NSW EPA requires a cradle to grave approach in the management of waste. Non-compliance with the waste guidelines can result in significant fines in accordance with the NSW Protection of the Environment Operations Act.

5.4 TASK 1 – PRELIMINARIES AND SITE PREPARATION

At least 30 days prior to the commencement of remediation, notice shall be given to Council. A list of all required work permits will be obtained from Council and arrangements are to be made to obtain the necessary approvals from the relevant regulatory authorities.

The site itself will be prepared in accordance with the requirements of the Environmental Management Plan outlined in **Section 7**. Once cleared, a thorough walkover inspection of the site shall be conducted, to assess for visible evidence indicating the presence of UPSS and/or contamination.

5.5 TASK 2 – FURTHER INVESTIGATION WORKS

Due to the identified data gaps outlined in **Section 3.7** of this RAP the following additional works are required in order to properly characterise the environmental status of the site. This will enable the assessment of the risks associated with potential exposure of human and ecological receptors to residual contamination. The data gap closure investigations should include:

- Prior to any demolition, a detailed hazardous materials survey should be undertaken to identify any potential hazardous substances requiring management and to minimise any impact to the site soils;

- In addition the exact location of the USTs, including associated infrastructure (i.e. location of former bowsers and lines traced back to USTs) should be established by the use of a GPR and then removed in accordance with the UPSS 2014 Regulation;

- Following demolition, further soil investigation involving a minimum of nine additional boreholes is required across the site surface to supplement the former test bores BH1 – BH5 (proposed sampling locations are indicated on **Figure 2**). The additional boreholes are to be located in previously inaccessible areas of the site (i.e. beneath current building footprints and to depth of basements, where refusal occurred with the use of a hand auger), the north-western part of the site in the vicinity of BH2 to establish the lateral extents of the deeper filling area and its quality, as well as the north-eastern portion of the site (on review, the previously shown site boundary (E22293AA, **Figure 2**) has been now aligned to the boundary shown on the surveying map, resulting in sampling location BH4 comprising an offsite location). The new bores will extend to at least 0.5m within natural soils, with soil sampling and laboratory analysis for the potential contaminants of concern;

- Data gap closure investigations in relation to groundwater will involve the installation of three new monitoring wells located as follows:

  – one well located east and up-hydraulic gradient of the site, to target potential off-site contamination migrating into the site;

  – one well located south-west and up-gradient of the site, to target potential contaminant migration from the UST (as it is likely located beneath the footpath of Valentine Street); and

  – one well located north-west and down-hydraulic gradient of the site, to target potential contaminants migrating off-site.

- A survey of the monitoring wells and standing water level measurement is also required in order to extrapolate and confirm the groundwater flow direction.

- Assess for potential vapour risk by undertaking VOC testing in soils and groundwater.

Should contamination be identified during additional investigatory works, an addendum to the RAP will be required to address the identified contamination.

5.6 TASK 3 – UPSS AND UNDERGROUND PITS

The results from the assessment phase (EI, 2014) indicated that two abandoned UPSSs are likely present on site, possibly resulting in petroleum hydrocarbon contamination of nearby fill soils, underlying natural soils and groundwater. A geophysical survey utilising the Ground Penetrating Radar method should be conducted across the site by a suitable, qualified contractor, in order to confirm the exact position of suspected underground tanks and infrastructure, as well as to survey for any additional, unknown (or forgotten) UPSS that may still be present on the site.

Residual liquids may be present within the underground tanks and product lines that remain on the site. Any liquid waste should be classified for disposal purposes as defined in NSW EPA (2014).

The following methodology is proposed for these areas, as well as any other UPSS which may be subsequently encountered during the data-closure investigations and site remediation phase:

- Appropriate decommissioning and removal the USPSSs and any associated filling points, fuel feed lines and vent pipes (firstly draining where necessary) in accordance with:

  – AS4976 – 2008, Australian Standard for the removal and disposal of underground petroleum storage tanks;

  – POEO (Underground Petroleum Storage System) Regulations (2019); and

  - NSW Safework and other requirements under the Work Health and Safety Act and associated regulations.

- Field screening of soil samples collected from the base and side walls of the final excavations in accordance with EPA (2014) Technical Note: Investigation of Service Station Sites, during which, a portable photo-ionisation detector (PID) will be used as a field screening tool to provide indicative (semi-quantitative) data in relation to VOC concentrations in soil headspace samples, together with visual and olfactory observations.

- Validation samples will be collected from excavation surfaces (walls and bases) for laboratory analysis for petroleum hydrocarbons, BTEX, PAHs and heavy metals.

Petroleum hydrocarbon impacted soils are to be stockpiled separately from other site fill/soils, for ex-situ, waste classification assessment. Water that may collect within remedial excavations will require water sampling and testing to enable appropriate disposal and /or recycling.

5.7 TASK 4 – MATERIALS AND WASTE MANAGEMENT

Prior to being assigned to an appropriate waste disposal facility, all waste fill/soils will be classified in accordance with the EPA (2014) *Waste Classification Guidelines.* If prior immobilisation treatment of the waste soils is required, disposal consent will be obtained from the NSW EPA prior to spoil transport.

All excavated soils shall be stockpiled separately within the designated excavation area, or transported to a suitable compound (with appropriate waste tracking documentation) for temporary storage, to enable waste classification sampling and testing. All stockpile heights must be limited to a maximum of 2 m. After waste classification, the materials will be transported and disposed to EPA-licensed, waste landfill facilities.

In accordance with the NEPM (2013) guidelines, stockpiled fill/soils will be sampled and laboratory analysed for waste classification purposes in accordance with the following methodology:

- Collection of one sample per 25 m^3 of stockpiled material for the fill/soils produced by the hotspots excavation;

- Collection of one intra-laboratory duplicate for every 10 primary samples collected and one inter-laboratory duplicate for every 20 primary samples collected;

- Collection of one rinsate blank per sampling round;

- Analysis of all samples from impacted areas for heavy metals (including lead), TRHs, BTEX and PAHs; and

- Preparation of a Waste Classification Certificate detailing the interpreted soil waste classification for each stockpile, to enable appropriate off-site disposal.

The proposed sampling plan may be varied due to site constraints; however guidance from the appointed Environmental Project Manager must be sought to ensure that deviations from this RAP are properly documented, as required under the EPA (2020) guidelines. Where anomalies in fill/soil consistency are noted (such as heavy staining, odour and/or presence of waste or oils), additional sampling and analysis may be necessary and guidance in this regard should be sought from the appointed Environmental Project Manager.

If the stockpiled materials contain concentrations of contaminants that exceed the disposal guidelines for *Restricted Solid Waste* (i.e. the materials are classed as potentially *Hazardous Waste*), they will be held on-site pending the determination of alternative disposal arrangements and/or on-site treatment (i.e. stabilisation and/or micro-encapsulation). If required, disposal consent will be sought from the EPA NSW

prior to spoil transport. Contingency measures to handle and manage the disposal of spoil materials that fail to meet landfill threshold criteria are provided in **Section 7.3**.

Table 5-2 summarises the measures that should be implemented in respect of materials handling during excavation and remediation works at the site.

Table 5-2 Materials handling and management requirements

Item	Description/ Requirements
Potential for asbestos containing materials	All asbestos handling, removal, transport and disposal must be performed in accordance with NSW legislative requirements. The National Occupational Health and Safety Commission Code of Practice for the Safe Removal of Asbestos, 2nd Edition [NOHSC 2002(2005)], April 2005 provides more guidance. During excavation works, any surface asbestos cement fragments encountered should be segregated and placed in 200µm thick polythene bags (1200 mm x 900 mm). Bags are to be sealed and double bagged to reduce the risk of the bags splitting
Suitably qualified contractors	Although current laboratory testing has not revealed the presence of asbestos in fill materials at the site, subsequent to results from the additional investigation and taking into consideration the likelihood of its presence, works must be carried out under the direct supervision of a suitably qualified contractor. Should asbestos identified to be present during the additional data gap closure works, excavation of soils impacted by asbestos shall be undertaken in accordance with the control measures recommended within the RAP and with direction from a consultant qualified in occupational hygiene who has been engaged independently of the removal contractor. Correct implementation of these measures should ensure that; • All site staff are aware of the requirements to be adhered to • There is no discernable release of dust potentially containing asbestos fibres into the atmosphere as a consequence of the works. • There is no discernable release of contaminated soil into any waterway as a consequence of the works. • There are no pollution incidents, health impacts or complaints.
Personal protective equipment	All persons engaged in excavation of soils potentially impacted by asbestos should wear appropriate PPE in accordance with the site safety plan to be prepared by the site principal contractor.
Material tracking	Materials excavated from the site should be tracked in order to provide detailed and accurate information about the location and quantity of all materials both on and offsite from the time of their excavation until their disposal. The location of disposal locations will be determined by the remediation contractor. For any truck leaving the site, the following information would be recorded: • Origin of material; • Material type; • Approximate volume; and • Truck registration number. Such information should be provided to the remediation consultant for reporting purposes. This information, along with the landfill docket number, will be provided in the validation report.

Item	Description/ Requirements
Stockpiling of materials	All stockpiles will be maintained in an orderly and safe condition (≤2m height). Batters will be formed with sloped angles that are appropriate to prevent collapse or sliding of the stockpiled materials.
Stockpile locations	The location of the stockpiles will be selected to fit with the expected stages of the project. Stockpiles will be located in accordance with the following general requirements: • Stockpiles will only be placed at approved locations; • Stockpiles will be strategically located to mitigate environmental impacts while facilitating material handling requirements; and • Contaminated materials will only be stockpiled in non-remediated areas of the site or at locations that do not pose any risk of environmental impairment of the stockpile area or surrounding areas (e.g. hardstand areas).
Stockpile area preparation	Stockpiles will only be constructed in areas of the site that have been located and prepared in accordance with the requirements of this RAP. All such preparatory works will be undertaken prior to the placement of material in the stockpile. Stockpiles must be located on sealed surfaces such as sealed concrete, asphalt, high density polyethylene or a mixture of these, to mitigate appropriately potential cross contamination of underlying soil. The stockpile areas are to be securely bundled using silt fencing and hay bales around the perimeter of each stockpile area to prevent surface water / silt laden surface water from entering or leaving the stockpiles. Access routes will be established around the material stockpiles to enable access from adjoining haul roads
Stockpile covering	The stockpiles of contaminated material will have to be covered with a waterproof membrane (type polyethylene sheet) to prevent further increase of moisture due to rainwater infiltration and to reduce wind-blown dust or odour emission at the end of each day. Stockpiles shall be lightly conditioned by sprinkler to prevent dust blow. Should the stockpile remain in-situ for over 24 hours, silt fences or hay bales should be erected around each stockpile to prevent losses from surface erosion (runoff).
Backfilling	Any material imported at the site should be certified VENM or ENM.
Loading of material	Direct loading of contaminated fill / soils to appropriate transport vehicles is preferred, with the transport of contaminated material off the site to be via a clearly distinguished haul route. Removal of waste materials from the site shall only be carried out by a recognised contractor holding the appropriate EPA NSW licenses, consents and approvals. Measures shall be implemented to ensure no contaminated material is spilled onto public roadways or tracked off-site on vehicle wheels. Such measures will include the deployment of a vehicle washing/cleaning facility, which should be placed at a location before the egress point on the site. The facility shall be able to handle all vehicles and plant operating on-site. All trucks transporting soils from the site are to be covered with tarpaulins (or equivalent). Residue from the cleaning facility will be collected periodically and either dewatered on site in a contained bunded area or disposed as a slurry to an approved facility. Such residue will be deemed contaminated unless shown by validation to be below criteria. The proposed waste transport route will be notified to Council and truck dispatch shall be logged and recorded by the contractor for each load leaving the site.

Item	Description/ Requirements
Transport of materials	All haulage routes for trucks transporting soil, materials, equipment and machinery to and from the site shall comply with all road traffic rules, minimise noise, vibration and odour to adjacent premises, utilise state roads and minimise use of local road. Consultation with the local Council would be recommended to facilitate selection of the most suitable transport route. All site vehicles should also conduct deliveries of soil, materials equipment or machinery during the approved hours of remediation; securely cover all loads to prevent any dust or odour emissions during transportation, exit the site in a forward direction and avoid tracking soil or sediment onto the road.
Air monitoring	An occupational hygienist should carry out air monitoring during each shift where excavation and removal of soils potentially impacted by asbestos is occurring. Air monitoring should be undertaken surrounding the work area and transit routes on site. If deemed necessary by the hygienist, personal exposure air monitoring can be undertaken on the workers within the work area. Monitoring should be conducted by an independent hygienist at the perimeter of the area and within excavator cabs (at the discretion of the hygienist).
Material visual inspection prior to validation sampling.	Primarily, following the completion of the remedial excavation works to the depths detailed in the RAP, a suitably qualified environmental scientist should undertake a visual inspection of the work area. If visual observations indicate the presence of contamination, removal contractors should re-enter the work area to rectify any issues arising from the inspection (likely to consist of further excavation or 'chasing out' impacted material until soils are deemed to be clear from evidence of potential contamination based on a visual inspection and odours). Following satisfactory completion of the visual inspection, an independent environmental scientist should carry out validation sampling of soils at the excavation base and walls to be sent for laboratory analysis. Only following satisfactory validation, will removal works be deemed as completed.

5.8 TASK 5 – CERTIFICATION OF IMPORTED BACKFILL MATERIAL

Should soils be required to backfill excavations, the imported filling material is to be certified as meeting the criteria by the supplying contractor. Analytical results presented by the contractor to validate imported filling must be derived using NATA-accredited methods, obtained on representative samples that were collected at an appropriate frequency (e.g. 1 sample per 25m^3). All imported clean fill validation results must be included in the final site validation report.

Should excavated materials be identified to be potentially uncontaminated, or potentially suitable for reuse on the subject site, the following confirmation procedure shall be undertaken:

- The identified material is to be visually assessed to determine whether the material can be physically isolated from other potentially contaminated material;
- Should it be found that isolation on a visual basis is feasible, the identified 'clean' materials shall be separately stockpiled in a demarcated area, which is either concrete-paved, or to be lined with an impermeable membrane;
- Verification sampling and analysis shall be conducted on the isolated material at a nominal minimal frequency of one sample per 25m^3;

- Subject to analytical results showing TRH and BTEX and/or heavy metal concentrations that are within the criteria, isolated 'clean' materials may then be reused as filling material on-site, along with any additional imported and validated backfill materials; and
- NO soil or rock is to be imported onto the site for backfilling purposes, unless the supporting documentation is approved by the appointed Environmental Project Manager.

5.9 REMEDIATION SCHEDULE

An estimated schedule for the remedial works is detailed below in **Table 5-3**. The proposed schedule is based on the remedial works being completed as outlined in this RAP and is dependent on the Council approval of the DA and the condition of consent. The estimated timescale is detailed below.

Table 5-3: Indicative remedial schedule

Timeframe	Action
2 weeks	Auditor Approval of RAP
2-3 weeks	Additional Investigation
2-3 weeks	Classification, excavation and offsite disposal of contaminated material and remaining soils for and during basement construction
1-2 week	Validation Sampling
4-6 weeks	Validation Reporting
2 weeks	Auditor Review of Validation Report
TBA	Site Audit Statement and Site Audit Report

6 VALIDATION PLAN

6.1 VALIDATION RATIONALE

The remediation of the UST and associated infrastructure will be deemed acceptable based on the achievement of the following two validation objectives:

1. ***Remedial Excavations*** – Validation of all remedial excavation areas where infrastructure or contaminated soils have been removed will involve sampling and analysis to ensure that contaminant concentrations are within the *Site Criteria* (**Section 4**). The sampling frequency will be in accordance with the NEPC (2013) and EPA (2014) sampling design guidelines and all tests shall be performed by NATA-accredited environmental analytical laboratories.

   Each excavation and ground surface sample obtained for soil validation purposes will be analysed for TRHs and BTEX, as well as any other relevant contaminant that may be identified during the waste soil classification process (e.g. heavy metals, VOCs).

2. ***Backfill Materials*** – Should backfilling be required, validation of imported fill materials used for the backfilling of remediated areas would be required to verify their suitability for the proposed land use. Sampling shall be conducted at a nominal density of 1 sample per $25m^3$ up to a volume of $200m^3$, with all tests performed by NATA-accredited environmental analytical laboratories. Testing of imported materials intended for backfilling of excavated areas shall include but not be limited to the minimum suite specified for imported fill under the EPA (2014) Technical Note (e.g. heavy metals, TRHs, BTEX, PAHs, OCPs, PCBs and asbestos).

6.2 SOIL VALIDATION DESIGN

The site conceptual model suggests that the site infrastructure is constructed onto fill soils underlying residual clays, followed by sandstone. Up to date data reveal filling materials to extend to approximately 0.8m BGL with a deep filling area at the north-western part of the site. Based on information provided from the previous investigation (EI, 2014), it is anticipated that the UST locations will be underneath the footpath of Valentine Street, likely constructed within natural soils and backfilled. The amount of validation samples required for the UPSS is therefore dependant on the remediation area of the UPSS.

Validation sampling would be undertaken following the removal of identified contaminated material to ensure that the vertical and lateral extent of the contamination has been defined. Should residual contamination be identified, it would be ”chased out” where appropriate until material exceeding the validation criteria has been removed. As part of the contingency process, however, consideration would also need to be given to potential impacts to flora.

