Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Preliminary Remediation Action Plan

The Ribbon
31 Wheat Road, Darling Harbour NSW

Prepared for
Grocon Group

Project 73201.04
March 2016

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	73201.04	Document No.	R.001.Rev0
Document title	Preliminary Remediation Action Plan The Ribbon		
Site address	31 Wheat Road, Darling Harbour NSW		
Report prepared for	Grocon Group		
File name	73201.04.R.001.Rev0.pRAP.docx		

Document status and review

Status	Prepared by	Reviewed by	Date issued
Draft A	Nerilee Edwards	Paul Gorman	23 March 2016
Revision 0	Nerilee Edwards	Paul Gorman	30 March 2016

Distribution of copies

Status	Electronic	Paper	Issued to
Draft A	1		Justin Clark
Revision 0	1		Justin Clark

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

	Signature	Date
Author		30 March 2016
Reviewer		30 March 2016

bsi. ISO 9001 Quality Management

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

Table of Contents

Preliminary Remediation Action Plan
The Ribbon
31 Wheat Road, Darling Harbour NSW

1. Introduction

1.1 Overview

This report presents a preliminary remediation action plan (RAP) undertaken for the proposed "the ribbon" development at 31 Wheat Road, Darling Harbour NSW. The RAP was commissioned by Mr Justin Clark of Grocon Group and was undertaken in accordance with Douglas Partners (DP)' proposal dated 23 March 2016.

The proposed redevelopment is known as 'The Ribbon' and will comprise a hotel and serviced apartments, with associated landscaping and public open space areas. The general layout of the proposed development is shown on Drawing 1, Appendix A. The proposed development footprint is herein referred to as "the site".

This RAP has been prepared to address a requirement from the NSW Department of Planning and Environment in a letter entitled *State Significant Development Application for redevelopment of IMAX, Darling Harbour (SSD 7388)*, dated 10 March 2016.

DP has previously conducted a contamination and geotechnical investigation for the proposed development at discussed in Section 3.

1.2 Site Identification

The site is located at 31 Wheat Road, Darling Harbour and is identified as Lots 401, 402, 403, 404, 405 and part Lot 406 in deposited plan 862501. The site is zoned Darling Harbour Plan No. 7 under the City of Sydney regional environmental plan under Schedule 6, Part 7, Clause 23 of the *Environmental Planning and Assessment Act 1979*, as amended. The site covers an area of approximately 13,600 m^2 (1.36 hectares, ha), made up of a proposed building footprint of about 4,600 m^2 and surrounding open space/public area of about 9,000 m^2.

The site locality and boundaries are shown on Drawing 2, Appendix A, whilst the proposed building footprint and public domain areas within the site are shown on Drawings 3A and 3B, Appendix A.

1.3 Proposed Development

The bulk of the proposed civil / excavation / construction works is understood to centre on the proposed building footprint totalling approximately 4,600 m^2. Proposed bulk excavation depths in this area are understood to be approximately 0.5 m and 2.5 m below the existing ground level (bgl). A

larger area (public domain) enveloping this footprint is subject to changes in landscaping including artistic features, with localised excavation depths predicted to be no more than 0.5 m bgl. The low impact area of the site occupies approximately 9,000 m^2.

1.4 RAP Objectives

The objectives of the RAP are to:

- Present a summary of the contamination issues identified at the site;
- Provide the requirements for additional contamination investigation;
- Detail how the need for remediation or management will be assessed;
- Identify the principals for remediation/ management of the site (if required); and
- Provide a framework for any remediation/ management which may be required at the site.

1.5 Regulatory Framework

The RAP has been prepared to assist the Grocon Group to meet the regulatory requirements for approval of the proposed development under the *Environmental Planning and Assessment Act* (NSW) 1979. Of particular relevance is the State Environmental Planning Policy (SEPP) 55 – *Remediation of Land* (SEPP55).

Technical aspects of this RAP are based on *Contaminated Land Management Act* (NSW) 1997 *(as amended 2008)* (the CLM Act) and guidance endorsed the by the NSW Environmental Protection Authority (EPA) under the CLM Act, including

- National Environment Protection Council (NEPC) *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013)* (NEPC 2013);
- NSW Office of Environment and Heritage (OEH) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (reprinted 2011) (OEH 2011).

2. Site Information

2.1 Site Description

The site is irregular in shape and covers an area of approximately 1.3 ha, made up of the proposed building footprint of about 4,600 m^2 and surrounding open space/public area of about 9,000 m^2. It is bounded by the Western Distributor to the north and south, and is currently occupied by the IMAX Theatre. The Darling Harbour wharf structure is located beneath the northern portion of the site. Stormwater culverts cross the central and western portions of the site in a north-south direction.

At the time of the fieldwork for the detailed site investigation by DP (refer to Section 3) the proposed building footprint was largely covered by the existing IMAX building (an operating movie theatre),

which also included a number of other operating businesses including a café and restaurant. The area outside of the IMAX building was largely paved. To the rear of the IMAX building was a power generator enclosure, cold storage facilities, a garbage disposal compaction unit and private car parking facilities. A sea wall exists beneath the northern portion of the IMAX building, as shown on Drawing 3A. Two major stormwater culverts pass beneath the centre and just west of the IMAX building.

The large site area (i.e. surrounding the proposed building footprint as shown on Drawing 3B) comprised a mix of public recreation areas including paved walking areas, grassed and landscaped areas, footpaths, seating areas, and an access / drop off area to the east of the IMAX building. This area has been levelled and benched to form the various features. The northern part of the site is suspended above the water line beyond the existing sea wall.

As shown on Drawing 2 the site is impacted by the Western Distributor (suspended above the site).

2.2 Surrounding Land Use

The surrounding land use is as follows:

North: Cockle Bay and Cockle Bay Wharf

East: Wheat Road

South: Western Distributor

West: Paved and vegetated open space, part of the Darling Harbour public space

2.3 Topography and Surface Water

The site is located just south of Cockle Bay. The site has been constructed on reclaimed land, and has an existing ground level around the IMAX building of around Reduced Level (RL) 2.5 m relative to the Australian Height Datum (AHD). As noted above levelling and benching has been used to form the various landscaping features within the site, with ground level variations likely to be in the order of 1.5 m.

Surface water within the site will follow the natural topography and be collected by the numerous stormwater collection pits scattered across the site. Stormwater drainage outlets are anticipated to be in Cockle Bay.

2.4 Geology

Reference to the Sydney 1:100,000 series geological sheet indicates that the site is located on an area of reclaimed land, which overlies Hawkesbury Sandstone bedrock. Hawkesbury sandstone typically comprises medium to coarse grained quartz sandstone with minor shale and laminite lenses. Current and previous investigations on the site and nearby areas confirm the presence of fill overlying Hawkesbury Sandstone.

2.5 Soil

The site is located on an area that is identified as disturbed terrain in the Sydney 1:100,000 Soils Landscape Sheet. Disturbed terrain is heavily impacted by human activity including removal or burial of soil.

2.6 Acid Sulphate Soils

The NSW Acid Sulphate Soil Risk map identified the site as being within Disturbed Terrain (soil code X2). The legend for this classification states that soil investigation is required to assess acid sulphate soil potential.

2.7 Registered Bore Search

A search of the NSW Office of Water (NOW) data for registered bores conducted as part of the phase 1 contamination assessment by DP (refer to Section 3) and identified twelve (12) groundwater bores located within approximately 1 km of the site, of which three were located within 500 m of the site. Standing water level details were provided for seven of the twelve bores. A review of the registered bores search in September 2013 confirmed the findings.

The closest bores recorded standing water levels at between 2.35 m bgl and 10.50 m bgl. Drillers logs supplied indicated that the lithology across the area generally comprised fill overlying sand and sandstone bedrock.

2.8 Regional Hydrogeology

Groundwater in the region (and at the site) is expected to flow north towards Cockle Bay, the expected receiving body for groundwater. Groundwater levels in the two monitoring wells installed at the site as part of the detailed site investigation (refer to Section 3) were measured at about 2 m bgl, however, due to the proximity of Cockle Bay it is likely that groundwater beneath the site is tidal.

2.9 Notification under CLM and POEO Act

The EPA publishes records of contaminated sites under Section 58 of the *Contaminated Land Management Act* 1997 (CLM Act) and environmental protection licences issued under the *Protection of the Environment Operations Act* 1997 (POEO Act) on a public database via the internet. A search of the public databases was conducted on the 21 March 2016, as detailed below.

Notices under the CLM Act relate to the investigation and/or remediation of significantly contaminated land as defined under this Act. More specifically, the Notices cover the following:

- Actions taken by the EPA under Sections 15, 17 and 28 of the CLM Act; and

- Site audit statements provided to the EPA under Section 52 of the CLM Act on sites subject to an in-force declaration or order.