The collection of validation samples will be based on:

- visual observations; and
- screening of material using a photoionisation detector (PID) for the presence of elevated levels of volatile organic compounds (VOCs).

All samples should be sent under appropriate ‘chain of custody’ (CoCs) to NATA accredited laboratories.

Based on the above comments, the following validation sample design is proposed in **Table 6-1** below.

Table 6-1 Validation Sampling Design

Item/Area (source)	Sampling Density	Potential Contaminants
Classification of remaining natural soils within the basement excavation	Ensuring that an adequate number of samples have been retrieved during the further soil investigation phase (**Section 5.5**) to validate the site on a 10 m grid (surface and depth).	TPH, BTEX, selected PAHs, heavy metals, selected asbestos & pesticides
Underground storage tanks & fuel infrastructure EPA (2014) Technical Note: Investigation of Service Station Sites.	• Min 5 samples from each tank pit as per NSW EPA (2014) including walls and base • tank liquids & sludges as per NSW DECCW (2014) • selected seepage samples • 1 sample per bowser • addition base and wall samples if greater than 1 tank per pit • 1 sample per 8.5 m run of line trench exposed	TPH, BTEX, selected PAHs, heavy metals
Remediated hotspots (if any identified in subsequent data gap closure works)	Linear – 1 sampling location per 10m length of excavation walls. Vertical –1 sampling location per 0.5m depth of excavation. Base – 1 sample per 100 m^2.	Relevant contaminant(s) of concern
Groundwater	Appropriate wells will be sampled following source removal and near the end of the site preparation works. Selected seepage zones will be sampled if encountered in tank pit excavation.	TPH, BTEX, PAHs, heavy metals, VOCs
Landfarm and Stockpiled Material	Any soil material stockpiled on-site for landfarming or for re-evaluation for waste classification should be sampled at a rate of one per 25 m^3. Landfarmed material suitable for re-use may be tested at a higher frequency depending on the re-use options. Stockpiled crushed concrete will be tested at a rate of one per 25 m^3 for recycling or reuse.	
Imported Fill Material	If material is required to be sourced from off-site to reinstate the sites, it should be certified suitable for the intended use. If the material is not Virgin Natural Excavated Material (VENM) or if no suitable certification can be supplied by the source then the material should be sampled at a rate of one per 100 m^3.	

Excavation of contaminated material shall continue until the analytical results indicate compliance with the criteria (i.e. either the concentrations of all contaminants are within the criteria, or the 95% UCL average contaminant concentration for each detected parameter is within the criteria). If results indicate that additional excavation is necessary, the excavation shall be extended until the excavation surface samples indicate that the location is validated as meeting the criteria for each respective contaminant.

6.3 SOIL SAMPLING METHODOLOGY

The soil sampling and handling of the collected samples is proposed in **Table 6-2**.

Table 6-2 Sample Collection and Handling

Action	Description
Sample Collection (soils)	Soil validation sampling will be directly from the exposed surface of excavation, or from the material brought to the surface by the backhoe/excavator bucket. Sampling data shall be recorded to comply with routine chain of custody requirements.
Sampling, handling, transport and tracking	• The use of stainless steel sampling equipment; • Washing of all sampling equipment, including hand tools or excavator parts in contact with the sample, in a 3% solution of phosphate free detergent (Decon 90) then rinsing with potable water prior to each sample being collected; transfer of the sample into new glass jars or plastic bags, with each plastic bag individually sealed to eliminate cross contamination during transportation to the laboratory; • Labelling of the sample containers with individual and unique identification including Project No., Sample No., Sampling depth, date and time of sampling; • Placement of the containers into a chilled, enclosed and secure container for transport to the laboratory; and • Use of chain of custody documentation to ensure that sample tracking and custody can be cross-checked at any point in the transfer of samples from the field to ultimate hand-over to the environmental laboratory.
Sample Containers & Holding Times	• Metals - 250g glass jar / refrigeration 4^{o}C / 6 months (maximum holding period); • TRH/BTEX - 250g glass jar / refrigeration 4^{o}C / 14 days (maximum holding period); • PAH - 250g glass jar / refrigeration 4^{o}C / 14 days (maximum holding period); and • Asbestos - 10 Litre resealable plastic (polyethylene) bag / no refrigeration / indefinite holding time.
Laboratory Analysis	• Each sample obtained for soil validation purposes will be analysed for metals (8), TPHs, BTEX, PAHs, and asbestos as well as any other relevant contaminant that may be identified during the further soil investigation process (i.e. VOCs). Soil leachate testing (ASLP) may also be required to assess potential for mobilisation of any residual fill contaminants. • Testing of imported materials intended for backfilling of excavated areas shall include but not be limited to the minimum suite specified for imported fill under the EPA (2014) guideline (e.g. heavy metals, TPHs, BTEX, PAHs, OCPs, OPPs, PCBs and asbestos).

Action	Description
Field QA/QC	Quality assurance (QA) and quality control (QC) procedures will be adopted throughout the field sampling programme to ensure sampling precision and accuracy, which will be assessed through the analysis of 10% field duplicate/replicate samples. Appropriate sampling procedures will be undertaken to prevent cross contamination, in accordance with EI's Standard Operating Procedures Manual, which specifies that: • Standard operating procedures are followed; • Site safety plans are developed prior to works commencement; • Split duplicate field samples are collected and analysed; • Samples are stored under secure, temperature controlled conditions; • Chain of custody documentation is employed for the handling, transport and delivery of samples to the contracted environmental laboratory; and • Contaminated soil, fill or groundwater originating from the site area is disposed in accordance with relevant regulatory guidelines. In total, field QA/QC will include one in 10 samples to be tested as blind field duplicates, one in 20 samples to be tested as inter-laboratory duplicates (ILD), as well as one VOC trip blank sample and one equipment wash blank sample per sample batch.
Laboratory Quality Assurance and Quality Control	The contract laboratory will conduct in-house QA/QC procedures involving the routine analysis of: • Reagent blanks; • Spike recoveries; • Laboratory duplicates; • Calibration standards and blanks; • QC statistical data; and • Control standards and recovery plots.
Achievement of Data Quality Objectives	Based on the analysis of quality control samples (i.e. duplicates/replicates and in-house laboratory QA/QC procedures), the following data quality objectives are required to be achieved: • Conformance with specified holding times; • Accuracy of spiked samples will be in the range of 70-130%; and • Field and laboratory duplicates and replicates samples will have a precision average of +/- 30% relative percent difference (RPD). An assessment of the overall data quality should be presented in the final validation report, in accordance with the DEC (2006) *Guidelines for the NSW Site Auditor Scheme*.

6.4 DATA QUALITY OBJECTIVES

The scope of remediation works has been devised broadly in accordance with the following Data Quality Objective (DQO) process, as defined in Australian Standard *"Guide to the Sampling and Investigation of Potentially Contaminated Soil Part 1: Non-volatile and semi-volatile compounds"* (AS 4482.1 – 1997). The DQO process for the proposed remediation and site validation program is outlined within **Table 6-3**:

Table 6-3 Data Quality Objective Remediation

Step	Description
State the Problem	The site requires to be rendered suitable for residential land uses with minimum soil access (including hotels). The site validation program will therefore need to verify that soil samples collected from the remediated areas meet the adopted remediation criteria for the intended land use, relevant to the respective part of the site being validated. Soils will be classified, excavated and removed offsite to allow for basement construction.
Identify the Decision	The completeness of the remediation works will therefore be determined by the further assessment and the subsequent validation analyses. Remediation will be deemed to be complete when all validation samples of any remedial work meet the remediation criteria and/or when the remediation goals have been attained (e.g. the contamination risk is reduced to acceptable levels). The required decisions are therefore related to answering the following two questions: Is the soil and groundwater quality suitable for the proposed land use? and Will site soils and groundwater require further remediation and/or special management before the site can be used for residential purposes?
Identify Inputs to the Decision	Inputs to the decision will include: • Additional soil and groundwater sampling and analysis • Soil validation sampling of any remedial works; • Systematic soil validation sampling from remediated excavation surfaces; • Sampling from stockpiled material for waste classification; • Laboratory analytical results for tested validation samples; and • Assessment of analytical results in relation to the remediation criteria.
Define the Boundary of the Assessment	Lateral - The boundary of the assessment is defined by the boundary of the subject site. The proposed basement will be constructed and excavated boundary to boundary. Vertical – The depth to which soils meet the adopted remediation criteria and natural soils remaining within the proposed basement bulk excavation at approximately 3.0mAHD Temporal – the findings of this assessment will hold true for as long as the site use remains passive in nature; that is, for as long as the site is used for residential land use with minimal soil access (including hotels) and there are no activities taking place onsite or on the immediately adjacent properties that may compromise onsite environmental conditions.
Develop a Decision Rule	Laboratory test results will be assessed against the adopted remediation criteria for soils remaining on site, and against SCC/TCLP thresholds for waste classification for soils to be disposed off-site. Should the remediation criteria be exceeded then additional excavations and/or investigations will be required to delineate vertical and lateral extent of contamination. Laboratory test results will be accepted if: • All contracted laboratories are accredited by NATA for the analyses undertaken; • All detection limits fall below the remediation criteria; • Analyte concentrations in rinsate (i.e. blank) samples do not vary significantly

Step	Description
	from concentrations in the distilled water used for equipment rinsing; • RPDs for duplicate samples are within accepted limits; and • Laboratory QA/QC protocols and results comply with NEPM requirements. Further decisions are also required following the additional assessment. This may require updating of the RAP to include an acid sulfate soil management plan, a soil gas (soil vapour) and groundwater remediation or management.
Specify Acceptable Limits on Decision Errors	The remediation consultant must identify the potential decision errors, evaluate the potential consequences and severity of decision error consequences, define the null hypothesis and specify what level of false positive or false negative decision error will be acceptable for the validation assessment. Details are to be presented in the final validation assessment report. Specific limits for this project are to be in accordance with the appropriate NSW EPA guidance, appropriate indicators of data quality and standard procedures for field sampling and handling. Tolerable limits will be quantified as follows: • Sampling on a 10 m grid will allow detection of a circular hotspot with a diameter of nominally 10 m with 95% certainty. • The acceptance of the site as validated will be based on the probability that the 95% Upper Confidence Limits (UCL) of the data will satisfy the given site criteria. Therefore a limit on the decision error will be 5% that a conclusive statement may be incorrect. Soil and groundwater concentrations for chemicals of concern that are below investigation criteria made or approved by the NSW EPA will be treated as acceptable and indicative of suitability for the proposed land use(s).
Optimise the Design for Obtaining Data	In order to identify the most resource-effective sampling and analysis design for general data that are expected to satisfy the DQOs: • Written instructions will be used to guide field personnel in the required fieldwork activities. • Representative soil samples will be collected from the site and analysed to allow characterisation of soils. A review of the results will be undertaken to determine if additional sampling is warranted. Additional investigations would be considered to be warranted where soil concentrations are found to exceed remediation criteria endorsed by the NSW EPA, relevant to the proposed land use(s). • In order to facilitate the development and prevent unnecessary delays due to rework (in case of failed validation samples) the builder/subcontractor responsible for excavation works will be required to liaise closely with the environmental consultant as to required turnaround time for samples.

6.5 REPORTING

All fieldwork, chemical analysis, discussions, conclusions and recommendations will be documented in a validation report for the site. The validation report will be prepared in general accordance with requirements of the NSW EPA (2020) *Consultants Reporting on Contaminated Land: Contaminated Land Guidelines* and EPA (2017) *Guidelines for the NSW Site Auditor Scheme*. This report shall be submitted to Council at the completion of the remediation works program.

The report shall confirm that the site has been remediated to a suitable standard for the proposed development and occupation and that no related adverse environmental effects have occurred as a result of the temporary works. It shall also include details of the remediation methodology, the total volume and final disposal destinations for all contaminated materials removed from site, and confirm that placed fill meets the adopted remediation criteria.

No building construction other than the necessary demolition and excavation works should commence until the remediation and validation report has been accepted by Council or a Site Audit Statement has been issued.

6.6 AUDITOR LIAISON AND SIGN OFF

The validation strategy for the site has been designed to be flexible and involve continuous liaison with the Site Auditor. The process of liaison is designed to enable the Auditor to keep a continuous check on each phase of works, including results and quality control for the proposed remediation program.

7 SITE MANAGEMENT

7.1 RESPONSIBILITIES AND CONTACTS

The overall responsibilities for the various parties involved with the remediation are outlined in **Table 7-1.**

Table 7-1 Site Management Responsibilities

Responsible Party	Details/Contacts	Responsible for:
Principal Project Manager (PPM)	Mitchell Favaloro Samprian Pty Ltd 580 Parramatta Road, PETERSHAM NSW 2049	Overall management of the site remedial activities
Property Owner	Samprian Pty Ltd	Management of the site and associated remedial activities, particularly with respect to policy and operational procedures
Environmental Management Coordinator (EMC)	TBA	• ensure that the site remediation works are carried out in an environmentally responsible manner; • liaise between the appointed Environmental Consultant and Council providing regular updates and informing of any problems encountered; • ensure that all environmental protection measures are in place and are functioning correctly during site remediation works; and • report any environmental issues to owner.
Demolition, Earthworks or Remediation Contractor	TBA	• ensure that all operations are carried out as identified in the RAP (demolition and remediation), as directed by the PPM and EMC; • induct all employees, subcontractors and authorised visitors on procedures with respect to site works, WHS and environmental management procedures; • report any environmental issues to EMC; • maintain site induction, site visitor and complaint registers; • fugitive emissions and dust leaving the confines of the site must be suitably controlled and minimised; • water containing any suspended matter or contaminants must not leave the site in a manner which could pollute the environment, and must be minimised and suitably controlled; • vehicles shall be cleaned and secured so that no mud, soil or water are deposited on any public roadways or adjacent areas; and • noise and vibration levels at the site boundaries must comply with the legislative requirements.

Responsible Party	Details/Contacts	Responsible for:
Environmental Consultant	TBA	• ensure that all operations are carried out as identified in the RAP (demolition and remediation); and • advise should scenario arise deviating from the RAP.
Site Auditor	TBA	• reviewing proposed remediation strategies and ensuring remediation is technically feasible, environmentally justifiable and consistent with relevant legislation and guidelines; • review actions taken demolition, earthworks or remediation contractor; and • ensure all works have complied with the RAP and remedial procedures deem the site suitable for the intended land use.

7.2 MANAGEMENT PLANS

All work should be undertaken with due regard to the minimisation of environmental effects and to meet all statutory environmental and safety requirements (**Section 7.4**). An Environmental Management Plan (EMP) should be developed for the site works by the site manager or contractor which should also take into account the Council DA conditions and guidance including but not limited to:

- DA Conditions of Consent; and
- Sydney Council Development Control Plan 2012 (Sheet 015).

The overall site management is displayed in **Table 7-2**.

Table 7-2 Site Management Measures

Category	Measure
Site Stormwater Management and Control	Appropriate measures shall be taken to ensure that potentially contaminated water does not leave the site. Such measures should include, but not be limited to: • Construction of stormwater diversion channel and linear drainage sumps with catch pits in the remediation area to divert and isolate stormwater from any contaminated areas; • Provision of sediment traps including geotextiles or hay bales; and • Discharge of any water to drains and water bodies must meet the appropriate effluent discharge consent condition under the *Protection of the Environmental Operations Act*. This will be verified by sampling and analyses undertaken by the contractor. Laboratory analytical reports for tested discharge waters must be maintained on site and made available for inspection by Council's representative or the relevant authority.
Traffic and Load Management	All vehicular traffic shall use only routes approved by the Council to and from the selected landfill. All loads shall be tarpaulin-covered and lightly wetted to ensure that no materials or dust are dropped or deposited outside, or within the site. Each truck prior to exiting the site, shall be inspected prior to despatch and either logged out as clean (wheels and chassis), or hosed down within the wheel wash / wash down bay until designated as 'clean'.

Category	Measure
	All loads will be lightly conditioned and covered before leaving the site. Each load of contaminated spoil leaving the site shall be accounted for, such that its origin, despatch time, cleanliness of the vehicle, route, destination and arrival time are recorded. Appropriate (trip ticket) docket information confirming disposal shall be maintained for inspection.
Excavations	Records of all excavations and stockpile locations shall be maintained. All unsealed contaminated stockpile locations will be re-validated following spoil removal. A site diary or log will also be maintained to record daily progress, abnormal occurrences, incidents, truck movements and load characteristics.
Dust and Odour	Control of dust and odour during the course of the remediation works shall be maintained by the contractor and may include but not necessarily be limited to: • The use of a water cart, as and when appropriate, to eliminate wind-blown dust; • Use of sprays or sprinklers on stockpiles or loads to lightly condition the material; • Use of tarpaulin or tack-coat emulsion or sprays to prevent dust blow from stockpiles or from vehicle loads; • Covering of stockpiles or loads with polythene or geotextile membranes; • Restriction of stockpile heights to 2m above surrounding site level; • Ceasing works during periods of inclement weather such as high winds or heavy rain; and • Regular checking of the fugitive dust and odour issues to ensure compliance with the EMP requirements, undertaking immediate remedial measures to rectify any cases of excessive dust or odour (e.g. use of misting sprays or odour masking agent).
Noise and Vibration	Noise and vibration will be restricted to reasonable levels. All plant and machinery used on site will be noise muffled to ensure that noise emissions do not breach statutory levels.
Hours of Operation	Working hours will be restricted to those specified by Council (e.g. 7am to 7pm weekdays and 7am to 5pm Saturdays; no Sunday work shall be permitted).
Incident Management and Community Relations	Site preparation works will include extensive demolition and site preparation including remedial works, which will involve numerous project teams, machinery and vehicles handling on site soils, some of which have been identified as contaminated and/or potentially hazardous (i.e. building waste, asbestos, USTs, contaminated soils, etc.). While various environmental management and occupational safety plans will be developed to protect human health and the environment, incidents may occur which pose a risk to the various stakeholders. To mitigate these risks and ensure that a suitable response is carried out quickly, a response plan to any incident that may occur on site will be prepared and various responsibilities assigned. The site health hand safety plan and environmental management plan will document these procedures and responsibilities and incident contact numbers should be maintained in an on-site register. All other relevant emergency contact numbers such as Police, Fire Brigade, and Hospital will be listed in the Health and Safety Plan and posted on-site for easy access. As part of the process to manage incident response, various contingency management issues are documented in the following section.