The search of the database revealed that the subject site is not listed. There are also no sites listed in Cockle Bay or Darling Harbour.

It should be noted that the EPA record of Notices for Contaminated Land does not provide a record of all contaminated land in NSW. The fact that the site is not listed does not mean that the site is not contaminated.

Environmental protection licences under the POEO Act are issued to the owner or operators of various industrial premises. Licence conditions relate to pollution prevention and monitoring, and cleaner production through recycling and reuse and the implementation of best practice.

The EPA has made available a public register of licences under Section 308 of the POEO Act. The register contains:

- Environment protection licences;
- Applications for new licences and to transfer or vary existing licences;
- Environment protection and noise control notices;
- Convictions and prosecutions under the POEO Act;
- The results of civil proceedings;
- Licence review information;
- Exemptions from the provisions of the POEO Act or Regulations;
- Approvals granted under clause 9 of the POEO (Control of Burning) Regulation;
- Approvals granted under clause 7A of the POEO (Clean Air) Regulation.

The search of the public register indicates that there are no licences or civil proceedings listed for the site.

3. Previous Investigations by DP

3.1 Discovery Village

In 1986 and 1987 DP undertook two geotechnical investigations in the area for the Discovery Village project in Darling Harbour. The results were included in the reports titled:

- *Report on Geotechnical Investigation, Discovery Village, Darling Harbour*, DP Report 9710, dated July 1986; and
- *Report on Geotechnical Investigation, Discovery Village, Darling Harbour*, DP Report 9710-2, dated March 1987.

These investigations, in the area of the current proposed works, included two cored boreholes (DV12 and DV13), three augered boreholes (DV119, DC18 and DC21) and three cone penetration tests which were continued from the base of shallow augered boreholes (DC16, DC17 and DC19).

The principal strata sequentially encountered (beneath pavement materials) comprised:

- Fill – gravelly sand, clayey silty sand and crushed sandstone fill to depths of 1.9 to 4.0 m bgl;
- Alluvium – very loose to loose silty clayey sand, and some soft dark grey organic marine clay (encountered in DV13, DV119, DC16 and DC17 only), to depths of 4.2 m to 6.7 m bgl;
- Residual – dense, clayey sand to depths of 4.4 m to 6.9 m bgl; and
- Sandstone – weak to medium strong and slightly fractured, to a maximum tested depth of 9.4 m bgl.

Groundwater was encountered at approximately 2.4 m depth (RL -0.2 m to -0.1 m) during drilling in boreholes DV12 and DV13.

No testing for contaminants was undertaken, however there were no visual indicators or odours noted to suggest significant contamination issues.

This summary is present for general information purposes only and as such no drawing showing the noted bore locations has been included.

3.2 Theatre Development

In 1992 DP undertook a geotechnical investigation at the site for the (then proposed) IMAX Theatre. The results of the investigation were reported in:

- *Report on Geotechnical Investigation, Theatre Development, Darling Harbour*, DP Project 19013, dated November 1992.

The field investigation comprised five cored boreholes (Bores 1 to 5), two of which were abandoned due to encountering obstructions (Bores 2 and 4).

The principal strata sequentially encountered (beneath pavement materials) comprised:

- Fill – gravelly sand, clayey silty sand and crushed sandstone fill to depth of 4.0 m to 4.6 m bgl;
- Alluvium – soft to firm, dark grey organic marine clay, encountered to depths of 5.3 m to 6.5 m bgl;
- Residual – dense, clayey sand in Bore 1 only; overlying
- Sandstone – medium to high strength, slightly weathered to fresh and slightly fractured to unbroken to a maximum tested depth of 9.55 m bgl.

Groundwater was encountered at 2.15 m to 2.40 m depth (RL 0.15 m to 0.41 m) during the drilling.

No testing for contaminants was undertaken, however there were no visual indicators or odours noted to suggest significant contamination issues.

This summary is present for general information purposes only and as such no drawing showing the noted bore locations has been included.

3.3 Geotechnical Desktop Study (DP, 2012)

DP conducted a geotechnical desktop study for the site in 2012. The report was entitled:

- *Report on Geotechnical Desktop Study, The Ribbon, 31 Wheat Road Darling Harbour*. Ref: 73201.00/Rev 1, November 2012.

Based on the desktop study, the ground profile at the site was summarised as shown in Table 1 below.

Table 1: Geotechnical Model

Material	RL Range (m, AHD)	Thickness (m)	Description
Filling	+2.5 to -2.0	1.9 to 4.6	Generally poorly compacted, gravelly sand with clay, concrete and crushed sandstone
Alluvium	+0.4 to -4.3	1.0 to 4.2	Generally loose silty clayey sand and some soft -firm marine clay
Residual	-1.9 to -4.5	0.0 to 0.7	Dense clayey sand
Sandstone	-2.1(1) -4.5(2)	-	Medium to high strength sandstone, with some low strength bands

NOTE: (1) Located in the eastern part of the site, Borehole DC19
(2) Located in the western part of the site, Borehole DC16

Groundwater at the site was noted to be affected by tidal influences, although the extent of tidal influence is uncertain. The mean high water level for Sydney is approximately RL +0.5 m AHD. The previous boreholes intersected groundwater between RL -0.2 m and +0.4 m AHD. It can be expected that groundwater could fluctuate between approximately RL -0.5 and +0.5 m AHD during construction. However, the groundwater level could be expected to rise to RL +1.0 to +1.5 m AHD during heavy rainfall events when coupled with a high tide.

3.4 Phase 1 Contamination Assessment (DP, 2013a)

DP issued a Phase 1 Contamination Assessment report for the site in 2013. The report was entitled:

- *Report on Phase 1 Contamination Assessment, IMAX Theatre, 31 Wheat Road Darling Harbour*. Ref: 73201.01, February 2013 (DP, 2013a).

DP (2013a) involved a desktop assessment, in order to assess the potential for contamination of the site based on historic and current site usage, and to assess the suitability of the site for the proposed development. No intrusive investigation was conducted as part of the investigation.

The DP (2013a) report found that the site was historically part of the Cockle Bay finger wharves. Cockle Bay had been a major industrial and goods handling precinct. Rail lines and associated warehouses were noted to be in the surrounding region. During the 1980s the site was part of a redevelopment area, proposed to revitalise the area which was no longer being utilised for industrial purposes. The extensive rail line was removed, and the site became largely occupied by the IMAX building.

The historic title deed search identified that the site was largely government owned, and was currently owned by the Sydney Harbour Foreshore Authority. A search of the NSW Dangerous Goods database indicated that there were no dangerous goods stores or depots registered for the site. The Section 149 certificates obtained from the City of Sydney Council identified that the land was subject to flood related development controls, and is identified as being land in a foreshore area.

Areas of environmental concern were indicated to be fill imported from unknown sources, asbestos materials and rail yard/light industrial activities. Fill may have been used for levelling purposes during land reclamation, there is the potential that asbestos may have entered the surface soil during the removal of former buildings, and historic uses may have caused potential infiltration of paint residue, solvents and chemicals into the soil and groundwater.

The report considered that the site could be made suitable for the proposed redevelopment subject to the completion of an intrusive investigation assessing soil and groundwater.

3.5 Detailed Site Investigation (DP, 2013b)

DP issued a detailed site investigation for contamination for the site in 2013. The report was entitled:

- *Report on Detailed Site Investigation, Proposed "The Ribbon" Development, 31 Wheat Road Darling Harbour*. Ref: 73201.02, September 2013 (DP, 2013b).

Borehole locations from the investigation are shown on Drawings 3A and 3B, Appendix A, Borehole logs are provided in Appendix B, and a summary of laboratory results is provided in Appendix C.

DP (2013b) identified the primary potential contaminants of concern to be associated with imported fill of unknown origin, the historic use of the site (industrial purposes and demolition of former buildings potentially containing asbestos or lead); and possible former adjacent industrial land uses. Specifically the contaminants of potential concern were identified to be total petroleum hydrocarbons (TPH), benzene, toluene, ethyl benzene and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAH), heavy metals, asbestos, phenols, polychlorinated biphenyls (PCB), organochlorine pesticides (OCP), organophosphorus pesticides (OPP) and volatile organic compounds (VOC).

DP (2013b) included a total of nineteen test bores drilled across the site, with two locations being converted into groundwater monitoring wells. Test bores were drilled through concrete pavers, concrete slab or roadbase. Bores were generally found to contain fill, underlain by sand, sandy clay or sandstone. Free groundwater was observed at several locations during drilling.

The top of natural materials was encountered between 0.7 and 8.9 m bgl, although 12 locations were discontinued in filling due to refusal (mainly on concrete) or reaching the target depth (generally

5 m bgl). Ash and slag were detected in the fill at some locations. No odours or staining were observed at any of the sampling locations.

No phase separated hydrocarbon or hydrocarbon odours were observed in groundwater.

No health investigation / health screening level (HIL/HSL) exceedances were reported in the soils, suggesting that the soils within the site are not likely to present a health risk to workers on the project or future users of the site. While a number of locations were found to have chemical concentrations for some metals and PAH above the adopted ecological investigation / screening level (EIL/ESL), based on the historic, current and proposed land use (i.e. largely commercial purposes and recreational use with significant paving), the exceedances were not considered to be significant and were assessed as unlikely to pose a risk to plants and biota within the site.

No asbestos fragments were observed in the bores and no asbestos was detected at the laboratory reporting limits in the soil samples analysed. However, it was noted that given the history of the site and the extensive filling, the potential for asbestos to be present in soils could not be discounted.

Groundwater concentrations at bores C12 and C15 were generally within the adopted groundwater assessment criteria (GAC), with the exception of copper, zinc and some PAH. Furthermore, elevated levels of TRH were detected in the groundwater, although no published threshold levels existed for some TRH. The groundwater at the site is tidal and likely to be influenced by activities within Cockle Bay as well as contaminants that may be present in fill outside the site (i.e. in the remainder of Darling Harbour). As no HSL exceedances are reported, the contaminant levels only have significance in terms of disposal should dewatering be required.

Waste classification results indicated that the fill beneath the site is provisionally classified as General Solid Waste (non-putrescible). A degree of *ex situ* confirmation of this classification is recommended during civil works.

The results of the investigation overall indicated that the site is generally suitable, from a contamination standpoint, for the proposed “The Ribbon” development.

It was noted that at the time of the investigation the IMAX building was still in place, restricting access to areas of the site. DP (2013b) recommended that once demolition has occurred, additional sampling should be conducted in the IMAX building footprint in order to bring the sampling density in line with the NSW EPA *Contaminated Sites Sampling Design Guidelines* (1995) (EPA, 1995).

It was also noted that as with all sites, assessment is based on the findings at discrete test locations. DP (2013b) recommended that if any signs of contamination not identified in the report were encountered during redevelopment, they should be appropriately assessed and managed.

Should disposal of groundwater in excavations be required further testing of the groundwater was recommended to be undertaken to assess disposal options, in light of the minor contaminants detected.

4. Conceptual Site Model

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

Figure 1, below, provides a diagrammatic representation of where risk is present from contamination based on source – pathway – receptor linkages. A risk is only present if a source, pathway and receptor are all present. If one of these is removed, the corresponding risk to human health or the environment is also removed.

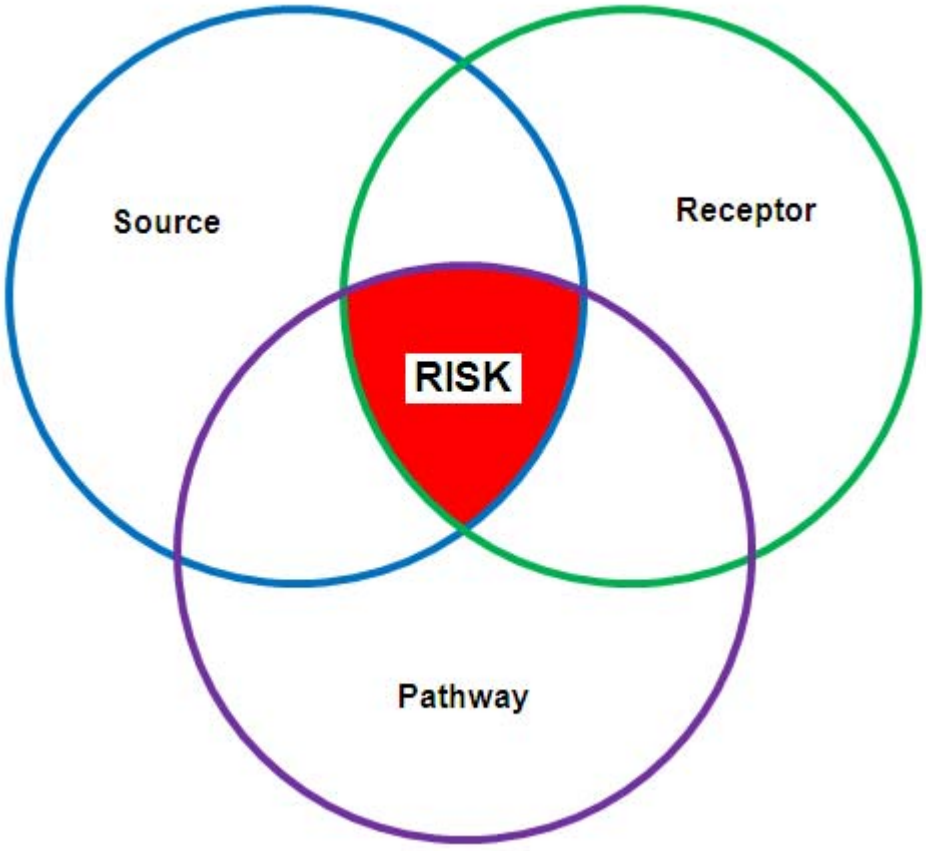


Figure 1: Presence of Risk with Respect to Source – Pathway – Receptor linkages

The CSM has been prepared based on the previous assessments and has been used in determining an appropriate remediation strategy for the site.

4.1 Potential Contamination Sources

Based on DP (2013a) the following potential sources of contamination have been identified. Note, DP (2013b) did not identify any contamination above the health-based investigation levels, however given the noted data gaps, the potential for contamination in between test locations has been considered in this CSM.

Table 2: Potential Contamination Sources and Contaminants of Concern

Potential Source	Description of Potential Contaminating Activity	Contaminants of Concern
Imported fill of unknown origin (S1)	Fill material is likely to have been imported onto the site for levelling purposes during land reclamation. The source of the fill material is unknown.	Common contaminants associated with fill are heavy metals, TPH, BTEX, PAH, PCB, OC, phenols and asbestos.
Previous land use (S2)	Wharves and Rail yard	Asbestos, heavy metals, TPH, BTEX, PAH, VOC
	Industrial Purposes	
Previous adjacent land uses (S3)	Possible unknown industrial land uses – possible contamination of the subject site through migration in ground/tidal water, or of liquid contaminants through soils	Common contaminants which may have migrated onto the site include heavy metals, TPH, BTEX, PAH, PCB, OCP, phenol

4.2 Potential Receptors

4.2.1 Human Health Receptors

R1 – Construction workers at the site

R2 – Final end users (commercial and recreational)

R3 – Intrusive maintenance workers at the site following redevelopment

R4 – land users in adjacent areas (recreational, commercial)

4.2.2 Environmental Receptors

R5 – Surface Water (Cockle Bay)

R6 – Groundwater

R7 – Ecology

4.2.3 Other Receptors

R8 – Buried infrastructure

R9 – Buildings

4.3 Potential Pathways

Potential pathways for contamination to reach the identified receptors include the following:

P1 – Direct contact with soil or groundwater

P2 – Dust and/ or vapour

P3 – Leaching of contaminants and vertical migration into groundwater

P4 – Surface water run-off

P5 – Lateral migration of groundwater providing base flow to watercourses

Notes: no vapours are considered likely given the results of DP (2013b).

4.4 Summary of CSM

A 'source–pathway–receptor' approach has been used to assess the potential risks of harm being caused to human, water or environmental receptors from contamination sources on or in the vicinity of the site, via exposure pathways. The possible pathways between the above sources and receptors are provided in Table 3 below. The table also shows the management pathway for any issues where a potential complete pathway exists.