7.3 REMEDIAL CONTINGENCY MANAGEMENT AND MEASURES

7.3.1 Contingency Management

Corrective actions for the management of anticipated environmental issues that may arise on-site during the course of the site preparation works and remediation are presented below in **Table 7-3**.

Table 7-3 Management of Problems During Site Remediation

Anticipated Problems	Corrective Actions
Chemical / fuel spill	Stop work, notify above site project manager. Use accessible soil or appropriate absorbent material on site to absorb the spill (if practicable). Stockpile the impacted material in a secure location, sample and determine the appropriate disposal option.
Hazardous materials e.g. asbestos and lead paint within current building structure	Work to be suspended and hazardous materials to be removed by a suitably qualified contactor, in accordance with WorkCover regulations
Excessive Dust	Use water sprays to suppress the dust or stop site activities generating the dust until it abates.
Excessive Noise	Identify the source, isolate the source if possible, modify the actions of the source or erect temporary noise barriers if required.
Excessive Odours/Vapours	Stage works to minimise odours/vapours. Ensure adequate ventilation whilst working indoors. If excessive organic odours/vapours are being generated, stop works and monitor ambient air across site for organic vapours with a PID (maximum of 10 ppm) and odours at site boundaries. Implement control measures including respirators for on-site workers, use of odour suppressants, wetting down of excavated material.
Excessive rainfall	Ensure sediment and surface water controls are operating correctly. If possible divert surface water away from active work areas or excavations.
Water in excavations	Collect samples and assess against relevant NSW DEC *Waste Classification Guidelines (2014)* assessment criteria, to enable disposal options to be formulated.
Leaking machinery or equipment	Stop the identified leak (if possible). Clean up the spill with absorbent material. Stockpile the impacted material in a secure location, sample and determine the appropriate disposal/treatment option.
Failure of erosion or sedimentation control measures	Stop work, repair failed control measure.
Unearthing unexpected materials, fill or waste	Stop activities, contact the site project manager. Prepare a management plan to address the issue.
Identification of cultural or building heritage items	Stop work and notify site project manager. Prepare action or conservation plan as required.
Equipment failures	Ensure that spare equipment is on hand at site, or that the failed equipment can be serviced by site personnel or a local contractor.
Complaint Management	Notify Client, Project Managers and Environmental Consultant (if required) following complaint. Report complaint as per management procedures. Implement control measures to address reason of complaint (if possible). Notify complainant of results of remedial actions.

At this stage it is anticipated that the proposed remedial technologies should be effective in dealing with the contamination present, however remedial contingencies may be required should the scenarios detailed in the **Table 7-4** arise. This table also addresses excavated soils which should be stockpiled

separately and depending on their waste classification, disposed according to the EPA (2014) *Waste Classification Guidelines*.

Table 7-4 Remedial Contingencies

Scenario	Remedial Contingencies/Actions Required
Highly contaminated soils (odours, colouration and/or oily residues) not identified during previous investigation are encountered, particularly at site boundaries.	Work to be suspended until the Environmental Project Manager can further assess impacted soils/ materials and associated risks. Under no circumstances shall the contractor or any site personnel undertake to move such materials, without prior advice by the appointed environmental specialist. Should contamination be identified during additional investigatory works, an addendum to the RAP may be required to address the identified contamination.
Additional underground systems are encountered at the site.	Systems to be removed and the excavations appropriately validated and backfilled (if required) by experienced contractor. Tank removal works supervised and reported by appropriate environmental consultant in accordance with UPSS guidelines (DECCW 2009).
Highly impacted sludges are located in "cleaned" UPSSs or during concrete removal works.	The leachability of the lead, other heavy metals and hydrocarbons will need to be assessed before disposal options are considered.
Suspected asbestos containing material is encountered.	Work to be suspended and area quarantined. Area inspected and sampled by qualified Hazmat professionals. Asbestos removed by a suitably qualified contactor, in accordance with WorkCover regulations.
Residual soil impacts remain on-site	Review/assess potential vapour hazard. If there is a vapour risk additional remedial measures may be required including installation of a vapour barrier or passive or active vapour extraction system.
Waste Classification	Contaminated spoil materials that fail to meet the criteria will be handled as follows: 1. Materials will be carefully excavated and placed in separately demarcated and contained locations and separately stockpiled on the basis of on-site observations and the contaminant exceedances detected. 2. Stockpiles of excavated materials will be appropriately bunded with hay bales/sandbags and if required, covered and/or lined with impermeable plastic sheeting, or alternatively placed in an appropriate container e.g. waste skip, with appropriate cover. 3. Sampling and analysis of segregated stockpiles will be conducted to determine the concentrations of the target contaminant parameters in the excavated materials. 4. Disposal arrangements will be determined based on sampling results as follows: • material that falls below the CT1 thresholds for General Solid Waste as outlined in Table 6-2 shall be collected and disposed direct to landfill; • material that exceeds the CT1 screening thresholds for and shall be tested for leachability with respect to the elevated contaminants using the TCLP method, and subject to meeting the relevant disposal requirements, will be dispatched off-site for disposal as either

Scenario	Remedial Contingencies/Actions Required
	General Solid Waste or Restricted Solid Waste; and • those materials that exceed the TCLP2/SCC2 criteria for landfill disposal, as outlined in Table 6-3, shall be further segregated into separate stockpiles and await alternate treatment and disposal arrangements. 5. Stockpiled materials that cannot be landfilled directly (i.e. those that are awaiting TCLP results or that fail the combined specific concentration and TCLP testing, or require to be stored pending treatment), will be covered by anchored geotextile to prevent erosion and wind blow of contaminated materials. 6. Approval of the immobilisation method for materials exceeding the leaching guidelines must be obtained from the EPA NSW and disposal consent must be sought from the Hazardous Material Advice Unit prior to the removal of such wastes from the site.
Contaminated groundwater (including LNAPL or DNAPL) encountered.	Review of groundwater conditions on site, may require further groundwater investigations / remediation and longer-term management plan. Any dewatering may require approval under the Water Management Act (2000) Remedial measures may include, source removal, natural attenuation, bioremediation, PSH recovery using active pumping (including hydraulic control), installation of a groundwater permeability barrier or similar or in-situ oxidation or stabilisation.
Groundwater contaminant plume is identified and is migrating off-site or there are increases in concentration due to increased infiltration (following demolition).	Review contaminant increase and analytes. Review active remediation alternatives (if necessary). Ensure down-gradient monitoring is undertaken. Carry out fate and transport modelling (if required) and assess the need for further action.
Contamination is identified near heritage items or significant trees (if identified).	Stop work. Review contaminant concentrations and risks to heritage items / flora. Assess human health and environmental risks if contamination remains in place. Review natural attenuation options.
Changes in proposed future land uses at the site.	Review of the remediation works completed for the site.
If existing fill is determined to be geotechnically unsuitable for the proposed development and is to be removed.	After the removal of fill, further testing will be required to validate the natural soil surface (samples retrieved on a 10 m by 10 m grid).

7.4 WORK HEALTH SAFETY ISSUES

7.4.1 Work Health and Safety Plan

As required by the NSW Work Health and Safety Act 2011 and associated Regulations, a Work Health and Safety (WHS) Plan should be prepared by the Principal Contractor (see **Section 7.1**), to manage the health and safety of site workers and nearby residents and address such issues as site security, exclusion zones, excavation safety, vibration, noise, odour and dust levels. The plan should address the risks during the remediation works and cover site specific requirements associated with the contaminants present within the site soils and groundwater. The use of personal protective equipment (PPE) and environmental management measures (e.g. dust control etc.) should be documented where necessary.

The site officer responsible for implementing health and safety procedures should induct all site personnel so that they understand the Work Health and Safety Plan prior to commencing site works and all site staff should sign a statement to that effect. Contractors employed at the site will be responsible for ensuring that their employees are aware of and comply with, the requirements of this document. All site personnel must also be aware of the relevant emergency contact numbers which should be include in the WHS Plan and provided at the facilities at the site.

It is the contractor's responsibility, with assistance from client/owner(s) of the site to ensure that all other permits, approvals, consents or licences are current.

7.4.2 Chemical Hazards

Contaminated site have chemical compounds substances or materials that may be present a risk to human health and the environment. These include but are not limited heavy metals, TRHs, VOCs (including BTEX), PAHs and asbestos. The possible risks to site personnel associated with contaminated site include:

- Ingestion of contaminated soil or water;
- Dermal contact with contaminated soil or water; and
- Inhalation of dusts, aerosols or vapours containing contaminants.

The site specific WHS plan should set out controls to mitigate any potential risks.

7.4.3 Physical Hazards

The following hazards are associated with conditions that may be created during site works:

- Heat exposure;
- Buried services;
- Noise, vibration and dust;
- Electrical equipment; and
- The operation of heavy plant equipment.

7.5 PERSONAL PROTECTIVE EQUIPMENT (PPE) AND MONITORING.

Personnel should, wherever possible, avoid direct contact with potentially contaminated material. Workers are to ensure that surface waters or groundwater is not ingested or swallowed and that direct skin contact with soil and water is avoided.

- Air monitoring should be carried out during the asbestos fibre impacted soils.

All personnel on site will be required to wear the following protection at all times:

- Steel-capped boots;
- Safety glasses or safety goggles with side shields;
- Hard hat; and

- Hearing protection when working in the vicinity of machinery or plant equipment (if noise levels exceed exposure standards).

8 CONCLUSIONS

Based on the information available, this RAP has been prepared to undertake remediation at 757-763 George Street, Haymarket NSW. It is envisaged that these site will be partially demolished, concrete pavements removed and remediated in stages which will require the development of appropriate sampling and analysis, hazardous materials, environmental management and demolition plan in order that the site be remediated to allow the proposed hotel and retail development (residential land use with minimal soil access). The following stages are therefore considered to achieve the overall objective of the remediation but no remediation schedule has been developed:

- Review and approval of the RAP by the NSW Accredited Site Auditor to allow commencement of the site works (including demolition);
- Selection of a suitably qualified and licensed demolition and remediation contractor;
- Preparation of appropriate demolition, work health and safety and environmental management plans;
- Preliminaries including approvals and community engagement;
- Demolition of the site buildings and infrastructure;
- UPSS removal and validation;
- Further investigation to address remaining data gaps and amendment of RAP if deemed necessary;
- Waste classification and bulk excavation of soils to allow for basement excavation;
- Implementation of the remedial measures identified in the RAP;
- Validation sampling in accordance to the approved RAP;
- Validation reporting; and
- Preparation of a Site Audit Statement (SAS) and Site Audit Report (SAR) to indicate the site is suitable for residential and open space development.

The remediation strategy for the site has been designed to be flexible and involve continuous liaison with the appointed NSW EPA Accredited Site Auditor.

In summary, EI Australia considers that the site can be made suitable for the proposed development following the implementation of this RAP.

9 STATEMENT OF LIMITATIONS

This report has been prepared for the exclusive use of Samprian Pty Ltd, who is the only intended beneficiary of our work. The scope of the investigations carried out for the purpose of this report is limited to those agreed with Samprian Pty Ltd.

No other party should rely on the document without the prior written consent of EI, and EI undertakes no duty, or accepts any responsibility or liability, to any third party who purports to rely upon this document without EI's approval.

EI has used a degree of care and skill ordinarily exercised in similar investigations by reputable members of the environmental industry in Australia as at the date of this document. No other warranty, expressed or implied, is made or intended. Each section of this report must be read in conjunction with the whole of this report, including its appendices and attachments.

The conclusions presented in this report are based on a limited investigation of conditions, with specific sampling locations chosen to be as representative as possible under the given circumstances.

EI's professional opinions are reasonable and based on its professional judgment, experience, training and results from analytical data. EI may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified by EI.

EI's professional opinions contained in this document are subject to modification if additional information is obtained through further investigation, observations, or validation testing and analysis during remedial activities. In some cases, further testing and analysis may be required, which may result in a further report with different conclusions.

REFERENCES

ANZECC/ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, October 2000.

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NEPM (2013) Schedule B1 Guideline on Investigation Levels for Soil and Groundwater, Schedule B2 Guideline on Site Characterisation and Schedule B4 Guideline on site-specific health risk assessments, National Environmental Protection (Assessment of Site Contamination) Measure 1999, National Environmental Protection Council, December 1999, Amendment 2013.

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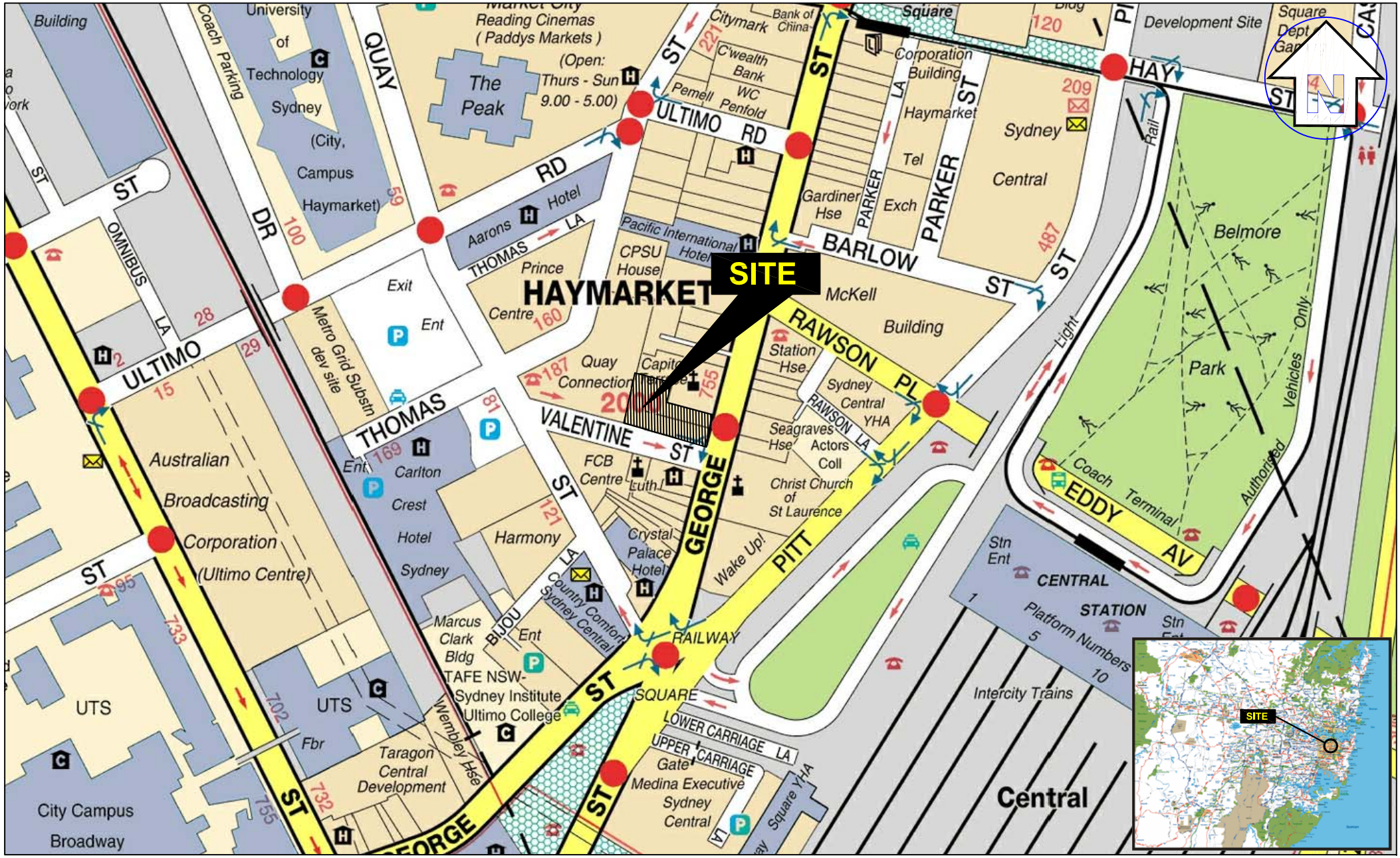
ABBREVIATIONS