Table 3: Conceptual Site Model

Source	Transport Pathway	Receptor	Comments	Management Pathway
	Human Health			
S1: Imported fill of unknown origin (heavy metals, TRH, BTEX, PAH, PCB, OC, phenols and asbestos) S2: Previous land use (Asbestos, heavy metals, TRH, BTEX, PAH, VOC) S3: Previous adjacent land uses (heavy metals, TPH, BTEX, PAH, PCB, OCP, phenol)	P1 – Direct contact with soil or groundwater (dermal or ingestion)	R1 – Construction workers	- Complete pathway considered to exist.	- Adoption of appropriate Work Health & Safety (WHS) procedures, and compliance with a Construction Environmental Management Plan (CEMP) - Testing of areas not previously accessible.
		R2 – Final end users (commercial and recreational)	- No complete pathway considered to exist beneath buildings or pavements. - Complete pathway may exist between soils and end users in soft landscaping areas, although suitable topsoil is expected to be used, reducing the risk of exposure	- Testing of areas not previously accessible. - If required, development of a Remediation Work Method Statement (RWMS) in accordance with Section 7.
		R3 – Intrusive Maintenance workers	- Complete pathway considered to exist.	- Testing of areas not previously accessible. - If required development of long term management plan in accordance with Section 9.7.
		R4 – Land-users in adjacent areas (recreational, commercial)	- No complete pathway considered to exist. - Groundwater is not considered suitable for beneficial use.	No management required

Source	Transport Pathway	Receptor	Comments	Management Pathway
	P2 – Dust and/or vapours (inhalation)	R1 – Construction workers	- Complete pathway considered to exist.	- Adoption of appropriate WHS procedures, and compliance with a CEMP - Testing of areas not previously accessible.
		R2 – Final end users (commercial and recreational)	- Complete pathway considered to potentially exist. - Results to date (DP, 2013b) indicate the potential for vapour to be an issue of concern is low. - Surface finishings (pavements, imported topsoil) will reduce the risk of exposure.	- Testing of areas not previously accessible. - If required, development of RWMS in accordance with Section 7.
		R3 – Intrusive Maintenance workers	- Complete pathway considered to exist.	- Testing of areas not previously accessible. - If required, development of long term management plan in accordance with Section 9.7.
		R4 – Landusers in adjacent areas (recreational, commercial)	- Complete pathway considered to exist. - Results to date (DP, 2013b) indicate the potential for vapour to be an issue of concern is low. - Surface finishings (pavements, imported topsoil) will reduce the risk of exposure.	- Testing of areas not previously accessible. - If required, development of RWMS in accordance with Section 7.

Source	Transport Pathway	Receptor	Comments	Management Pathway
	Environment			
	P1 – Direct contact with soil or groundwater	R7 – Ecology	- Complete pathway considered to exist. -Any contamination at the site is likely to have been present for decades, and any impact to the terrestrial ecology is likely to have already occurred. given the already degraded value of any terrestrial ecology at the site, it is considered that protection of organisms in the subsurface filling is not warranted and not practical.	No management required
	P5 – Leaching of contaminants and vertical mitigation into groundwater	R6 – Groundwater R7 – Ecology	- Complete pathway considered to exist. - The results to date (DP, 2013b) are considered to be consistent with expected analyte levels in surroundings areas	- Testing of areas not previously accessible. - If required, development of RWMS in accordance with Section 7.
	P6 – Migration of contaminants in groundwater	R6 – Groundwater R5 – Surface Water (Cockle Bay) R7 – Ecology	- Complete pathway considered to potentially exist. - It is likely that groundwater beneath the site is tidal, and readily connected with Cockle Bay, adjacent to the site. The results to date (DP, 2013b) are considered to be consistent with expected analyte levels in surroundings areas, including within Cockle Bay.	No management required based on results to date (DP, 2013b)

Source	Transport Pathway	Receptor	Comments	Management Pathway
	P7 – Surface water run-off	R5 – Surface Water (Cockle Bay)	- Complete pathway considered to exist.	- Testing of areas not previously accessible.
		R7 – Ecology	- Can be managed by implementing an appropriate remediation strategy to prevent surface water coming into contact with any contaminated media. This is likely to occur as part of the redevelopment through the construction of pavements and use of topsoils suitable for plant growth.	- If required, development of RWMS in accordance with Section 7.
	Buildings and Structures			
	P1 – Direct contact with soil or groundwater	R8 – Buried infrastructure	- Complete pathway considered to exist.	- Testing of areas not previously accessible.
		R9 – Buildings	- Results to date (DP, 2013b) indicate the potential for impact on engineered structures is low.	- If required, development of RWMS in accordance with Section 7.
	P4 – Vapour intrusion and explosion/ fire	R8 – Buried infrastructure	- Complete pathway considered to exist	- Testing of areas not previously accessible.
		R9 – Buildings	- Results to date (DP, 2013b) indicate the potential for vapour to be an issue of concern is low.	- If required, development of RWMS in accordance with Section 7.

5. Further Investigation and the Need for Remediation/ Management

Based on the data gaps identified in DP (2013b), additional intrusive investigation will be required to determine the suitability of the site for the proposed development, and the need or otherwise for remediation or management of contamination. This will be conducted as detailed below.

5.1 Intrusive Testing Regime

Intrusive testing is required for potential contaminants and acid sulphate soils (ASS).

For contamination investigation, the appropriate sampling density is considered to be that recommended in the EPA (1995). Based on a site area of approximately 1.36 ha a total of 24 sample locations are recommended. A total of 19 test bores have previously been sampled, however the full depth of filling was only investigated in 7 of these locations. On this basis additional sampling locations are recommended, targeting the previously accessible areas and soils at depths in areas where not previously assessed. At least some of this testing would need to be conducted following demolition of current site structures.

For ASS, investigation from six (6) locations is recommended in accordance with NSW Acid Sulfate Soil Management Advisory Committee (ASSMAC), *Acid Sulfate Soil Manual* 1998 (ASSMAC, 1998) recommendations for sites of 1 to 2 hectares. In general investigation requires testing at 0.5 m intervals to a depth of 1 m beyond the proposed depth of excavation/ disturbance. This is considered appropriate to a depth of 3.5 m to assess the proposed bulk excavation.

For foundations, it is considered that appropriate methodology would be *in situ* testing to bedrock, or *ex situ* testing of piling returns to determine management/ disposal requirements. If *ex situ* testing is undertaken, however, soils need to be managed as potentially containing ASS prior to testing.

The investigation will be undertaken in accordance with the methodology provided in Section 9. Where possible, samples will be collected using methods which minimise disturbance (e.g. push tubes or standard penetration tests (SPTs)).

5.2 Investigation Levels

The investigation levels, which will also be used as initial remediation acceptance criteria (RAC) are provided in Section 6.

5.3 Determination of the Need for Remediation/ Management

Remediation or management will be determined NOT to be necessary where an area/ issue has been appropriately characterised and one of the following applies:

- All results are within the applicable investigation levels; or
- Statistical analysis of the results in accordance with NEPC (2013) indicates that no significant contamination is present; or

- A risk assessment (qualitative or quantitative) indicates that there is no unacceptable risk from the identified levels of contaminants; or
- Remediation or management is likely to cause greater adverse effect than leaving the contamination undisturbed.

6. Remediation Acceptance Criteria and Investigation Levels

6.1 Remediation Acceptance Criteria

The remediation acceptance criteria will be "*no unacceptable risk to human health or the environment*". The risk will be assessed in general accordance with NEPC (2013).

Risk may be assessed to be acceptable based on:

- No pathway between the contaminant of concern and the receptor being available or foreseeably becoming available in the future; or
- All contaminants of concern being within risk-based site investigation levels. Site investigation levels may comprise generally conservative published levels appropriate for the proposed land use or site-specific concentrations calculated based on a quantitative risk assessment.

6.2 Soil Assessment Criteria

The soil assessment criteria (SAC) comprise health-based investigation levels (HILs), health screening levels (HSLs), environmental investigation levels (EILs), and environmental screening levels (ESLs) as detailed below. The laboratory Practical Quantitation Limit (PQL) has also been adopted as a screening level for some contaminants.

6.2.1 Health Investigation Levels

The HILs are scientifically based, generic assessment criteria designed to be used in the first stage (Tier 1) of an assessment of potential risks to human health from chronic exposure to contaminants. They are intentionally conservative and are based on a reasonable worst-case scenario for four generic land use scenarios. Given the proposed land uses, the following HILs have been adopted:

- HIL C – public open space such as parks, playgrounds, playing fields, secondary schools and footpaths. To be applied due to the use of the bulk of the site for public recreation; and
- HIL D – commercial / industrial. To be used for the proposed building footprint.

The adopted HILs, from Table 1A(1), Schedule B1 of NEPC (2013) are shown on the following Table 4. Only those analytes common to both Table 1A(1) and the contaminants of potential concern have been included.