AHD	Australian Height Datum (e.g. mAHD)
ASS	Acid sulfate soils
ANZECC	Australian and New Zealand Environment Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BH	Borehole
BTEX	Benzene, Toluene, Ethyl benzene, Xylene
CSM	Conceptual Site Model
DECC	Department of Environment and Climate Change, NSW (formerly DEC) Department of Environment and Conservation, NSW
DP	Deposited Plan
DQO	Data Quality Objectives
EPA	Environment Protection Authority
EMP	Environmental Management Plan
ENM	Excavated Natural Material
F1	TPH C6 – C10 less the sum of BTEX concentrations
F2	TPH >C10 – C16 less the concentration of naphthalene
GIL	Groundwater Investigation Level
GME	Groundwater monitoring event
HIL	Health-based Investigation Level
HSL	Health-based Screening Level
km	Kilometres
m	Metres
m BGL	Metres below ground level
µg/L	Micrograms per litre
NATA	National Association of Testing Authorities, Australia
NEPC	National Environmental Protection Council
OCP	Organochlorine Pesticides
OPP	Organophosphate Pesticides
PAHs	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance / Quality Control
RAP	Remediation Action Plan
SIL	Soil Investigation Level
TBA	To Be Announced
TCLP	Toxicity Characteristics Leaching Procedure
TPHs	Total Petroleum Hydrocarbons
UCL	Upper Confidence Limit
UPSS	Underground Petroleum Storage System
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VENM	Virgin Excavated Natural Material
VOC	Volatile Organic Compounds

FIGURES



Environmental Investigations Australia
Contamination | Remediation | Geotechnical
Suite 6.01, 55 Miller Street, PYRMONT 2009
Ph (02) 9516 0722 Fax (02) 9518 5088

Drawn:	V.T.
Approved:	N.F.
Date:	3/03/15
Approx Scale:	N.T.S

Ceerose Pty Ltd
Remediation Action Plan
757-763 George Street, Haymarket, NSW
Site Locality Plan

Figure:
1

Project: E22293 AB

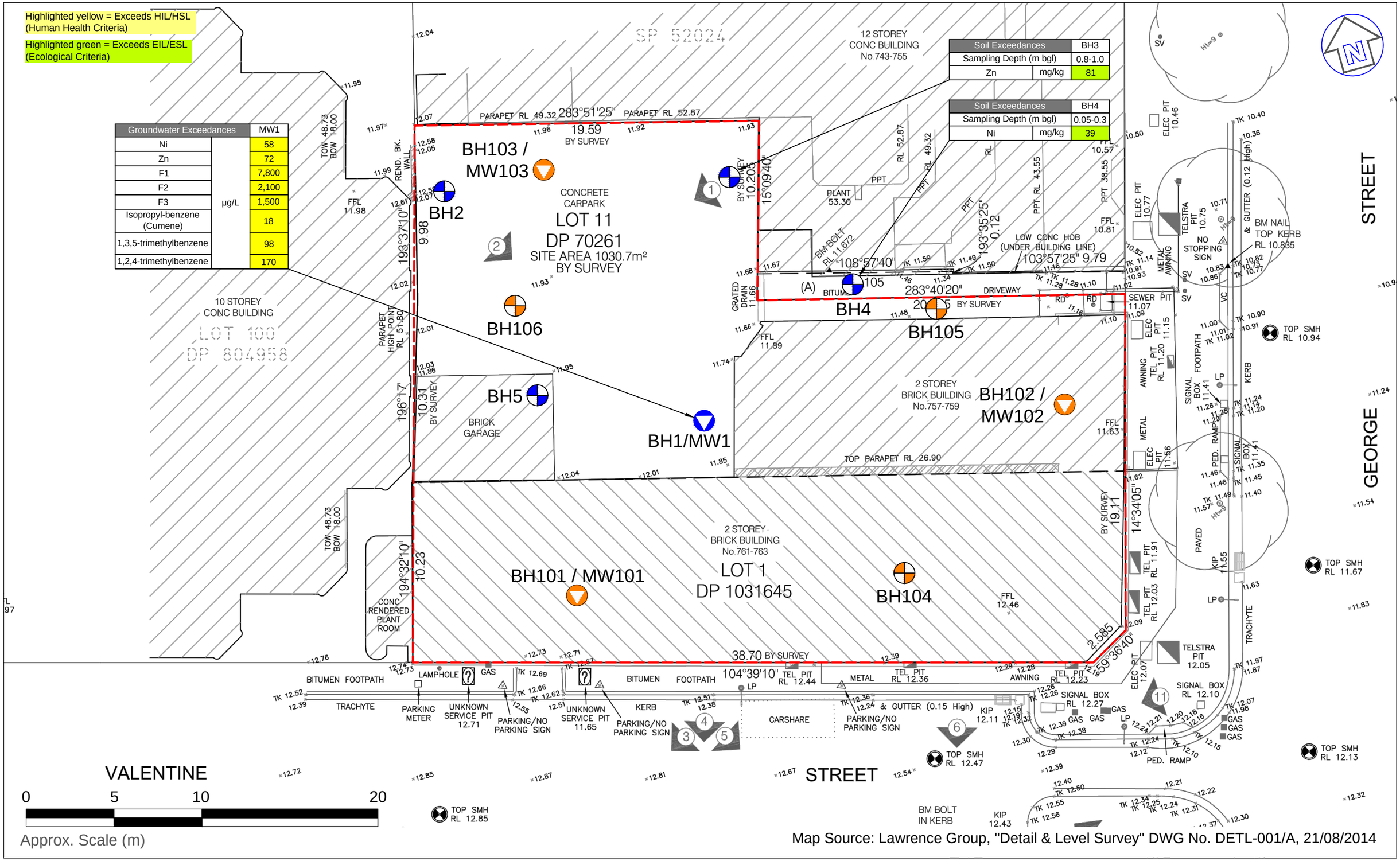
Highlighted yellow = Exceeds HIL/HSL (Human Health Criteria)

Highlighted green = Exceeds EIL/ESL (Ecological Criteria)

Groundwater Exceedances		MW1
Ni	µg/L	58
Zn		72
F1		7,800
F2		2,100
F3		1,500
Isopropyl-benzene (Cumene)		18
1,3,5-trimethylbenzene		98
1,2,4-trimethylbenzene		170

Soil Exceedances		BH3
Sampling Depth (m bgl)		0.8-1.0
Zn	mg/kg	81

Soil Exceedances		BH4
Sampling Depth (m bgl)		0.05-0.3
Ni	mg/kg	39



Map Source: Lawrence Group, "Detail & Level Survey" DWG No. DETL-001/A, 21/08/2014

LEGEND

- Approximate Borehole Location
- Approximate Monitoring Well / Borehole Location
- Approximate Site Boundary
- Proposed Borehole Location
- Proposed Monitoring Well / Borehole Location

Environmental Investigations Australia
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Drawn:	V.T.
Approved:	N.F.
Date:	3/03/14
Approx Scale:	1:200 @ A3 or As Shown

Ceerose Pty Ltd
Remediation Action Plan
757-763 George Street, Haymarket, NSW
Former and Proposed Sampling Location Plan w/- Soil / Groundwater Exceedances

Figure: 2

Project: E22293 AB

APPENDIX A
PROPOSED DEVELOPMENT PLANS

Appendix A - Survey

LEGEND

BENCH MARK	▲
TELSTRA PIT	TEL
ELECTRIC LIGHT POLE	LP
POWER POLE	PP
SIGN POST	SP
SEWER INSPECTION PIT	SIP
SEWER VENT	SEWER
MANHOLE	MH
SEWER MANHOLE	SMH
STOP VALVE	SV
WATER HYDRANT	HYD
WATER METER	WM
GAS METER	GM
STATE SURVEY MARK	SSM

NOTE:

NO BOUNDARY SURVEY HAS BEEN UNDERTAKEN. BEARINGS, DIMENSIONS AND AREAS ARE FROM TITLE ONLY AND ARE SUBJECT TO CONFIRMATION BY BOUNDARY SURVEY.

SERVICES SHOWN ARE INDICATIVE ONLY. POSITIONS ARE BASED ON SURFACE INDICATOR(S) LOCATED DURING FIELD SURVEY. CONFIRMATION OF THE EXACT POSITION SHOULD BE MADE PRIOR TO ANY EXCAVATION WORK. OTHER SERVICES MAY EXIST WHICH ARE NOT SHOWN.

LEVELS ARE BASED ON AUSTRALIAN HEIGHT DATUM (AHD) USING THE BENCHMARKS PROVIDED BY YOU THE CLIENT IN THE DETAIL NAMED 149237-DETL-001A.

AZIMUTH HAS BEEN OBTAINED USING THE BENCHMARKS PROVIDED BY YOU THE CLIENT IN THE DETAIL NAMED 149237-DETL-001A.

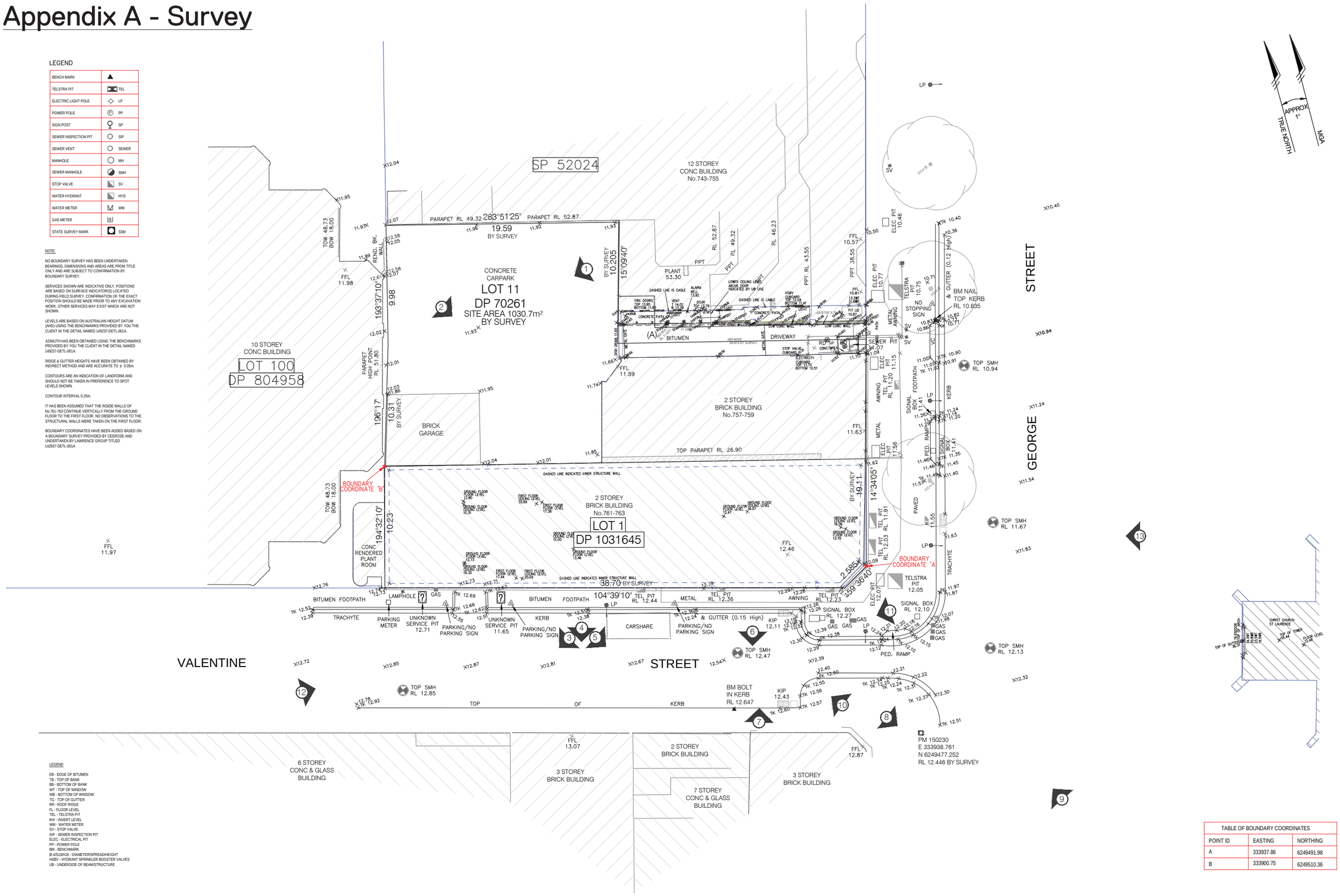
RIDGE & GUTTER HEIGHTS HAVE BEEN OBTAINED BY INDIRECT METHOD AND ARE ACCURATE TO ± 0.05m.

CONTOURS ARE AN INDICATION OF LANDFORM AND SHOULD NOT BE TAKEN IN PREFERENCE TO SPOT LEVELS SHOWN.

CONTOUR INTERVAL 0.25m.

IT HAS BEEN ASSUMED THAT THE INSIDE WALLS OF No.761-763 CONTINUE VERTICALLY FROM THE GROUND FLOOR TO THE FIRST FLOOR. NO OBSERVATIONS TO THE STRUCTURAL WALLS WERE TAKEN ON THE FIRST FLOOR.

BOUNDARY COORDINATES HAVE BEEN ADDED BASED ON A BOUNDARY SURVEY PROVIDED BY CEEROSE AND UNDERTAKEN BY LAWRENCE GROUP TITLED 142937-DETL-001A



LEGEND

EB - EDGE OF BITUMEN
TB - TOP OF BANK
BB - BOTTOM OF BANK
WT - TOP OF WINDOW
WB - BOTTOM OF WINDOW
TG - TOP OF GUTTER
RR - ROOF RIDGE
FL - FLOOR LEVEL
TEL - TELSTRA PIT
INV - INVERT LEVEL
WM - WATER METER
SV - STOP VALVE
SIP - SEWER INSPECTION PIT
ELEC - ELECTRICAL PIT
PP - POWER POLE
BM - BENCHMARK
Ø 457/3/0/18 - DIAMETER/SPREAD/HEIGHT
HSBV - HYDRANT SPRINKLER BOOSTER VALVES
UB - UNDERSIDE OF BEAM/STRUCTURE

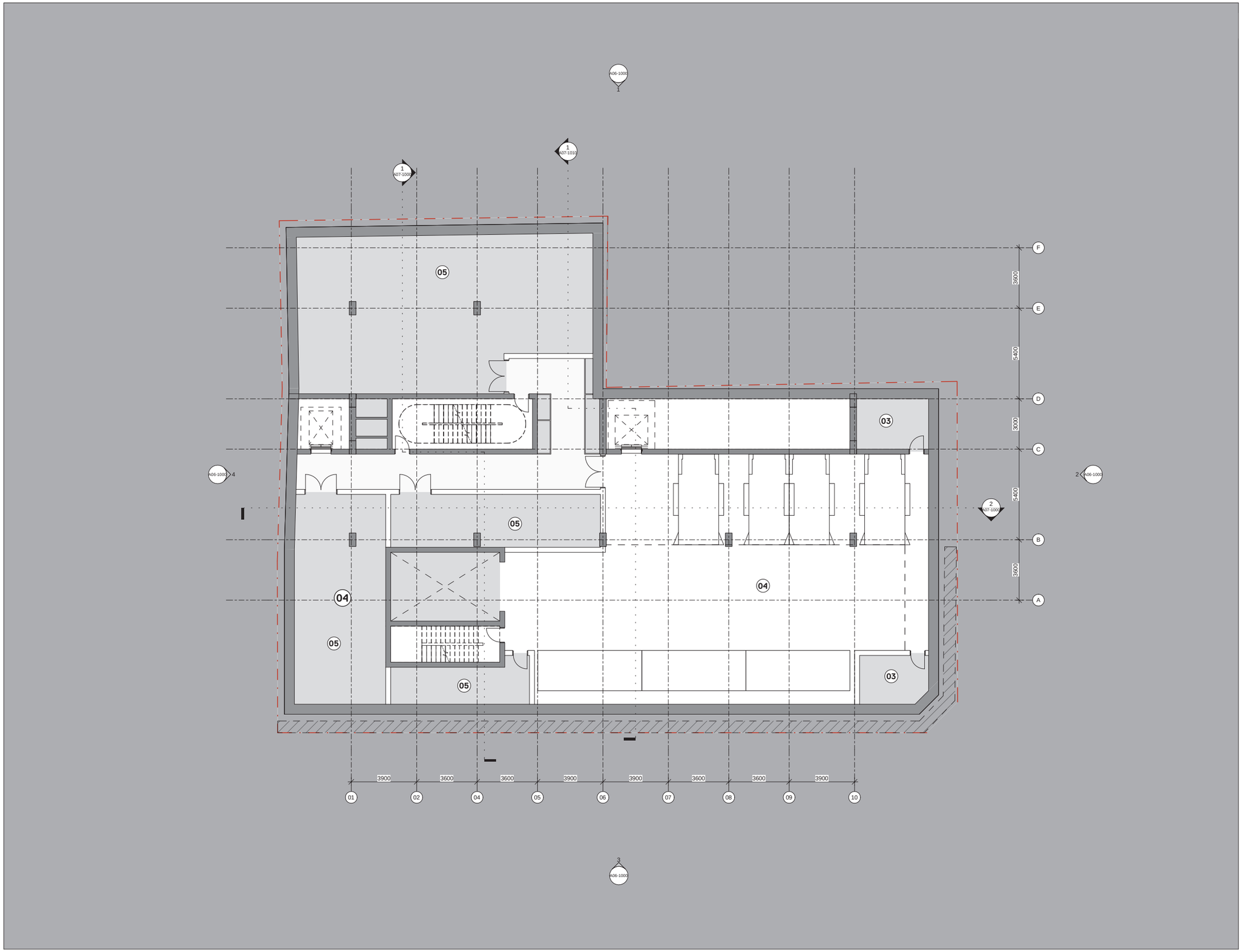
TABLE OF BOUNDARY COORDINATES		
POINT ID	EASTING	NORTHING
A	333937.86	6249491.98
B	333900.75	6249510.36

TOTAL SURVEYING SOLUTIONS
SUITE 5 / 21 ELIZABETH STREET, CAMDEN NSW 2570
Ph. (02) 4655 4035 Fax. (02) 46 55 7094 Email: tss@totalsurveying.com.au

DRAWING: PLAN SHOWING DETAIL & LEVELS OVER DP 70261 & DP1031645	JOB No.: 151191	LGA: CITY OF SYDNEY
	PLAN No.: 151191_C	DATUM: AHD
CLIENT: CEEROSE PTY LTD	DATE: 09.12.2015	SCALE: 1:100@A0
PROJECT: HAYMARKET	DRAWN: RA	CONT. INTERVAL: 0.25m
ADDRESS: CORNER OF GEORGE STREET & VALENTINE STREET, HAYMARKET	CHK: CD	SHEET 1 OF 1

REVISION No.	REVISION DATE:	COMMENT:
B	25.11.2015	RESTORED FULL OPACITY TO UNDERLYING SURVEY DONE BY LAWRENCE GROUP.
C	09.12.2015	ADDED BOUNDARY MARK COORDINATES

BAR SCALE
PLOTTED SCALE 1:100 (A1 SIZE SHEET)



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T +61 2 9253 0200
www.grimshaw.global

Level 2, 333 George Street,
Sydney, NSW 2000, AUS

DRAWING NOTICES

Do not scale - all dimensions to be checked on site. Grimshaw drawings to be read in conjunction with grimshaw and specialist specifications. Drawings to be read in conjunction with m&e, structural, fire and acoustic information.

01 Reception
02 Retail/ Amenity
03 BOH
04 Car Park
05 Plant
06 Circulation
07 External Terrace
08 3.5* Hotel Room

CLIENT
Samprian Pty Ltd

CONSULTANTS

PROJECT NAME
757-763 GEORGE ST

PROJECT NO.
19287

ADDRESS
757-763 GEORGE ST, SYDNEY, NSW, AUSTRALIA

REV	BY	DATE	DESCRIPTION
1		16.10.20	Issue for Information

KEY PLAN

NORTH

DRAWING TITLE
GA PLAN - LEVEL B2 - BASEMENT 02

SCALE
1 : 100 @ A1

STATUS
For Information

DRW	CH	APPR	DRW DATE	REV
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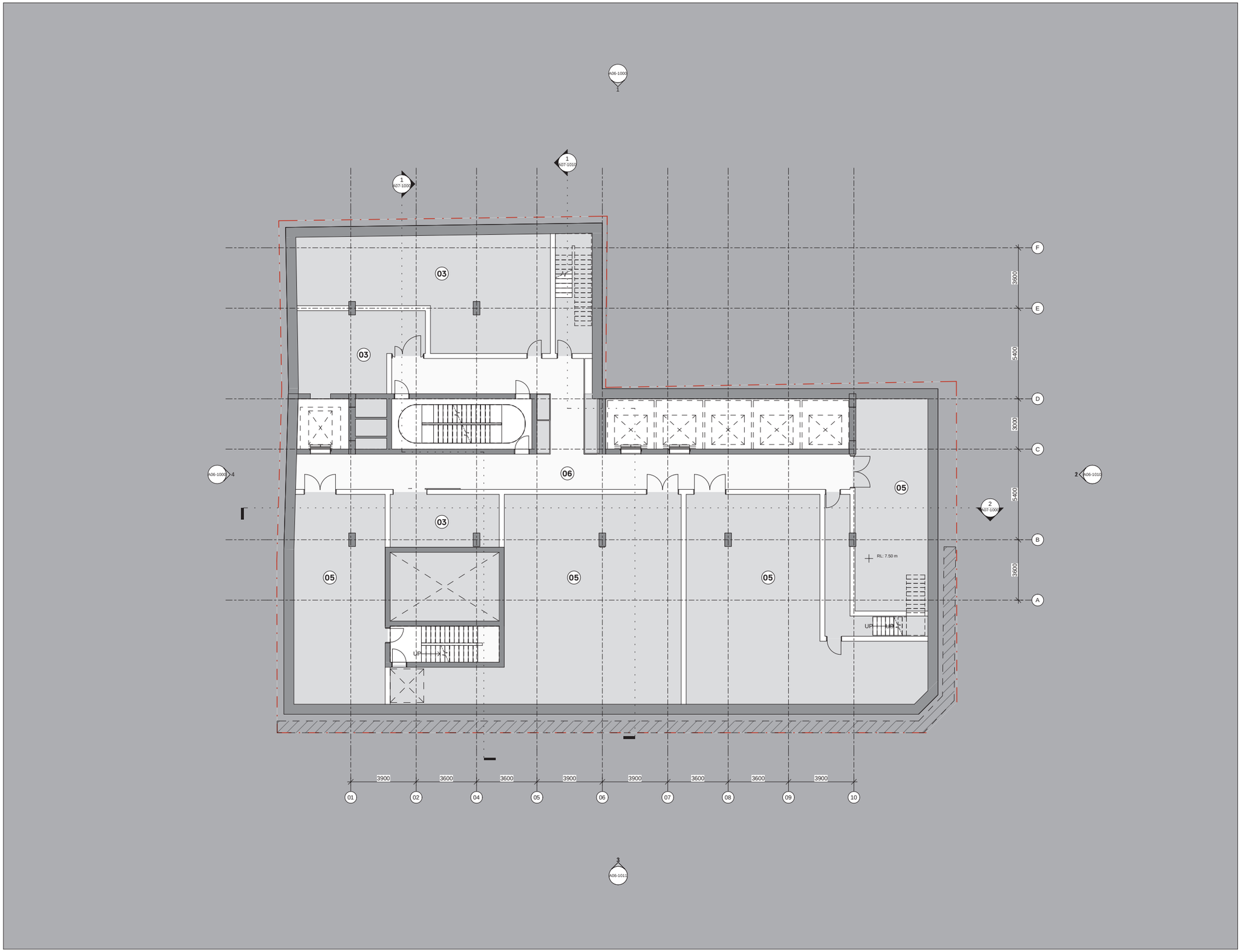
A03-1000-01



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PROJECT NO.
19287

ADDRESS
757-763 GEORGE ST, SYDNEY, NSW, AUSTRALIA

REV	BY	DATE	DESCRIPTION
1		16.10.20	Issue for Information

KEY PLAN

NORTH

DRAWING TITLE
GA PLAN - LEVEL B1 - BASEMENT 01

SCALE
1 : 100 @ A1

STATUS
For Information

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DRAWING NO.
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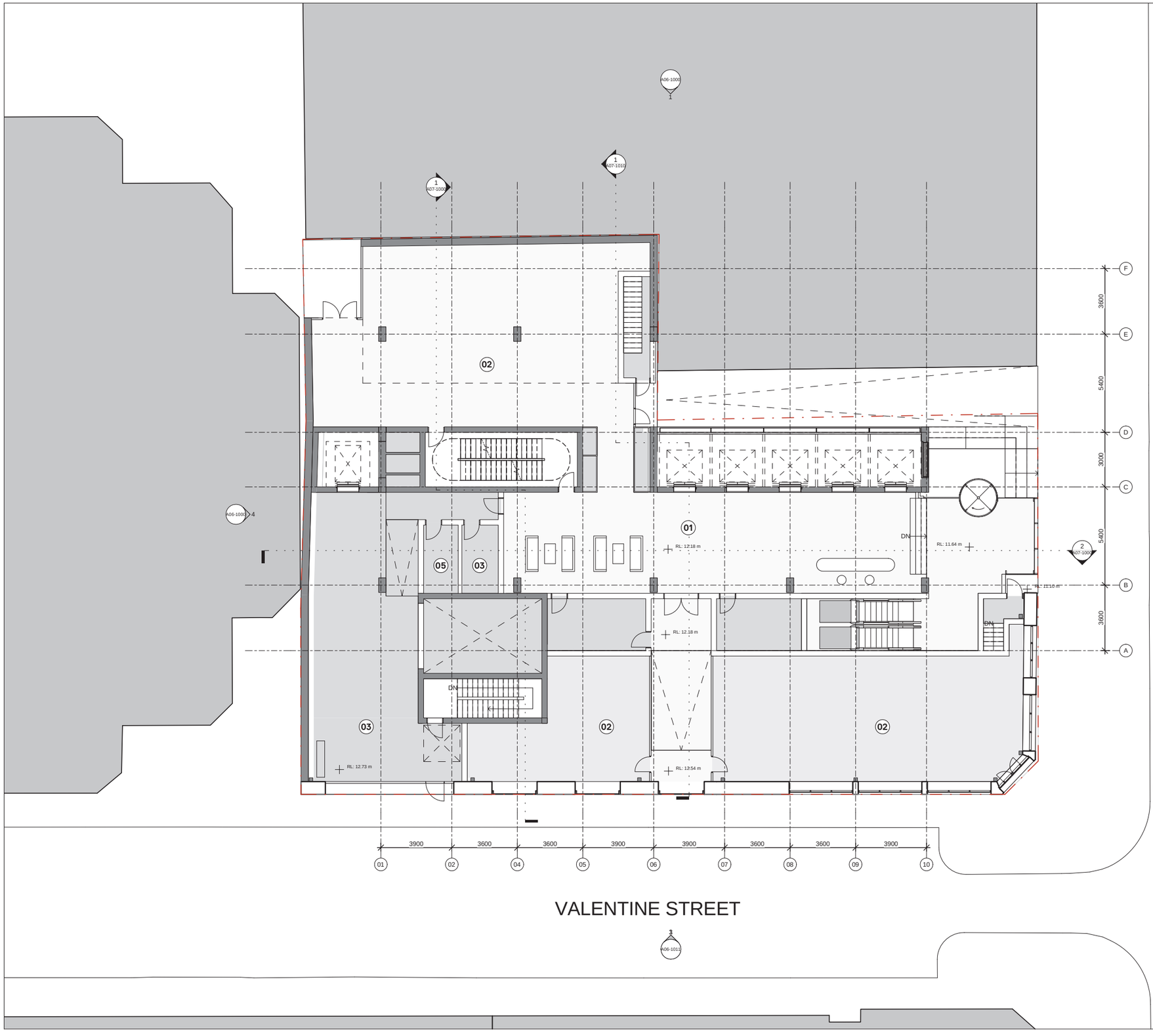

01 Reception
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CLIENT
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CONSULTANTS

PROJECT NAME
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PROJECT NO.
19287

ADDRESS
757-763 GEORGE ST, SYDNEY, NSW, AUSTRALIA

REV	BY	DATE	DESCRIPTION
1		16.10.20	Issue for Information

KEY PLAN

NORTH

DRAWING TITLE
GA PLAN - LEVEL 01 - GROUND

SCALE
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STATUS
For Information

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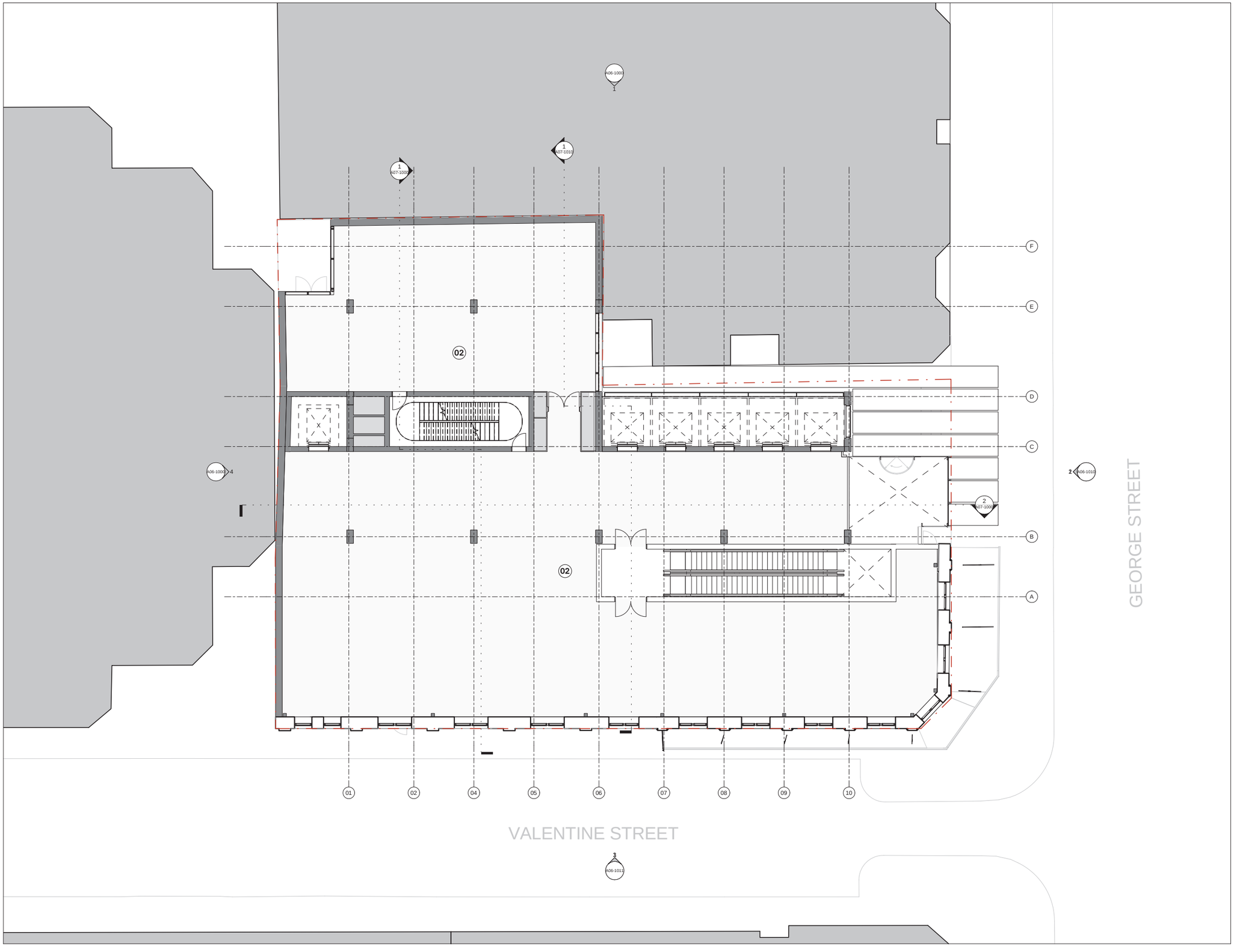

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01 Reception
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03 BOH
04 Car Park
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08 3.5* Hotel Room

CLIENT
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CONSULTANTS

PROJECT NAME
757-763 GEORGE ST

PROJECT NO.
19287

ADDRESS
757-763 GEORGE ST, SYDNEY, NSW, AUSTRALIA

REV	BY	DATE	DESCRIPTION
1		16.10.20	Issue for Information

KEY PLAN

NORTH

DRAWING TITLE
GA PLAN - LEVEL 02 - MEZZANINE

SCALE
1 : 100 @ A1

STATUS
For Information

DRW	CH	APPR	DRW DATE	REV
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DRAWING NO.
A03-1003-01

APPENDIX B
PREVIOUS INVESTIGATION RESULTS

Table T1 - Soil Investigation Results - Heavy Metals

Report No.: E22293 AA

Sample ID	Arsenic[1] (mg/kg)	Cadmium (mg/kg)	Chromium[2] (mg/kg)	Copper (mg/kg)	Lead[3] (mg/kg)	Mercury[4] (mg/kg)	Nickel (mg/kg)	Zinc (mg/kg)
BH1-1	3	<0.3	6.3	3.9	3	<0.01	1.5	5.6
BH1-3	4	<0.3	15	<0.5	15	<0.01	<0.5	7.2
BH2-1	6	<0.3	4.5	6.4	6	<0.01	3.0	37
BH3-1	<3	<0.3	7.6	9.8	9	0.01	5.9	40
BH3-2	5	0.3	7.6	14	14	0.01	9.5	81
BH4-1	<3	<0.3	20	26	5	0.01	39	26
SILs								
HIL B	500	150	500	30,000	1,200	120	1,200	60,000
EIL	100[5]	NR	190	60	1100	NR	30	70

Notes:

Highlighted values indicate concentrations exceed adopted EIL.