Table 4: Health Investigation Levels for Soil Contaminants

Contaminant	HIL C Recreational/Open Space (mg/kg)	HIL D Commercial/Industrial (mg/kg)
Metals and Inorganics		
Arsenic	300	3,000
Cadmium	90	900
Chromium (VI)	300	3,600
Copper	17,000	240,000
Lead	600	1,500
Mercury (inorganic)	80	730
Nickel	1,200	6,000
Zinc	30,000	400,000
PAH		
Carcinogenic PAH (as benzo(a)pyrene TEQ)	3	40
Total PAH	300	4,000
OCP		
DDT+DDE+DDD	400	3,600
Aldrin + Dieldrin	10	45
Chlordane	70	530
Endosulfan (total)	340	2,000
Endrin	20	100
Heptachlor	10	50
HCB	10	80
Methoxychlor	400	2,500
Other Pesticides		
Chloropyrifos	250	2,000
Other Organics		
PCB	1	7

6.2.2 Health Screening Levels (Petroleum Contaminants)

Health Screening Levels (HSLs) are used to assess selected petroleum compounds and fractions to assess the risk to human health via inhalation and direct contact with affected soils and groundwater. The HSLs were developed by the Co-operative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE) and were derived through the consideration of health effects only, with particular emphasis on the vapour exposure pathway. Other considerations such as ecological risk, aesthetics, the presence of free phase product and explosive / fire risk are not addressed by the HSLs. As such the HSLs should be used similarly to the HILs, i.e. as a screening tool.

The HSLs have been developed for a range of petroleum hydrocarbons, and for different land uses, media, pathways, soil types and depths to contamination. HSLs have also been derived by CRC

CARE for direct contact with petroleum hydrocarbons for the four land use scenarios and intrusive maintenance workers.

The approach in the development of HSLs has sought to set a combination of assumptions and parameters that correspond to the reasonable exposure that can be expected for the range of scenarios. If the subject site does not fall within the range of assumed conditions the HSLs may not be protective and a more detailed consideration of the site specific situation should be carried out.

Again, given the proposed land uses, the following HSLs have been adopted:

- HSL C – recreational; and
- HSL D – commercial / industrial.

The HSLs are based on overlying soil type and depth. HSLs for sand have been included based on the materials encountered at the site (largely sand, refer to Section 3.5), and results were assessed against the appropriate HSLs based on the depth of the detected contamination (or potential for contamination) and the predominant overlying soil type. Given that the site is significantly filled, there is inherent variability in the fill composition and therefore contaminants can be detected a various depths. As an initial conservative assumption, the depth range of 1 to <1m has been adopted as an initial screening level.

The adopted soil HSLs for vapour intrusion, from Table 1A(3), Schedule B1 of NEPC (2013) and Table B3, Appendix B, CRC CARE Technical Report No. 10 (Intrusive Maintenance Worker) are shown on the following Table 5.

Table 5: Soil Health Screening Levels (HSLs) for Vapour Intrusion (mg/kg)

Analyte		HSL C	HSL D	Intrusive Maintenance Worker	Comments
TRH	$C_6 – C_{10}$ (less BTEX) [F1]	NL	260	NL	Sand Profile Depth to Contamination <1 m
	$>C_{10}-C_{16}$ (less Naphthalene) [F2]	NL	NL	NL	
BTEX	Benzene	NL	3	77	
	Toluene	NL	NL	NL	
	Ethyl Benzene	NL	NL	NL	
	Xylene	NL	230	NL	
PAH	Naphthalene	NL	NL	NL	

Notes:

The soil saturation concentration (Csat) is defined as the soil concentration at which the porewater phase cannot dissolve any more of an individual chemical. The soil vapour that is in equilibrium with the porewater will be at its maximum. If the derived soil HSL exceeds Csat, a soil vapour source concentration for a petroleum mixture could not exceed a level that would 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'.

The adopted soil HSLs for direct contact, from Table B4, Appendix B, CRC CARE Technical Report No. 10 are shown on the following Table 6.

Table 6: Soil Health Screening Levels (HSLs) for Direct Contact (mg/kg)

Analyte		HSL C	HSL D	Intrusive Maintenance Worker
TRH	$C_6 – C_{10}$	5,100	26,000	82,000
	$>C_{10}-C_{16}$	3,800	20,000	62,000
	$>C_{16}-C_{34}$	5,300	27,000	85,000
	$>C_{34}-C_{40}$	7,400	38,000	120,000
BTEX	Benzene	120	430	430
	Toluene	18,000	99,000	120,000
	Ethyl Benzene	5,300	27,000	85,000
	Xylene	15,000	81,000	130,000
PAH	Naphthalene	1,900	11,000	29,000

6.2.3 Management Limits (TPH Only)

NEPM (2013) Table 1B (7) provides 'management limits' for TPH fractions, which are applied after consideration of relevant HSLs. The management limits have been adopted to avoid or minimise the following potential effects of petroleum hydrocarbons:

- Formation of LNAPL;
- Fire and explosive hazards; and
- Effects on buried infrastructure e.g. penetration of, or damage to, in-ground services by hydrocarbons.

The presence of site TPH contamination at the levels of the management limits does not imply that there is no need for administrative notification or controls in accordance with jurisdictional requirements. The adopted management limits are shown in Table 7 and have been selected based on the CSM, Section 4.

Table 7: Management Limits for TPH Fractions in Soil

TRH Fraction	Soil Texture	Management Limit Residential, Parkland and Public Open Space (mg/kg)	Management Limit Commercial and Industrial (mg/kg)
C_6-C_9	Coarse	700	700
	Fine	800	800
$>C_{10}-C_{16}$	Coarse	1,000	1,000
	Fine	1,000	1,000
$>C_{16}-C_{34}$	Coarse	2,500	3,500
	Fine	3,500	5,000
$>C_{34}-C_{40}$	Coarse	10,000	10,000
	Fine	10,000	10,000

6.2.4 Ecological Investigation Levels

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

EIL = ABC + ACL, where

ABC = Ambient Background Concentration
ACL = Added Contaminant Limit

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

ACLs are based on the soil characteristics of pH, cation exchange capacity (CEC) and clay content.

EILs (and ACLs where appropriate) have been derived in NEPC (2013) for only a short list of contaminants including As, Cu, Cr (III), DDT, naphthalene, Ni, Pb and Zn. An *Interactive (Excel) Calculation Spreadsheet* may be used for calculating site-specific EILs, and has been provided in the ASC NEPM Toolbox.

The adopted EILs, derived from Tables 1B(1) to 1B(4), Schedule B1 of NEPC (2013), and the *Interactive (Excel) Calculation Spreadsheet* are shown on the following Table 8. The following site specific data and assumptions have been used to determine the EILs:

- protection levels of 80% (urban residential and public open space setting) and 60% (commercial / industrial) have been adopted;
- the EILs will apply to the top 2 m of the soil profile;
- given the likely source of soil contaminants (i.e. fill, historical spills) the contamination is considered as “aged” (>2 years);
- the majority of soils encountered at the site comprised sand with little clay content. In the absence of field or laboratory measurements a clay content of <10% has been estimated;
- given that the site is located in a highly developed area it is considered unlikely that a suitable location can be found to assess local background levels of the target contaminants in near surface soils. In the absence of iron concentration data in soils, the ABCs for old suburbs in high traffic areas, as derived from Olszowy et al. (1995), and presented in Schedule B5c of NEPC (2013) have been used. Given the age of the suburb (>2 years) the 25th percentile of the ABC is used, as recommended in Clause 2.5.7 of Schedule B1, NEPC (2013); and
- Based on pH and CEC values on samples from the site, the adopted values of pH 9.3 and CEC 26 cmol/kg were used.

Table 8: Ecological Investigation Levels (EILs) in mg/kg

Analyte		Urban residential and public open space	Commercial / Industrial	Comments
Heavy Metals	Arsenic	100	160	Adopted pH of 9.3 and CEC of 26 cmol/kg; assumed clay content <10%
	Copper	240	340	
	Nickel	320	550	
	Chromium III	410	680	
	Lead	1100	1800	
	Zinc	980	1500	
PAH	Naphthalene	170	370	
OCP	DDT	180	640	

6.2.5 Ecological Screening Levels – Petroleum Hydrocarbons

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

ESLs have been derived in NEPC (2013) for the same four petroleum fractions as the HSLs (F1 to F4) as well as BTEX and Benzo(a)pyrene. The adopted ESLs, from Table 1B(6), Schedule B1 of NEPC (2013) are shown on the following Table 9. The following site specific data and assumptions have been used to determine the ESLs:

- the ESLs will apply to the top 2 m of the soil profile;
- the ESLs for urban residential and public open space, and commercial / industrial apply; and
- the majority of soils encountered at the site comprised sand with little clay content. In the absence of field or laboratory measurements a “coarse” soil texture has been adopted.