SILs	Soil investigation levels.
HIL B	Health-based investigation levels for residential sites with minimal soil access, as per Table 1A(1) of NEPM 2013 Schedule B1
EIL	Ecological investigation levels for urban residential and public open space, as per Table 1B(1) - Table 1B(5) of NEPM 2013 Schedule B1. The most stringent Added Contaminant Limits (ACL) values were adopted for Copper, Nickel and Zinc as the physiochemical properties of site soils were not tested.
NR	No recommended soil assessment criteria are currently available for the indicated parameter(s).
1	Arsenic - HIL assumes 70% oral bioavailability. Site-specific bioavailability may be important and should be considered where appropriate (refer to NEPM 1999 Schedule B7 2013 Amendment).
2	HIL value is provided for Chromium VI while EIL value is provided for Chromium III. Reported sample concentrations were total Chromium including both VI and III. Speciation was not conducted as total Chromium were all under SILs.
3	Lead - HIL is based on blood lead models (IEUBK for HILs A, B and C and adult lead model for HIL D where 50% oral bioavailability has been considered. Site-specific bioavailability may be important and should be considered where appropriate.
4	Value shown is representative of inorganic mercury as provided in Table 1A(1) (refer to NEPM 2013 Schedule B1).
5	Aged values are applicable to arsenic contamination present in soil for at least two years. For fresh contamination refer to NEPM 1999 Schedule B5c 2013 Amendment.

Table T2 - Soil Investigation Results - TRH, BTEX and Naphthalene

Report No.: E22293 AA

Sample ID	Depth (m BGL)	Primary Soil Texture	Total Petroleum Hydrocarbons (mg/kg)					Benzene (mg/kg)	Toluene (mg/kg)	Ethyl benzene (mg/kg)	Total Xylenes (mg/kg)	Naphthalene (Volatile) (mg/kg)
			F1[1]	F2[2] plus Naphthalene	F2[2]	F3[3]	F4[4]					
BH1-1	0.10-0.20	FILL: Silty SAND	<25	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3	<0.1
BH1-3	1.00-1.20	CLAY	<25	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3	<0.1
BH2-1	0.11-0.21	FILL: SAND	<25	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3	<0.1
BH3-1	0.50-0.70	FILL: Gravelly Sand	<25	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3	<0.1
BH3-2	0.80-1.00	Sandy CLAY	<25	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3	<0.1
BH4-1	0.05-0.30	FILL: Gravel	<25	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3	<0.1
SILs												
HSL A & B (Sand)	0 m to <1 m	Sand	45	NR	110	NR	NR	0.5	160	55	40	3
	1 m to <2 m		70	NR	240	NR	NR	0.5	220	NL	60	NL
HSL A & B (Clay)	0 m to <1 m	Clay	50	NR	280	NR	NR	0.7	480	NL	110	5
	1 m to <2 m		90	NR	NL	NR	NR	1	NL	NL	310	NL
ESL[5]		Coarse grained	180*	120*	NR	300	2800	50	85	70	105	170
		Fine grained			NR	1300	5600	65	105	125	45	

Notes:

SILs	Soil investigation levels.
HSL A & B	Health screening level for residential sites, as per Table 1A(3) of NEPM 2013 Schedule B1. HSL is applied based on each sample's primary soil texture and source depth.
ESL	Ecological screening level for urban residential and public open sapce, as per Table 1B(6) of NEPM 2013 Schedule B1.
NL	'Not Limiting' If the derived soil vapour limit exceeds the soil concentration at which the pore water phase cannot dissolve any more of the individual chemical, i.e. where the soil vapour is at equilibrium with the pore water, then the soil vapour source cannot exceed a level that would result in the maximum allowable vapour risk for the given scenario, therefore the SIL is not limiting.
NR	No recommended soil assessment criteria are currently available for the indicated parameter(s).
1	F1 was obtained by subtracting the sum of BTEX concentrations from the C6-C10 fraction.
2	F2 refers to Total Recoverable Hydrocarbon >C10-C16, after subtracting the concentration of Naphatlene.
3	F3 refers to Total Recoverable Hydrocarbon >C16-C34.
4	F4 refers to Total Recoverable Hydrocarbon >C34-C40.
5	ESLs are of low reliability except where indicated by * which indicates that the ESL is of moderate reliability

Sample ID	Benzo(a)pyrene (mg/kg)	Carcinogenic PAHs (as BaP TEQ) (mg/kg)	Total PAH (mg/kg)
BH1-1	<0.1	<0.3	<0.8
BH1-3	<0.1	<0.3	<0.8
BH2-1	<0.1	<0.3	<0.8
BH3-1	<0.1	<0.3	<0.8
BH3-2	<0.1	<0.3	<0.8
BH4-1	0.3	0.5	2.4
SILs			
HIL B	NR	4	400
ESL	0.7	NR	NR

Notes:

SIL	Soil investigation levels.
HIL B	Health-based investigation level for residential sites with minimal soil access, as per Table 1A(1) of NEPM 2013 Schedule B1.
ESL	Ecological screening level for urban residential and public open sapce, as per Table 1B(6) of NEPM 2013 Schedule B1.
NR	No recommended soil assessment criteria are currently available for the indicated parameter(s).

Sample ID	Asbestos (% w/w)
BH1-1	<0.01
BH2-1	<0.01
BH3-1	<0.01
BH4-1	<0.01
SIL	
HSL B	0.04%

Notes:

SIL Soil investigation level.

HSL Health screening level for residential sites with minimal soil access, as per Table 7 of NEPM 2013 Schedule B1.

Table T5 - Soil Investigation Results - OCPs, OPPs PCBs

Report No.: E22293 AA

Sample ID	OCPs								Total OPPs (mg/kg)	Total PCBs (mg/kg)
	Aldrin (mg/kg)	Dieldrin (mg/kg)	Endrin (mg/kg)	Chlordane (mg/kg)	Heptachlor (mg/kg)	DDT (mg/kg)	DDD (mg/kg)	DDE (mg/kg)		
BH1-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	N.D	N.D.
BH2-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	N.D	N.D
BH3-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	N.D	N.D
BH3-2	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	N.D	N.D
BH4-1	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	N.D	N.D
SILs										
HIL B	Total 10		20	90	10	Total 600			NR	1
EILs	NR	NR	NR	NR	NR	180	NR	NR	NR	NR

Notes:

SIL	Soil investigation levels.
HIL B	Health-based investigation levels for residential sites with minimal soil access, as per Table 1A(1) of NEPM 2013 Schedule B1.
EIL	Ecological investigation levels for urban residential and public open space, as per Table 1B(5) of NEPM 2013 Schedule B1.
NR	No recommended soil assessment criteria are currently available for the indicated parameter(s).
N.D.	Concentrations of all tested analytes in this group was under laboratory's practical quantifation limit.

Sample ID	MW Screen Interval (m bgl)	Heavy Metals								BTEX				TRHs				PAH				
		Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Benzene	Toluene	Ethylbenzene	Total Xylene	F1*	F2**	F3 (>C_{16}-C_{34})	F4 (>C_{34}-C_{40})	Naphthalene	2-methylnaphthalene	1-methylnaphthalene	Total PAH (18)	Other PAH
MW1-1	6.0 - 12.0	<1	<0.1	<1	<1	<1	<0.1	58	72	12	160	250	1800	7800	2100	1500	<500	26	3.8	2.6	33	N.D.
GILs																						
GIL (Marine Waters)		NR	0.7[2]	27 (Cr III) / 4.4 (Cr VI)	1.3	4.4	0.1[2]	7	15[1]	500[1]	NR	NR	NR	NR	NR	NR	NR	50	NR	NR	NR	NR
HSL A & B [2]	4 m- <8m	NR	NR	NR	NR	NR	NR	NR	NR	800	NL	NL	NL	1000	1000	NR	NR	NL	NR	NR	NR	NR

Notes:

All results are in units of µg/L.

Highlighted values indicate concentrations exceed adopted GIL.

Highlighted values indicate BTEX/TRH concentrations are above the laboratory detection limits, which are used as interim investigation levels in the absence of assessment criteria.

GIL (Marine Water)	Groundwater investigation level. All GIL values were sourced from Table 1C of NEPM 2013 Schedule B1. GIL applies to typical slightly-moderately disturbed marine water systems was adopted, as the nearest surface water receptor was identified as Sydney Harbour.
HSL A & B	Health screening level for residential sites, as per Table 1A(4) of NEPM 2013 Schedule B1. As groundwater overlying the groundwater table was primarily sandstone, HSLs for sandy materials were adopted. HSLs were applied based on estimated groundwater source depth.
NL	The solubility limit is defined as the groundwater concentration at which the water cannot dissolve any more of an individual chemical based on a petroleum mixture. The soil vapour that is in equilibrium with the groundwater will be at its maximum. If the derived groundwater HSL exceeds the water solubility limit, a soil vapour source concentration for a petroleum mixture could not exceed a level that would result in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as 'not limiting' or 'NL'.
NR	No recommended assessment criteria are currently available for the indicated parameter(s).
N.D.	Concentrations of all tested analytes in this group were under laboratory's practical quantitation limit.
*	F1 was obtained by subtracting the sum of BTEX concentrations from the C6-C10 fraction.
**	F2 was obtained by subtracting Naphthalene from the >C10-C16 fraction.
1	Indicated threshold value may not protect key species from chronic toxicity. Ref. ANZECC & ARMCANZ (2000).
2	Chemicals for which possible bioaccumulation and secondary poisoning effects should be considered. Ref. ANZECC & ARMCANZ (2000).

Sample ID	MW Screen Interval (m bgl)	VOCs				
		Naphthalene	Isopropyl-benzene (Cumene)	1,3,5-trimethylbenzene	1,2,4-trimethylbenzene	Other VOCs
MW1-1	6.00 - 12.00	7.4	18	98	170	N.D.
GILs						
HSL A & B	4 m- <8m	NL	NR	NR	NR	NR
Cgw(OSWER)	-	150	8.4	25	24	NR

Notes: All results are in units of µg/L.

Highlighted values indicate concentrations exceed adopted GIL.

GILs Groundwater investigation levels.

HSL A & B Health screening levels for residential sites, as per Table 1A(4) of NEPM 2013 Schedule B1. As soils overlying the groundwater table were primarily sandstone, HSLs for sandy materials are adopted.

Cgw (OSWER) Target groundwater concentration (Cgw) correponding to indoor air concentrations associated with 10^{-5} incremental lifetime cancer risk, assuming the groundwater Gas to Indoor Air Attenuation Factor = 0.001 and partitioning across the water table obeys Henry's Law. The Cgw values were adopted from Table 2b, "OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and groundwaters" (US EPA, 2002). The Cgw values were used as interim screening levels only.

NL The solubility limit is defined as the groundwater concentration at which the water cannot dissolve any more of an individual chemical based on a petroleum mixture. The soil vapour that is in equilibrium with the groundwater will be at its maximum. If the derived groundwater HSL exceeds the water solubility limit, a soil vapour source concentration for a petroleum mixture could not exceed a level that would result in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as 'not limiting' or 'NL'.

NR No recommended groundwater assessment criteria are currently available for the indicated parameter(s).

N.D. Concentrations of all tested analytes in this group were under laboratory practical quantitation limit.

APPENDIX C
PREVIOUS BORELOGS

Environmental Investigations Australia
Contamination | Remediation | Geotechnical

BOREHOLE: BH1/MW1

Project	Haymarket Geotechnical investigation			Sheet	1 OF 3
Location	757-763 George St, Haymarket NSW	East	333917.4 m	Date Started	18/8/14
Position	Refer to Figure 2	North	6249510.4 m MGA94 Zone 56	Date Completed	18/8/14
Job No.	E22293	Contractor	Traccess Pty Ltd	Logged SK	Date: 18/8/14
Client	Ceerose Pty Ltd	Drill Rig	MD 3000	Checked RP	Date: 3/10/14
		Inclination	-90°		

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DT	-		0	0.10				-	FILL: CONCRETE; 100 mm.	-		CONCRETE HARDSTAND
AD/T	VH	GWNE			BH1-1 ES 0.10-0.20 m SPT 0.50-0.95 m 20,8,4 N=12 BH1-2 BH1-3 ES 1.00-1.20 m			-	FILL: Silty SAND; fine to medium grained, brown-red, trace brick gravel; medium to coarse, angular.	W	-	FILL
			1	0.80				CH	CLAY; high plasticity, brownish yellow with red mottling, trace fine to medium grained sand.			RESIDUAL SOIL
				1.50	SPT 1.50-1.95 m 3,4,7 N=11 BH1-4			CI	Silty CLAY; medium plasticity, pale grey mottled red, trace rootlets.	M - D	St	
	H		2									
			3	3.00	SPT 3.00-3.45 m 6,14,17 N=31 BH1-5			-	SANDSTONE; pale grey with orange iron staining, inferred extremely low strength, inferred extremely weathered.			WEATHERED ROCK
				3.80					From 3.8 m, as above, pale brown with orange-red ironstaining.			
			4									
					SPT 4.50-4.95 m 9,9,14 N=23 BH1-6					-	-	
			5									
				6.00								
	VH		6		SPT 6.00-6.25 m 16,30 N=30/100mm BH1-7			-	SANDSTONE; fine to medium grained, grey with orange ironstaining, inferred very low strength, inferred distinctly weathered.			
			7	7.30								
									Continued as Cored Borehole			
			8									
			9									
			10									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

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BOREHOLE: BH1/MW1

Project	Haymarket Geotechnical investigation			Sheet	2 OF 3
Location	757-763 George St, Haymarket NSW	East	333917.4 m	Date Started	18/8/14
Position	Refer to Figure 2	North	6249510.4 m MGA94 Zone 56	Date Completed	18/8/14
Job No.	E22293	Contractor	Traccess Pty Ltd	Logged SK	Date: 18/8/14
Client	Ceerose Pty Ltd	Drill Rig	MD 3000	Checked RP	Date: 3/10/14
		Inclination	-90°		

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (Ei, VL 0.03, L 0.1, M 0.3, H 1, VH 3, EH 10)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
				0							
				1							
				2							
				3							
				4							
				5							
				6							
				7							
					7.30		Continuation from non-cored borehole				
NMLC	60-70% RETURN	100	78 (83)	8			SANDSTONE; fine to medium grained, bedding dipping 0-5 degrees, <1 mm thick, average spacing = <1-5 mm, grey-pale brown.	DW / SW		7.36-7.55: BPx3 0 - 5° PR RF Fe SN 7.59: BP 5° PR RF CN	
					7.95					7.89: BP 10° PR RF CN	
				9			SANDSTONE; coarse grained, bedding dipping 10-30 degrees, 3-5 mm thick, average spacing = 1-10 mm, grey-dark grey.			8.62: JT 10° PR RF CN 8.62-8.73: JT 70 - 80° UN RF CN 8.73: BP 20° PR RF CN 8.90: JT 60° PR RF CN 9.00-9.20: JT 70° PR RF CN	
					9.22					9.21: BP 10° PR RF CN 9.33: BP 0° PR RF CN	
					9.55		SANDSTONE; fine to medium grained, bedding dipping 0-10 degrees, <1-3 mm thick, average spacing = <1-5 mm.			9.49-9.55: BPx3 0 - 10° PR RF CN avg sp = 20-50 mm	
				10			SANDSTONE; coarse grained, bedding dipping 10-30 degrees, 3-5 mm thick, average spacing = 10-30 mm, grey-dark grey.	FR			

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Environmental Investigations Australia
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BOREHOLE: BH1/MW1

Project	Haymarket Geotechnical investigation			Sheet	3 OF 3
Location	757-763 George St, Haymarket NSW	East	333917.4 m	Date Started	18/8/14
Position	Refer to Figure 2	North	6249510.4 m MGA94 Zone 56	Date Completed	18/8/14
Job No.	E22293	Contractor	Traccess Pty Ltd	Logged SK	Date: 18/8/14
Client	Ceerose Pty Ltd	Drill Rig	MD 3000	Checked RP	Date: 3/10/14
		Inclination	-90°		

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH_{10}, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
NMLC	60-70% RETURN	100		10	10.05		SANDSTONE; medium grained, bedding dipping 20-30 degrees, 2-3 mm thick, average spacing = 3-10 mm, grey-dark grey.	FR		9.94-10.04: HB 10.40-10.42: BPx2 30° PR RF CN	
					10.61		SANDSTONE; coarse grained, bedding dipping 0-10 degrees, <1 mm thick, average spacing = 10-30 mm, grey.			10.62: BP 0° PR RF CN	
				11	11.00		From 11 m, as above, bedding dipping 10-30 degrees, 3-5 mm thick, average spacing = 5-10 mm, grey-dark grey.			11.15-11.84: BPx3 10 - 30° PR RF CN avg sp = 100-500 mm	
		100	95 (87)		12.00		SANDSTONE; coarse grained, bedding dipping 0-10 degrees, 2-3 mm thick, average spacing = 1-5 mm, dark grey-grey.			12.04: BP 10° healed 12.06-12.12: BPx2 0° PR RF VNR Sandy CLAY; soft, sand is fine to medium grained 12.22-12.70: BPx3 0 - 10° PR RF CN avg sp = 200-300 mm	
				12	12.60		SANDSTONE; coarse grained, bedding dipping 0-10 degrees, <1 mm thick, average spacing = 10-30 mm, grey.				
				13	13.42		From 13.42 m, as above, bedding is 1-3 mm thick.			13.71-13.90: BPx2 10 - 20° PR RF CN	
		100	96 (89)	14	14.00		SANDSTONE; coarse grained, bedding dipping 20-30 degrees, 1-3 mm thick, average spacing = 10-30 mm, grey-dark grey.			14.07-14.51: DB 14.74: BP10 PR RF CN	
					14.95		Hole Terminated at 14.95 m Target depth reached. Monitoring well installed. Backfilled with bentonite and sand. Capped with concrete and gatic cover				
				15							
				16							
				17							
				18							
				19							
				20							

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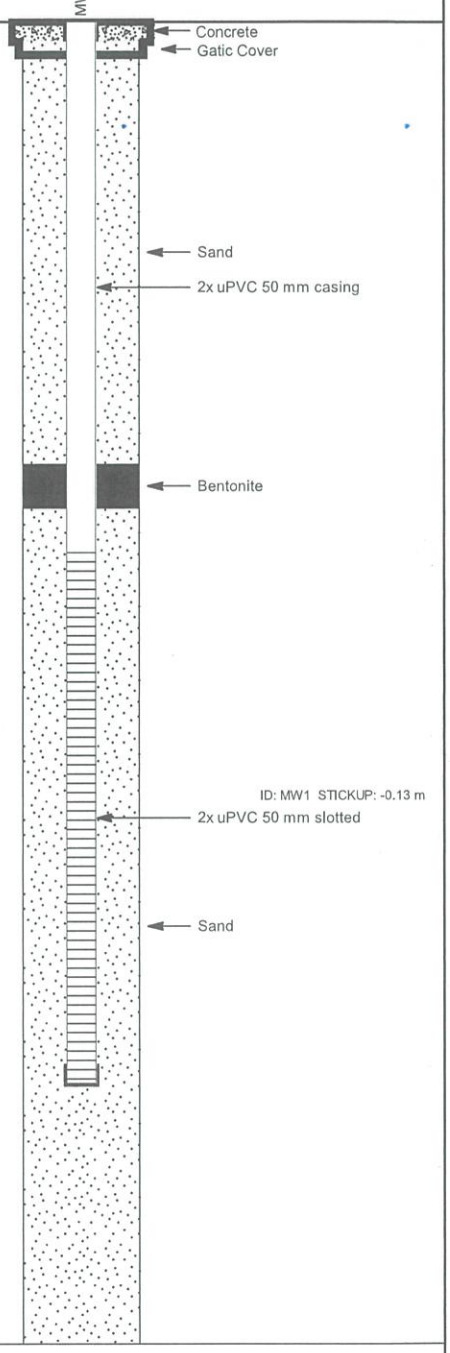
Hole ID: **BH1/MW1**

CLIENT	: Ceerose Pty Ltd	POSITION	: Refer to Figure 2	SHEET	: 1 OF 1
CONTRACTOR	: Traccess Pty Ltd	EASTING	: 333917.4 m	STATUS	:
PROJECT	: Haymarket Geotechnical investigation	NORTHING	: 6249510.4 m	LOGGED BY	: SK
LOCATION	: 757-763 George St, Haymarket NSW	COORD. SYS.	: MGA94 Zone 56	DRILL DATE	: 18/08/2014
PROJECT No.	: E22293	GROUND RL	:		

PIEZOMETER CONSTRUCTION DETAILS

ID	Type	Stick Up & RL	Tip Depth & RL	Installation Date	Static Water Level
MW1	Standpipe	-0.13 m	12.00 m	18/08/2014	

Method	Drilling Water	Depth (m)	Elevation (m AHD)	Graphic Log	Soil / Rock Description
DT					FILL: CONCRETE; 100 mm.
					FILL: Silty SAND; fine to medium grained, brown-red, trace brick gravel; medium to coarse, angular.
					CLAY; high plasticity, brownish yellow with red mottling, trace fine to medium grained sand.
		2			Silty CLAY; medium plasticity, pale grey mottled red, trace rootlets.
AD/T	GWNE	4			SANDSTONE; pale grey with orange iron staining, inferred extremely low strength, inferred extremely weathered. From 3.8 m, as above, pale brown with orange-red ironstaining.
		6			SANDSTONE; fine to medium grained, grey with orange ironstaining, inferred very low strength, inferred distinctly weathered.
NMLC	60-70% RETURN	8			SANDSTONE; fine to medium grained, bedding dipping 0-5 degrees, <1 mm thick, average spacing = <1-5 mm, grey-pale brown.
					SANDSTONE; coarse grained, bedding dipping 10-30 degrees, 3-5 mm thick, average spacing = 1-10 mm, grey-dark grey.
					SANDSTONE; fine to medium grained, bedding dipping 0-10 degrees, <1-3 mm thick, average spacing = <1-5 mm.
		10			SANDSTONE; coarse grained, bedding dipping 10-30 degrees, 3-5 mm thick, average spacing = 10-30 mm, grey-dark grey.
					SANDSTONE; medium grained, bedding dipping 20-30 degrees, 2-3 mm thick, average spacing = 3-10 mm, grey-dark grey.
					SANDSTONE; coarse grained, bedding dipping 0-10 degrees, <1 mm thick, average spacing = 10-30 mm, grey.
		12			From 11 m, as above, bedding dipping 10-30 degrees, 3-5 mm thick, average spacing = 5-10 mm, grey-dark grey.
					SANDSTONE; coarse grained, bedding dipping 0-10 degrees, 2-3 mm thick, average spacing = 1-5 mm, dark grey-grey.
					SANDSTONE; coarse grained, bedding dipping 0-10 degrees, <1 mm thick, average spacing = 10-30 mm, grey.
		14			From 13.42 m, as above, bedding is 1-3 mm thick.
					SANDSTONE; coarse grained, bedding dipping 20-30 degrees, 1-3 mm thick, average spacing = 10-30 mm, grey-dark grey.
		16			Hole Terminated at 14.95 m Target depth reached. Monitoring well installed. Backfilled with bentonite and sand. Capped with concrete and gatic cover



RIG	:	CHECKED BY	: RP	REMARK
INCLINATION	:	CHECKED DATE	: 03/10/2014	
AZIMUTH	:	APPROVED BY	:	
HOLE DIA.	:	APPROVED DATE	:	

REPORT OF BOREHOLE: BH1/MW1

CLIENT: Ceerose Pty Ltd
PROJECT: Preliminary Geotechnical Investigation

LOCATION: 757-763 George St, Haymarket NSW

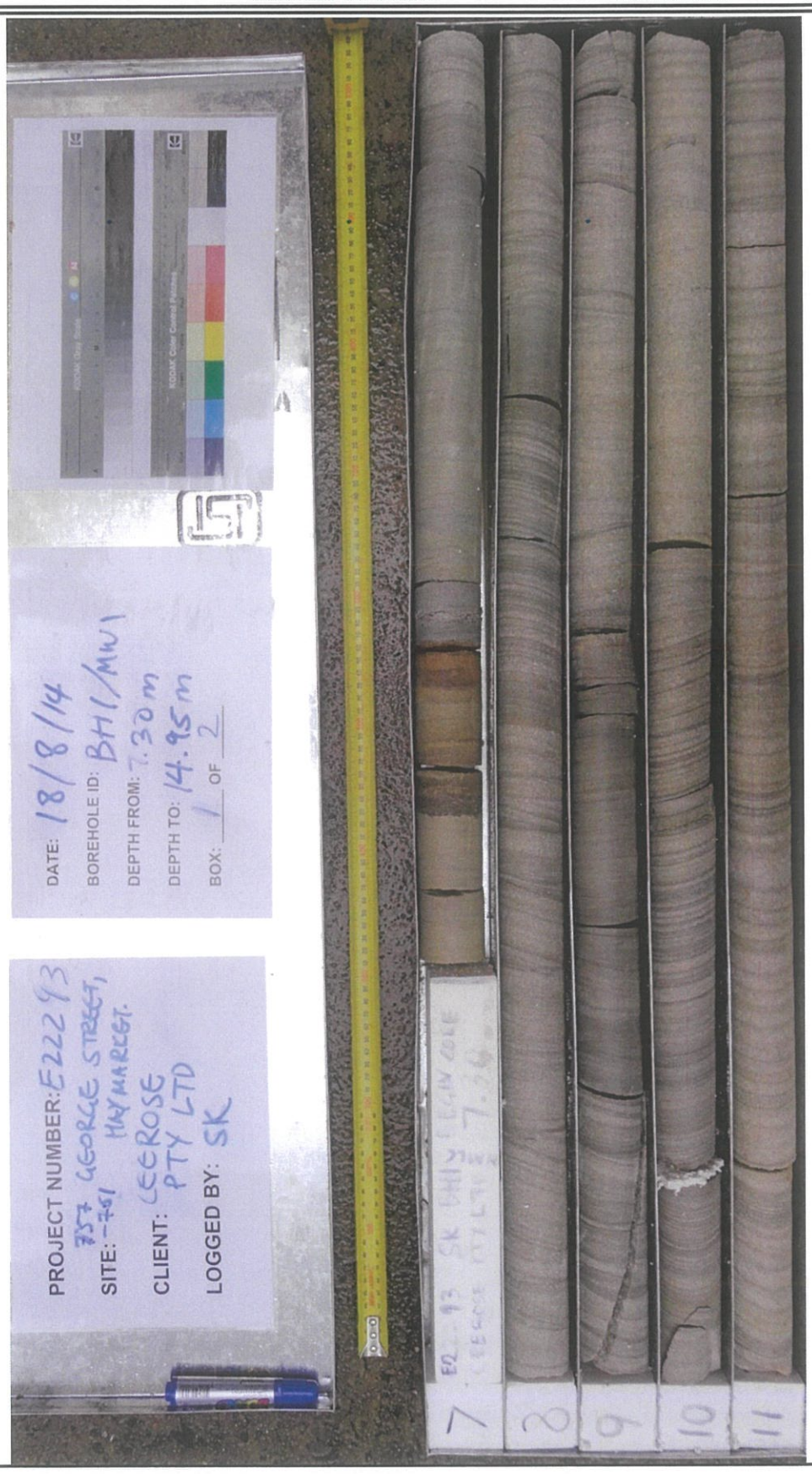
JOB NO: E22293

EAST: 333917.396 m
NORTH: 6249510.394 m MGA94 Zone 56

INCLINATION: -90°
BOX: 1 of 2
HOLE DEPTH: 14.95 m

DEPTH RANGE: 7.30 m to 14.95 m
DRILL RIG: MD 3000
DRILLER: Traccess Pty Ltd
LOGGED: SK DATE: 18/08/2014

CHECKED: RP DATE: 03/10/2014



REPORT OF BOREHOLE: BH1/MW1

CLIENT: Ceerose Pty Ltd
PROJECT: Preliminary Geotechnical Investigation

LOCATION: 757-763 George St, Haymarket NSW

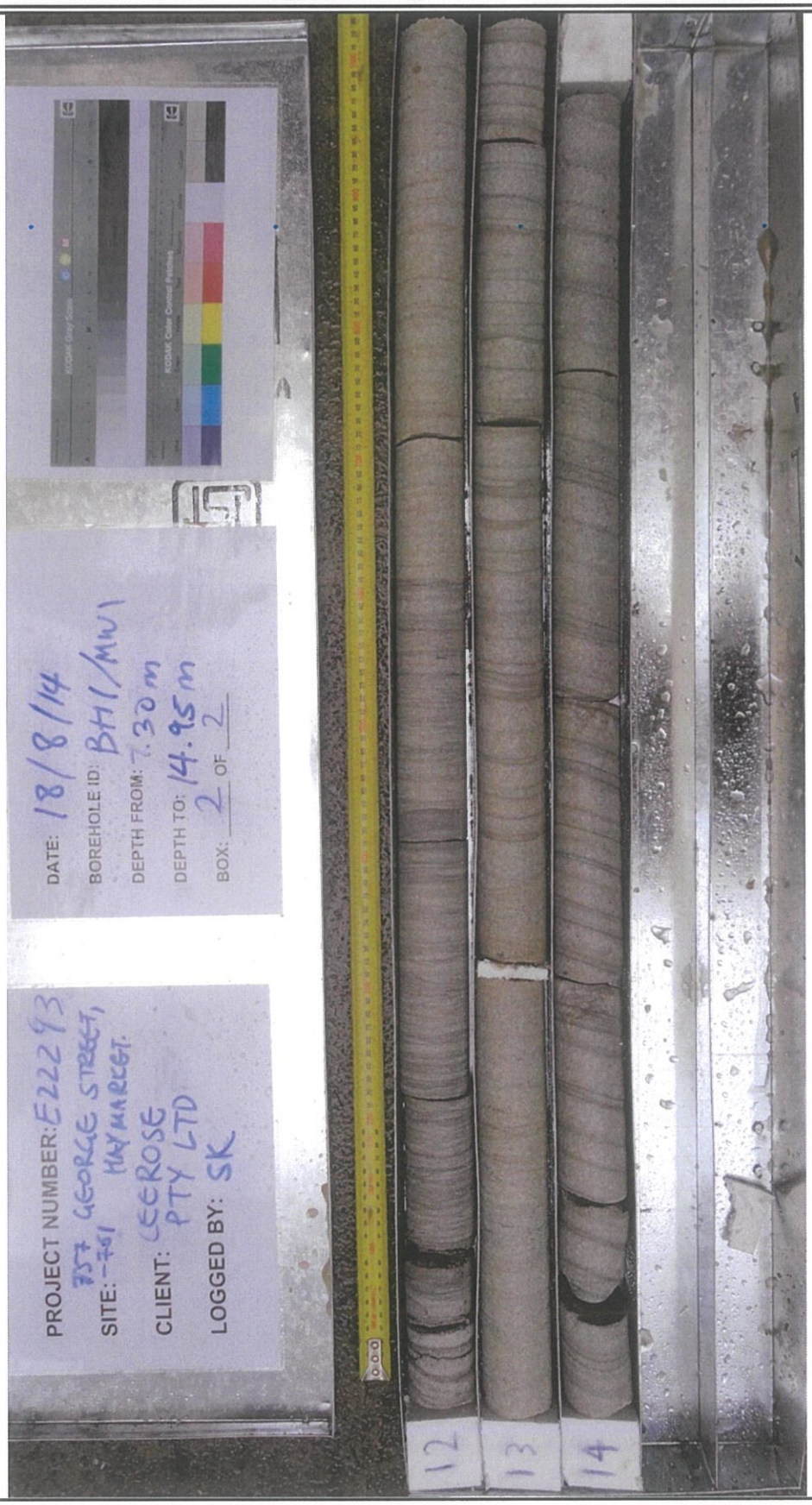
JOB NO: E22293

EAST: 333917.396 m
NORTH: 6249510.394 m MGA94 Zone 56

INCLINATION: -90°
BOX: 2 of 2
HOLE DEPTH: 14.95 m

DEPTH RANGE: 7.30 m to 14.95 m
DRILL RIG: MD 3000
DRILLER: Traccess Pty Ltd
LOGGED: SK DATE: 18/08/2014

CHECKED: RP DATE: 03/10/2014



BOREHOLE: BH2

Environmental Investigations Australia
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Project	Haymarket Geotechnical investigation			Sheet	1 OF 3
Location	757-763 George St, Haymarket NSW	East	333905.9 m	Date Started	18/8/14
Position	Refer to Figure 2	North	6249525.3 m MGA94 Zone 56	Date Completed	18/8/14
Job No.	E22293	Contractor	Traccess Pty Ltd	Logged SK	Date: 18/8/14
Client	Ceerose Pty Ltd	Drill Rig	MD 3000	Checked RP	Date: 3/10/14
		Inclination	-90°		

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DT	-		0	0.10				-	FILL: CONCRETE; 100 mm.	-		CONCRETE HARDSTAND
					BH2-1 ES 0.11-0.21 m			-	VOID: 10 mm.	W		FILL
				0.50				-	FILL: SAND; fine to coarse grained, poorly graded, pale brown.			
					SPT 0.50-0.95 m 1,1,1 N=2 BH2-2			-	FILL: Clayey SAND; fine to medium grained, brown-orange, trace brick and concrete gravel; coarse, subrounded.			
			1	1.50								
					SPT 1.50-1.95 m 1,2,3 N=5 BH2-3			-	FILL: Sandy CLAY; low plasticity, brown-orange, sand is fine to medium grained, trace brick and concrete gravel; fine to medium, angular.			
			2									
			3		SPT 3.00-3.45 m 1 BH2-4							
AD/T	E-F	GWNE	4							M - D	-	
				4.50								
					SPT 4.50-4.95 m 2,1,1 N=2 BH2-5			-	From 4.5 m, as above, brown with red mottling, trace brick and concrete gravel; medium to coarse, subangular to subrounded.			
			5									
			6	6.00								
	VH				SPT 6.00-6.02 m 8/20mm HB BH2-6				From 6.0-6.24 m, inferred dense brick layer.			
	H		7	7.25								
									Continued as Cored Borehole			
			8									
			9									
			10									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

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BOREHOLE: BH2

Project	Haymarket Geotechnical investigation			Sheet	2 OF 3
Location	757-763 George St, Haymarket NSW	East	333905.9 m	Date Started	18/8/14
Position	Refer to Figure 2	North	6249525.3 m MGA94 Zone 56	Date Completed	18/8/14
Job No.	E22293	Contractor	Traccess Pty Ltd	Logged SK	Date: 18/8/14
Client	Ceerose Pty Ltd	Drill Rig	MD 3000	Checked RP	Date: 3/10/14
		Inclination	-90°		