Table 9: Ecological Screening Levels (ESLs) in mg/kg

Analyte		Urban residential and public open space	Commercial / Industrial	Comments
TRH	$C_6 – C_{10}$ (less BTEX) [F1]	180*	215*	All ESLs are low reliability apart from those marked with * which are moderate reliability
	$>C_{10}-C_{16}$ [F2]	120*	170*	
	$>C_{16}-C_{34}$ [F3]	300	1,700	
	$>C_{34}-C_{40}$ [F4]	2,800	3,300	
BTEX	Benzene	50	75	
	Toluene	85	135	
	Ethyl Benzene	70	165	
	Xylenes	105	180	
PAH	Benzo(a)pyrene	0.7	1.4	

6.2.6 Asbestos

Bonded asbestos containing material (ACM) is the most common form of asbestos contamination across Australia. Mining, manufacturing or distribution of asbestos products may result in sites being contaminated by friable asbestos including free fibres. Severe weathering or damage to bonded ACM may also result in the formation of friable asbestos comprising fibrous asbestos (FA) and/or asbestos fines (AF).

Asbestos only poses a risk to human health when asbestos fibres are made airborne and inhaled. If asbestos is bound in a matrix such as cement or resin, it is not readily made airborne except through substantial physical damage. Bonded ACM in sound condition represents a low human health risk, whilst both FA and AF materials have the potential to generate, or be associated with, free asbestos fibres. Consequently, FA and AF must be carefully managed to prevent the release of asbestos fibres into the air.

Schedule B2 of NEPC (2013) describes the recommended assessment process for asbestos in soil, commencing with a preliminary assessment, looking into the site history and conditions and therefore the propensity for asbestos to be present. A detailed assessment of asbestos contamination is recommended in NEPC (2013) under the following circumstances:

- To resolve uncertain findings from the preliminary assessment (e.g. the extent, quality and quantity of asbestos in soil is not known and the potential for asbestos is identified); and/or
- The remediation and management approach requires asbestos contamination to be fully delineated and assessed (e.g. asbestos contamination is to be relocated and contained); and/or
- To assist in assessing the likely effectiveness of alternative remediation and management strategies; and/or
- Land uses are to be determined and delineated according to the extent and nature of the asbestos contamination.

If a detailed assessment is considered appropriate (e.g. to determine the need to manage asbestos to be retained on site, then the results will be compared with the thresholds provided in Table 10. If only preliminary assessment is undertaken, then any detection of asbestos will be considered to warrant further assessment and/ or remediation/ management.

Table 10: Asbestos HSLs

Form of Asbestos	HSL (w/w)	
	Recreational HSL C	Commercial/ Industrial HSL D
Bonded ACM	0.02%	0.05%
FA and AF	0.001%	
All forms of asbestos	No visible asbestos for surface soil	

NEPC (2013) defines the various asbestos types referred to above as follows:

Bonded ACM: Asbestos containing material which is in sound condition, bound in a matrix of cement or resin, and cannot pass a 7 mm x 7 mm sieve.

FA: Fibrous asbestos material including severely weathered cement sheet, insulation products and woven asbestos material. This material is typically un-bonded or was previously bonded and is now significantly degraded and crumbling.

AF: Fibrous asbestos material including severely weathered cement sheet, insulation products and woven asbestos material. This material is typically un-bonded or was previously bonded and is now significantly degraded and crumbling.

6.2.7 Acid Sulphate Soils

Assessment of acid sulphate soils will be conducted in general accordance with the following guidance:

- NSW Acid Sulfate Soil Management Advisory Committee (ASSMAC), 1998. *Acid Sulfate Soil Manual* (ASSMAC, 1998);
- NSW Environmental Protection Authority (EPA), 2014. *Waste Classification Guidelines* (EPA, 2014);
- Ahern CR, McElnea AE, Sullivan LA (2004). *Acid Sulfate Soils Laboratory Methods Guidelines*. Queensland Department of Natural Resources, Mines and Energy, Indooroopilly, Queensland, Australia; and
- Dear, S-E., Ahern, C. R., O'Brien, L. E., Dobos, S. K., McElnea, A. E., Moore, N. G. & Watling, K. M., 2014. *Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines*. Brisbane: Department of Science, Information Technology, Innovation and the Arts, Queensland Government.

6.2.8 Waste Classification

All soils to be disposed off-site must be classified in accordance with the POEO Act.

The guidelines for classifying soils for off-site disposal are the EPA *Waste Classification Guidelines* (2014) (EPA 2014). This includes guidance on levels of potential contaminants and acid sulphate soils.

6.3 Groundwater Assessment Criteria

The groundwater assessment criteria (GAC) comprise groundwater investigation levels (GILs) and HSLs as detailed below. The PQL has also been adopted as a screening level for some contaminants.

6.3.1 Groundwater Investigation Levels (Non-Petroleum Hydrocarbons)

Given the proximity of the site to Cockle Bay, and the fact that there are no registered water bores at the site or hydraulically down-gradient, domestic and recreational uses of the groundwater at the site or hydraulically down-gradient are highly unlikely. As such, the drinking water are not considered to be applicable.

On the basis of the identified potential human and ecological receptors, the adopted GILs are as follows:

- ANZECC & ARMCANZ (2000), *National water quality management strategy. Australian and New Zealand guidelines for fresh and marine water quality*, Australian and New Zealand Conservation Council & Agriculture, and Resource Management Council of Australia and New Zealand (ANZECC, 2000). Trigger values for a slightly / moderately disturbed marine water system, at a general protection level of protection of 95% of species.

The adopted GILs for the analytes included in the assessment (where applicable), and the corresponding source documents, are shown in Table 11.

Table 11: Groundwater Investigation Levels (in µg/L unless otherwise stated)

Analyte		NEPC (2013) Marine Waters [b]
MAH	Benzene	500
	Toluene	180[a]
	Ethyl Benzene	5.0[a]
	Xylenes	550 (m&p+o)
PAH	Naphthalene	50
	Benzo(a)pyrene	0.2[a]
	Anthracene	0.04[a]
	Phenanthrene	2.0[a]
	Fluoranthene	1.4[a]
Phenols	Phenol	400
Metals	Arsenic (V)	4.5[a]
	Cadmium	0.7
	Chromium (III)	27
	Chromium (VI)	4.4
	Copper	1.3
	Lead	4.4
	Mercury (total)	0.1
	Nickel	7.0
	Zinc	15

Analyte		NEPC (2013) Marine Waters [b]
OCP	Chlordane	0.001[a]
	DDT	0.0004[a]
	Endosulfan	0.005
	Endrin	0.004
	Heptachlor	0.0004[a]
	Aldrin	0.003[a]
	DDE	0.0005[a]
	Dieldrin	0.01[a]
	Methoxychlor	0.004[a]
PCB	Aroclor 1016	0.009[a]
	Aroclor 1221	1[a]
	Aroclor 1232	0.3[a]
	Aroclor 1242	0.6[a]
	Aroclor 1248	0.03[a]
	Aroclor 1254	0.03[a]
	Aroclor 1260	25[a]
OPP	Demeton-S-methyl	4[a]
	Diazinon	0.01
	Dimethoate	0.15
	Chloropyrifos	0.01
	Malathion	0.05
	Azinophos Methyl	0.02[a]
	Fenitrothion	0.2
	Parathion (ethyl)	0.004

Notes:

a in cases where no high reliability trigger values are provided, the low reliability trigger values provided in ANZECC (2000) were used as screening levels

b Investigation levels apply to typically sightly-moderately disturbed systems

6.3.2 Health Screening Levels (Petroleum Hydrocarbons)

The HSLs have been adopted based on the exposure scenarios identified in the CSM, Section 4 and are provided in Table 12. These have been sourced from NEPM (2013), Schedule B1, Table 1A (4).

The HSLs are used to assess selected petroleum hydrocarbons and fractions to assess the risk to human health via inhalation of vapours sourced from groundwater. Groundwater in wells has been measured between 1.85 m bgl and 2.55 m bgl. Groundwater was observed during drilling at approximately 1.9 and 2.4 m bgl. Based on this, and DP's experience, groundwater has been assumed to be generally at a depth of 2 m bgl.

Materials encountered at the site include fill, sand, sandy clay and sandstone, and as a conservative measure HSLs for sand have therefore been adopted as an initial screen.

Table 12: Groundwater Health Screening Levels (HSLs) for Vapour Intrusion (mg/L)

Analyte		HSL C	HSL D	Intrusive Maintenance Worker	Comments
TRH	$C_6 – C_{10}$ (less BTEX) [F1]	NL	6	NL	Sand Profile Depth to Contamination 2 m to <4 m
	$>C_{10}-C_{16}$ (less Naphthalene) [F2]	NL	NL	NL	
BTEX	Benzene	NL	5	NL	
	Toluene	NL	NL	NL	
	Ethyl Benzene	NL	NL	NL	
	Xylene	NL	NL	NL	
PAH	Naphthalene	NL	NL	NL	

Notes:

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 which 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 a given scenario. For these scenarios no HSL is presented for these chemicals. These are denoted as not limiting 'NL'.

7. Remediation Work Method Statements

7.1 Remediation Objectives

If remediation/ management is required, the objectives will be to:

- Appropriately address the management of any detected residual soil and groundwater impact that poses an unacceptable risk to on-site and potentially off-site human and ecological receptors;
- Render the site suitable, from a contamination perspective, for the proposed development;
- Minimise the risk of harm to human health and the environment during remediation; and
- Minimise the risk of harm to human health and the environment following remediation.

7.2 Preparation of Remediation Work Method Statements

If remediation or management is determined to be necessary based on identification of contamination during the further investigation (refer to Section 5), a Remediation Work Method Statement (RWMS) will be prepared. If multiple areas/ issues are identified, these may be covered by one or more RWMS.

The RWMS will be prepared in accordance with, and implemented as a sub-document of, this RAP. Any remediation/ management works will comply not only with the methods given in the RWMS, but also with the overarching requirements of this RAP.

Each RWMS will include:

- Clear identification of the issue/ area of concern;
- Determination of the remediation strategy to be adopted;
- Itemised step-by-step requirements for implementing the adopted strategy, including who will undertake each step;
- Validation requirements for the works.

The RWMS will be prepared by the Environmental Consultant in conjunction with the site owner/ developer. The final RWMS will be provided to the appropriate regulatory authority and the Contractor responsible for implementing the RWMS.

7.3 Selection of Remediation/ Management Strategies

If a RWMS is required, the selection of the remediation strategy will be based on the following considerations:

- Regulatory requirements, as discussed in Section 7.4;
- Potential impacts on adjacent site users and the environment;
- The development design and requirements, including excavation depths and surface finishings;
- The most effective method(s) for remediating/ managing the identified contaminants of concern;
- Timeframe; and
- Cost.

7.4 Regulatory Considerations

DEC (2006)[1] states that *"soil remediation and management is implemented in the following preferred order:*

1. *on-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;*
2. *off-site treatment of excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site;*
3. *removal of contaminated soil to an approved site or facility, followed where necessary by replacement with clean fill;*
4. *consolidation and isolation of the soil on-site by containment within a properly designed barrier.*

If remediation is likely to cause a greater adverse effect than leaving the site undisturbed, remediation should not proceed.

In cases where it is not viable to remediate large quantities of soil with low levels of contamination, alternative strategies should be considered or developed."

[1] NSW DEC, *Contaminated Site: Guidelines for the NSW Site Auditor Scheme* (2006)

DEC (2007)[2] covers remediation and management of groundwater and states: *"Where contamination is identified, the management objectives are to protect human and ecological health and to ultimately restore the groundwater to its natural background quality. To achieve these objectives, the following management responses must be considered:*

- *control short-term threats arising from the contamination;*
- *restrict groundwater use;*
- *prevent or minimise further migration of contaminants from source materials to groundwater;*
- *prevent or minimise further migration of the contaminant plume;*
- *clean up groundwater to protect human and ecological health, restore the capacity of the groundwater to support the relevant environmental values and, as far as practicable, return groundwater quality to its natural background quality.*

As a minimum, management of contaminated groundwater should continue until human and ecological health is protected and the capacity of the groundwater to support relevant environmental values is restored.

Management responses to groundwater contamination should focus on the greatest threats first, and the benefits of groundwater cleanup must outweigh any incidental negative impacts that could arise."

DEC (2007) further states "*Clean-up objectives for contaminated groundwater should be established in the following preferential order:*

1. *Clean up so natural background water quality is restored;*
2. *Clean up to protect the relevant environmental values of groundwater, and human and ecological health;*
3. *Clean up to the extent practicable."*

Another regulatory consideration is the need for an Environmental Protection Licence (EPL) for some remediation technologies in addition to approvals through the development application process. This is most likely to be required where a waste stream (e.g. contaminants volatilised in extracted vapours/ water) is produced.

7.5 Example Remediation Strategy

No contamination requiring remediation or management was identified in DP (2013b).

Based on the findings of DP (2013a and 2013b) and our experience of the area of the site, the most likely contamination at the site would be contaminants in soils with relatively low potential to impact groundwater. If this was identified a suitable remediation/ management strategy would be:

- Off-site disposal of soils to the depth of required bulk excavation; and
- If the contaminated extended below the bulk depth of excavation, on-site containment of soils below the proposed depth of bulk excavation. A suitable on-site containment method may

[2] DEC *Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination* (2007) (DEC 2007)

comprise construction of a capping layer (say pavement or 0.5 m thickness of "clean" soil) underlain by a marker layer indicating the presence of underlying contamination; and

- If contamination was contained at the site, preparation and implementation of a legally enforceable, long term management plan.

8. Implementation of RWMS

8.1 Roles and Responsibilities

8.1.1 Principal and Principals Representative

The Principal, Grocon Group, is responsible for the environmental performance of the remediation works, including implementation of acceptable environmental controls. The Principal will retain the overall responsibility for ensuring this RAP is appropriately implemented. The Principal is to nominate a representative (the Principal's Representative - PR), who is responsible for overseeing the implementation of this RAP and any RWMS. The actual implementation of these will, however, be conducted by the Contractor on behalf of the Principal.

The Principal will also be responsible for acquiring all necessary approvals for remediation works proposed. The responsibility of some specific approvals may be passed onto the Contractor.

8.1.2 Principal Contractor (the Contractor) and Site Manager

The Principal Contractor (referred to herein as the Contractor) is anticipated to be the party responsible for the day-to-day implementation of this RAP and any RWMS and shall fulfil the responsibilities of the Principal Contractor as defined by SafeWork. It is noted that the Contractor may appoint appropriately qualified sub-contractors and sub-consultants to assist as required.

The Contractor will nominate a Site Manager who will be responsible for day to day site management and first response to any unexpected finds encountered during works.

8.1.3 Environmental Consultant

The Environmental Consultant will provide advice on implementing this RAP, provide the further investigation and waste classification, prepare RWMS (if necessary) and validate that the site has been appropriately remediated (if necessary), and provide other advice under the CLM and POEO Acts.

The Environmental Consultant will also liaise with the Contractor and PR as required.

8.1.4 Project Surveyor (if required)

If required, a project surveyor will be engaged. The project surveyor will be a Registered Surveyor and will be responsible for undertaking the surveying work at the instruction of the Contractor. This may include, as required:

- Locations of investigation locations;
- Locations where remediation required (if any); and
- Extent, levels and thicknesses of the capping layer (if required).

8.1.5 Asbestos Contractor (if required)

If asbestos is identified, an Asbestos Contractor will be required. The Asbestos Contractor will need to hold a Class A or B licence (as appropriate) (issued by SafeWork NSW).

The Asbestos Contractor would be responsible for undertaking all asbestos works, and will include a SafeWork NSW licenced employee who is a licenced removalist who will be the works supervisor.

The Asbestos Contractor and Principal Contractor can be the same entity.

8.1.6 Occupational Hygienist (if required)

If asbestos is identified, an Occupational Hygienist will be required to provide, *inter alia*, advice and plans on WHS issues related to the asbestos works, asbestos air monitoring and clearance inspections.

The Occupational Hygienist will be suitably qualified/ licenced as required in accordance with the WHS Regulations.

The Environmental Consultant and Occupational Hygienist can be the same entity.

8.2 Programme

A programme and timing of works will be prepared by the Contractor.

8.3 Material Tracking and Disposal Records

All material movements on or off the site will be tracked by the Contractor, including:

- All excavated materials/ items (including buried concrete/ scrap metal etc);
- All liquids; and
- All imported soils/ crushed rock/ recycled materials.

The records for materials disposed off-site will include disposal locations, tonnages and trucking records. Soils materials will need an appropriate waste classification prior to disposal.

Imported material records will include the source of the material, and any paperwork required to show compliance with the POEO Act (e.g. virgin excavated natural material (VENM) certificates).

8.4 Minimising Cross Contamination

Management measures will be implemented to minimise cross contamination of any identified contaminated soils or groundwater during remediation. The scope of these works will be dependent on the remediation strategy to be adopted and works programme.

In general, however, materials of different contaminant "classes" should not be mixed. Hardstand or temporary barriers should be used to prevent cross contamination between stockpiles and underlying soils, and vehicles should be washed before moving from a higher contamination area to a lesser contamination area.

8.5 Groundwater and Stormwater Management

Groundwater and stormwater will be kept out of contact which each other where practical.