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (Ei 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
				0							
				1							
				2							
				3							
				4							
				5							
				6							
				7	7.25		Continuation from non-cored borehole				
NMLC	70-80% RETURN	100	64 (89)	8	8.35		SANDSTONE; fine grained, bedding dipping 0-5 degrees, dark grey with black organic matter through bedding.	DW		7.30-8.35: BPx22 0 - 5° PR RF Fe SN avg sp = 5-30 mm	
				9	9.42		SANDSTONE; medium to coarse grained, bedding dipping 10-30 degrees, 1-3 mm thick, average spacing = 3-10 mm, grey-dark grey.	SW		7.97-7.98: CS 10 mm, GRAVEL; coarse, subrounded 8.01-8.05: DS 40 mm, SAND; fine to medium grained 8.20-8.26: DZ 60 mm, SAND; fine to medium grained 8.62: BP 5° PR RF CN 9.07: BP 5° PR RF CN 9.26: BP 5° PR RF CN 9.35: JT 0 - 20° CU RF CN	
				10	9.74		SANDSTONE; fine to medium grained, bedding dipping 10-20 degrees, 1-3 mm thick, average spacing = <1-5 mm, dark grey-grey.	FR		9.51-9.73: BPx3 0 - 5° PR RF CN avg sp = 5-20 mm	

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

Environmental Investigations Australia
Contamination | Remediation | Geotechnical

BOREHOLE: BH2

Project	Haymarket Geotechnical investigation			Sheet	3 OF 3
Location	757-763 George St, Haymarket NSW	East	333905.9 m	Date Started	18/8/14
Position	Refer to Figure 2	North	6249525.3 m MGA94 Zone 56	Date Completed	18/8/14
Job No.	E22293	Contractor	Traccess Pty Ltd	Logged SK	Date: 18/8/14
Client	Ceerose Pty Ltd	Drill Rig	MD 3000	Checked RP	Date: 3/10/14
		Inclination	-90°		

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
NMLC	70-80% RETURN	100	64 (89)	10			SANDSTONE; coarse grained, bedding dipping 20-30 degrees, 1-3 mm thick, average spacing = 10-30 mm, pale grey-grey.	FR			
										10.60: JT 0° PR RF CN	
					10.90						
				11			From 10.9 m, average spacing = 3-10 mm.			11.14: JT 0° PR RF CN	
		100	93 (96)							11.33-11.82: BPx3 20 - 30° PR RF CN avg sp = 200-300 mm	
					12.00					11.95: JT 0° PR RF CN	
				12			Hole Terminated at 12.00 m Target depth reached. Backfilled to surface level with drilling spoil and concrete capped.				
				13							
				14							
				15							
				16							
				17							
				18							
				19							
				20							

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

REPORT OF BOREHOLE: BH2

CLIENT: Ceerose Pty Ltd
PROJECT: Preliminary Geotechnical Investigation

LOCATION: 757-763 George St, Haymarket NSW

JOB NO: E22293

EAST: 333905.891 m
NORTH: 6249525.260 m MGA94 Zone 56

INCLINATION: -90°
BOX: 1 of 1
HOLE DEPTH: 12.00 m

DEPTH RANGE: 7.25 m to 12.00 m
DRILL RIG: MD 3000
DRILLER: Traccess Pty Ltd
LOGGED: SK DATE: 18/08/2014

CHECKED: RP DATE: 03/10/2014

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BOREHOLE: BH3

Project	Haymarket Geotechnical investigation			Sheet	1 OF 1
Location	757-763 George St, Haymarket NSW			Date Started	21/10/14
Position	Refer to Figure 2			Date Completed	21/10/14
Job No.	E22293	Contractor		Logged DS	Date: 31/10/14
Client	Ceerose Pty Ltd	Drill Rig	HA	Checked NF	Date: 31/10/14
		Inclination	-90°		

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DT	-	GWNE	0.0					-	FILL: CONCRETE; 150 mm.	-	-	CONCRETE HARDSTAND
				0.15				-	FILL: BRICK FRAGMENTS; 150 mm.			FILL
				0.30				-	FILL: CONCRETE; 200 mm.			CONCRETE HARDSTAND
			0.5	0.50	BH3-1/B1 ES 0.50-0.70 m 0.50 m PID = 0 ppm			-	FILL: Gravelly SAND; fine to medium grained, orange-brown, medium to coarse grained gravel, no odour.			FILL
HA				0.70				CI	Sandy CLAY; medium plasticity, brown with red mottling, trace sand, inferred very stiff, no odour.	M		RESIDUAL SOIL
					BH3-2 ES 0.80-1.00 m 0.80 m PID = 0 ppm							
			1.0	1.00					Hole Terminated at 1.00 m Refusal			
			1.5									
			2.0									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

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BOREHOLE: BH4

Project	Haymarket Geotechnical investigation			Sheet	1 OF 1
Location	757-763 George St, Haymarket NSW			Date Started	21/10/14
Position	Refer to Figure 2			Date Completed	21/10/14
Job No.	E22293	Contractor		Logged DS	Date: 31/10/14
Client	Ceerose Pty Ltd	Drill Rig	HA	Checked NF	Date: 31/10/14
		Inclination	-90°		

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DT			0.0	0.05				-	FILL: BITUMEN; 50 mm.	-		PAVEMENT
HA	-	GWNE			BH4-1 ES 0.05-0.30 m 0.05 m PID = 0.ppm			-	FILL: GRAVEL; coarse grained, grey-black, trace fine to medium grained sand, no odour.	D	-	FILL
			0.5	0.50					Hole Terminated at 0.50 m Refusal			
			1.0									
			1.5									
			2.0									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

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BOREHOLE: BH5

Project	Haymarket Geotechnical investigation			Sheet	1 OF 1
Location	757-763 George St, Haymarket NSW			Date Started	21/10/14
Position	Refer to Figure 2			Date Completed	21/10/14
Job No.	E22293	Contractor		Logged DS	Date: 31/10/14
Client	Ceerose Pty Ltd	Drill Rig	HA	Checked NF	Date: 31/10/14
		Inclination	-90°		

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DT	-	GWNE	0.0					-	FILL: CONCRETE; 100 mm.	-	-	CONCRETE HARDSTAND
				0.10				-	FILL: BRICK; 300 mm.			PAVEMENT
				0.40					Hole Terminated at 0.40 m Refusal			
			0.5									
			1.0									
			1.5									
			2.0									

This borehole log should be read in conjunction with Environmental Investigations Australia's accompanying standard notes.

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EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT LOGS

DRILLING/EXCAVATION METHOD

HA	Hand Auger	RD	Rotary blade or drag bit	NQ	Diamond Core - 47 mm
DTC	Diatube Coring	RT	Rotary Tricone bit	NMLC	Diamond Core - 52 mm
NDD	Non-destructive digging	RAB	Rotary Air Blast	HQ	Diamond Core - 63 mm
AS*	Auger Screwing	RC	Reverse Circulation	HMLC	Diamond Core - 63mm
AD*	Auger Drilling	PT	Push Tube	BH	Tractor Mounted Backhoe
*V	V-Bit	CT	Cable Tool Rig	EX	Tracked Hydraulic Excavator
*T	TC-Bit, e.g. ADT	JET	Jetting	EE	Existing Excavation
ADH	Hollow Auger	WB	Washbore or Bailer	HAND	Excavated by Hand Methods

PENETRATION/EXCAVATION RESISTANCE

L **Low resistance.** Rapid penetration/ excavation possible with little effort from equipment used.

M **Medium resistance.** Penetration/ excavation possible at an acceptable rate with moderate effort from equipment used.

H **High resistance.** Penetration/ excavation is possible but at a slow rate and requires significant effort from equipment used.

R **Refusal/ Practical Refusal.** No further progress possible without risk of damage or unacceptable wear to equipment used.

These assessments are subjective and are dependent on many factors, including equipment power and weight, condition of excavation or drilling tools and experience of the operator.

WATER

Water level at date shown

Water inflow

Partial water loss

Complete water loss

GROUNDWATER NOT OBSERVED	Observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave-in of the borehole/ test pit.
GROUNDWATER NOT ENCOUNTERED	Borehole/ test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/ test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-2004
4,7,11 N=18	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following 150mm
seating 30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
Sampling	
DS	Disturbed Sample
BDS	Bulk disturbed Sample
GS	Gas Sample
WS	Water Sample
U63	Thin walled tube sample - number indicates nominal sample diameter in millimetres
Testing	
FP	Field Permeability test over section noted
FVS	Field Vane Shear test expressed as uncorrected shear strength (sv = peak value, sr = residual value)
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket Penetrometer test expressed as instrument reading in kPa
WPT	Water Pressure tests
DCP	Dynamic Cone Penetrometer test
CPT	Static Cone Penetration test
CPTu	Static Cone Penetration test with pore pressure (u) measurement

RANKING OF VISUALLY OBSERVABLE CONTAMINATION AND ODOUR (for specific soil contamination assessment

R = 0	No visible evidence of contamination	R = A	No non-natural odours identified
R = 1	Slight evidence of visible contamination	R = B	Slight non-natural odours identified
R = 2	Visible contamination	R = C	Moderate non-natural odours identified
R = 3	Significant visible contamination	R = D	Strong non-natural odours identified

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)

$$= \frac{\text{Length of core recevered}}{\text{Lengh of core run}} \text{ x } 100$$

SCR = Solid Core Recovery (%)

$$= \frac{\Sigma \text{ Length of cylindrical core recevered}}{\text{Lengh of core run}} \text{ x } 100$$

RQD = Rock Quality Designation (%)

$$= \frac{\Sigma \text{Axial Lenghts of core} > 100\text{mm}}{\text{Lengh of core run}} \text{ x } 100$$

MATERIAL BOUNDARIES

———— = inferred boundary

- - - - - - - - = probable boundary

— ?— ?— ?— ?— ? = possible boundary

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METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT LOGS

FILL

COUBLES or BOULDERS

GRAVEL (GP or GW)

ORGANIC SOILS (OL, OH or Pt)

SILT (ML or MH)

CLAY (CL, CI or CH)

SAND (SP or SW)

Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay

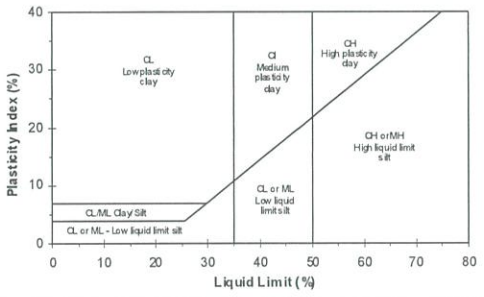
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil is broadly classified and described in Borehole and Test Pit Logs using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. Material properties are assessed in the field by visual/tactile methods.

PARTICLE SIZE CHARACTERISTICS

Major Division	Sub Division	Particle Size
BOULDERS		>200 mm
COBBLES		63 to 200 mm
GRAVEL	Coarse	20 to 63 mm
	Medium	6 to 20 mm
	Fine	2 to 6 mm
SAND	Coarse	0.6 to 2 mm
	Medium	0.2 to 0.6 mm
	Fine	0.075 to 0.2mm
SILT		0.002 to 0.075 mm
CLAY		<0.002 mm

PLASTICITY PROPERTIES



USCS SYMBOLS

Major Divisions		Symbol	Description
COARSE GRAINED SOILS More than 50% by dry mass less than 63mm is greater than 0.075mm	More than 50% of coarse grains are >2.36mm	GW	Well graded gravel and gravel-sand mixtures, little or no fines.
		GP	Poorly graded gravel and gravel-sand mixtures, little or no fines.
		GM	Silty gravel, gravel-sand-silt mixtures.
		GC	Clayey gravel, gravel-sand-clay mixtures.
	More than 50% of coarse grains are <2.36mm	SW	Well graded sand and gravelly sand, little or no fines.
		SP	Poorly graded sand and gravelly sand, little or no fines.
		SM	Silty sand, sand-silt mixtures.
		SC	Clayey sand, sandy-clay mixtures.
FINE GRAINED SOILS More than 50% by dry mass less than 63mm is less than 0.075mm	Liquid Limit less < 50%	ML	Inorganic silts of low plasticity, very fine sands, rock flour, silty or clayey fine sands.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.
		OL	Organic silts and organic silty clays of low plasticity.
	Liquid Limit > than 50%	MH	Inorganic silts of high plasticity.
		CH	Inorganic clays of high plasticity.
		OH	Organic clays of medium to high plasticity.
		PT	Peat muck and other highly organic soils.

MOISTURE CONDITION

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays & Silts may be brittle or friable and powdery.
M	Moist	Soils are darker than in the dry condition & may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

Moisture content of cohesive soils may also be described in relation to plastic limit (WP) or liquid limit (WL) [» much greater than, > greater than, < less than, « much less than].

CONSISTENCY

Symbol	Term	Undrained Shear Strength
VS	Very Soft	0. to 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
VSt	Very Stiff	100 to 200 kPa
H	Hard	Above 200 kPa

DENSITY

Symbol	Term	Density Index %	SPT "N" #
VL	Very Loose	< 15	0 to 4
L	Loose	15 to 35	4 to 10
MD	Medium Density	35 to 65	10 to 30
D	Dense	65 to 85	30 to 50
VD	Very Dense	Above 85	Above 50

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material. # SPT correlations are not stated in AS1726 – 1993, and may be subject to corrections for overburden pressure and equipment type.

MINOR COMPONENTS

Term	Assessment Guide	Proportion by Mass
Trace	Presence just detectable by feel or eye but soil properties little or no different to general properties of primary component	Coarse grained soils: ≤ 5% Fine grained soil: ≤15%
Some	Presence easily detectable by feel or eye but soil properties little or no different to general properties of primary component	Coarse grained soils: 5 - 12% Fine grained soil: 15 - 30%

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ABBREVIATIONS AND DESCRIPTIONS FOR ROCK MATERIAL AND DEFECTS

CLASSIFICATION AND INFERRED STRATIGRAPHY

Rock is broadly classified and described in Borehole Logs using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. Material properties are assessed in the field by visual/ tactile methods.

ROCK MATERIAL DESCRIPTION

Layering

Term	Description
Massive	No layering apparent
Poorly Developed	Layering just visible; little effect on properties
Well Developed	Layering (bedding, foliation, cleavage) distinct; rock breaks more easily parallel to layering

Structure

Term	Spacing (mm)
Thinly laminated	<6
Laminated	6 – 20
Very thinly bedded	20 – 60
Thinly bedded	60 – 200
Medium bedded	200 – 600
Thickly bedded	600 – 2,000
Very thickly bedded	> 2,000

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT TYPES

Defect Type	Abbr.	Description
Joint	J	Surface of a fracture or parting, formed without displacement, across which the rock has little or no tensile strength. May be closed or filled by air, water or soil or rock substance, which acts as cement.
Bedding Parting	B	Surface of fracture or parting, across which the rock has little or no tensile strength, parallel or sub-parallel to layering/ bedding. Bedding refers to the layering or stratification of a rock, indicating orientation during deposition, resulting in planar anisotropy in the rock material.
Foliation	X	Repetitive planar structure parallel to the shear direction or perpendicular to the direction of higher pressure, especially in metamorphic rock, e.g. Schistosity (S) and Gneissosity.
Contact	C	The surface between two types or ages of rock.
Cleavage	L	Cleavage planes appear as parallel, closely spaced and planar surfaces resulting from mechanical fracturing of rock through deformation or metamorphism, independent of bedding.
Sheared Seam/ Zone (Fault)	SS/SZ	Seam or zone with roughly parallel almost planar boundaries of rock substance cut by closely spaced (often <50 mm) parallel and usually smooth or slickensided joints or cleavage planes.
Crushed Seam/ Zone (Fault)	CS/CZ	Seam or zone composed of disoriented usually angular fragments of the host rock substance, with roughly parallel near-planar boundaries. The fragments may be of clay, silt, sand or gravel sizes or mixtures of these.
Decomposed Seam/ Zone	DS/DZ	Seam of soil substance, often with gradational boundaries, formed by weathering of the rock material in places.
Infilled Seam	IS/IZ	Seam of soil substance, usually clay or clayey, with very distinct roughly parallel boundaries, formed by soil migrating into joint or open cavity.
Schistocity	S	The foliation in schist or other coarse grained crystalline rock due to the parallel arrangement of platy or prismatic mineral grains, such as mica.
Vein	V	Distinct sheet-like body of minerals crystallised within rock through typically open-space filling or crack-seal growth.

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT SHAPE AND ROUGHNESS

Shape	Abbr.	Description	Roughness	Abbr.	Description
Planar	Pl	Consistent orientation	Polished	Po	Shiny smooth surface
Curved	Cu	Gradual change in orientation	Slickensided	Sl	Grooved or striated surface, usually polished
Undulating	Un	Wavy surface	Smooth	Sm	Smooth to touch. Few or no surface irregularities
Stepped	St	One or more well defined steps	Rough	Ro	Many small surface irregularities (amplitude generally <1mm). Feels like fine to coarse sandpaper
Irregular	Irr	Many sharp changes in orientation	Very Rough	VRo	Many large surface irregularities, amplitude generally >1mm. Feels like very coarse sandpaper

Orientation: **Vertical Boreholes –** The dip (inclination from horizontal) of the defect.
Inclined Boreholes – The inclination is measured as the acute angle to the core axis.

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT COATING

Coating	Abbr.	Description
Clean	Cn	No visible coating or infilling
Stain	Sn	No visible coating but surfaces are discoloured by staining, often limonite (orange-brown)
Veneer	Vr	A visible coating of soil or mineral substance, usually too thin to measure (< 1 mm); may be patchy

DEFECT APERTURE

Aperture	Abbr.	Description
Closed	Cl	
Open	O	Without Infill
Infilled	-	Soil or rock i.e. clay, talc, pyrite, quartz, etc.