All water to be disposed to the stormwater system must be "clean", and must have contaminants of potential concern (COPC) within the assessment criteria, acceptable pH, suspended solids/ turbidity, priority heavy metals, iron and oil and grease results. Disposal to stormwater also requires approval from City of Sydney Council, which will be sought by the Contractor.

Groundwater and any stormwater which has come into contact with potentially contaminated material will require testing for the COPC prior to off-site disposal.

Where water is not suitable for disposal to the stormwater system for any reason, alternate disposal options will be investigated. These may include on-site adsorption, disposal to sewer under a Trade Waste agreement or disposal as liquid waste to a specialist treatment facility.

Where alternate disposal is required due to contamination, the Environmental Consultant will be consulted for advice on options, and the Contractor will provide the Environmental Consultant with documents regarding the disposal for validation reporting purposes.

9. Methodology for Investigation and Validation

9.1 Data Quality Objectives and Indicators

The further investigation and validation assessment will be conducted in accordance with Data Quality Objectives (DQOs) and Quality Assurance/Quality Control (QA/QC) procedures to ensure the repeatability and reliability of the results.

The validation assessment will be planned in accordance with the following DQOs:

- State the Problem;
- Identify the Decision;
- Identify Inputs to the Decision;
- Define the Boundary of the Assessment;

- Develop a Decision Rule;
- Specify Acceptable Limits on Decision Errors; and
- Optimise the Design for Obtaining Data.

A checklist of Data Quality Indicators (DQI) in accordance with NEPC (2013) Schedule B2 will be completed as part of the validation assessment. The DQIs are:

- Documentation completeness;
- Data completeness;
- Data comparability and representativeness; and
- Data precision and accuracy.

Based on a fulfilment of the DQOs and DQIs an assessment of the overall data quality will be presented in the validation assessment report.

9.2 Field Records

Field records will be prepared and provided in the relevant reports. These will include:

- Sample locations
- Borehole logs or test pit logs (where appropriate) with sampling dates, descriptions of the drilling/ excavation methods, encountered strata, sampling depths and logger/ sampler;
- Record of samples (for surface samples), including sampling date, material description and sampler; and
- Photographs as required to record field observations.

9.3 Sample Collection and Analysis Requirements

Unless specified otherwise in the RWMS, the following sampling requirements will apply:

9.3.1 Soil Sampling Frequencies (Validation)

The sampling frequency will depend on the volume or area to be assessed and the previous results. The following sampling frequencies will be used. These frequencies may be reduced for large volumes or areas.

Visual Inspections and Signs of Environmental Concern

All areas to be assessed and validated will first be subject to a visual inspection.

If any signs of environmental concern (e.g. odours, staining) are observed in the area/material being tested, targeted sampling will be conducted as required to assess the contamination potentially associated with the observed sign of concern. This may require additional samples to those required by the testing frequencies given below.

Validation of excavation:

Small to medium excavations (base <500 m^2):

- Base of excavation: 1 sample per 25-50 m^2 or part thereof. Where high local variation is expected, a minimum of 3 samples will be collected.
- Sides of excavation: 1 sample per 10 m length or part thereof. Additional samples will be collected at depths of concern where there is more than one depth of concern, with a minimum of 1 sample per 1.5 m depth.

Large excavations (base ≥500 m^2):

- Base of excavation: sampling on a grid at a density in accordance with the EPA (1995) or a minimum of 10 samples. In sub-areas with any specific signs of concern, a higher sampling density may be required.
- Sides of excavation: 1 sample per 20 m length or part thereof. Additional samples will be collected at depths of concern where there is more than one depth of concern, with a minimum of 1 sample per 1.5 m depth.

Stockpiles

Samples will be collected from stockpiles at various depths to characterise the full depth of the stockpile.

Validation/ assessment of stockpiled soils (note actual frequency will be determined based on volume, contamination risk and homogeneity of the material):

- Stockpiles ≤250 m^3: 1 sample per 25 m^3 or a minimum of 3 samples;
- Stockpiles 250 – 1,000 m^3: 1 sample per 50-100 m^3, or a minimum of 10 samples; and
- Stockpiles >1,000 m^3: 1 sample per 100-250 m^3, or a minimum of 10 samples.

A sampling regime will be determined by the Environmental Consultant in the event that a stockpile has a volume significantly greater than 1,000 m^3.

Where contaminated soils are stored or treated on bare soils, the footprint of the stockpile requires validation following removal of the contaminated soils.

9.3.2 Groundwater Sampling Frequencies

No additional groundwater investigation is proposed.

If groundwater testing is required, due either to observations of concern in the groundwater or for disposal purposes, an appropriate sampling frequency will be determined by the Environmental Consultant.

9.3.3 Field Methods

Soils
The following general sampling methodology is to be implemented for all sampling:

- Preparing record of samples, including sample date, location, description, signs of concern, and any field results;
- Sampling from surface or from the utilised plant using disposable sampling equipment or stainless steel hand tools;
- Decontaminating all re-useable sampling equipment prior to collecting each sample using a 3% solution of phosphate free detergent (Decon 90) and distilled water;
- Transferring samples into a sealable plastic bag, and then placement in a second plastic bag (i.e. double bagging) (for asbestos analysis);
- Transferring samples into laboratory-prepared glass jars with Teflon-lined lid, and capping immediately (for chemical analytes);
- Labelling sample containers with individual and unique identification, including project number and sample number;
- Placing the plastic bags for asbestos into a sealed container for transport to the laboratory;
- Placing the glass jars for chemical analysis into a cooled, insulated and sealed 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 hand-over to the laboratory.

Water
The following general sampling methodology is to be implemented for all sampling:

- Preparing record of samples, including sample date, location, description, signs of concern, and any field results;
- Decontaminating all re-useable sampling equipment prior to collecting each sample using a 3% solution of phosphate free detergent (Decon 90) and distilled water;
- Immediate placement of sample in laboratory prepared sample containers and capping;
- Labelling sample containers with individual and unique identification, including project number and sample number;
- Placing the samples into a cooled, insulated and sealed 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 hand-over to the laboratory.

For ‘grab’ groundwater samples (e.g. from an excavation pit), the following additional sampling methodology is to be implemented for all sampling:

- Collection of sample from the depth of concern, which will be the water surface for petroleum contaminants; and

- Collection of samples directly into sampling containers, or sampling using disposable or decontaminated glass sampling equipment.

For samples from groundwater wells, the following additional sampling methodology is to be implemented for all sampling:

- Collection of sample from depth of concern, which will be the water surface for petroleum contaminants;
- Micro-purging of well using a low flow pump until field parameters (pH, temperature, dissolved oxygen, EC and redox) have stabilised; and
- Once field parameters had stabilised the samples were collected using a low flow pump. Use of new disposable equipment (bladders and tubing) for each sample.

9.4 Laboratory Analysis

Laboratory analysis of samples will be undertaken by laboratories with national associated of testing authorities (NATA) accreditation for the analyte being tested and with appropriate QA/QC assessment to meet the requirements of Section 9.5.

It is anticipated that at least two laboratories will be employed to undertake the testing, a primary laboratory and secondary laboratory, which will analyse inter-laboratory replicate samples.

Samples will be analysed for the contaminants of concern identified for the sampling purpose. These contaminants will be identified based on the CSM (Section 4), available laboratory results from previous testing, field observations and the objective of the analysis.

9.5 Quality Control and Quality Assurance

QA/QC procedures will be adopted to ensure the repeatability and reliability of the results.

Field QA/QC testing will include the following:

- 5% sample inter-laboratory analysis, analysed for the same suite as primary sample;
- 5% sample intra-laboratory analysis, analysed for the same suite as primary sample;
- Rinsate samples (where re-useable sampling equipment is used), analysed for the suite of analytes analysed by the majority of the primary samples;
- Trip spike samples (one per batch of samples tested for BTEX where volatile contaminants are of concern); and
- Trip blank samples (one per batch of samples tested for BTEX where volatile contaminants are of concern).

The laboratory will undertake analysis in accordance with its accreditation, including in-house QA/QC procedures. These may include:

- Reagent blanks;
- Spike recovery analysis;
- Laboratory duplicate analysis;
- Analysis of control standards;
- Calibration standards and blanks; and
- Statistical analysis of QC data including control standards and recovery plots.

The quality control analytical results will be assessed using the following criteria:

- Sampling location rationale met the sampling objective;
- Standard operating procedures are followed;
- Appropriate QA/QC samples are collected/prepared and analysed;
- Samples are stored under secure, temperature controlled conditions;
- Chain of custody documentation is employed for the handling, transport and delivery of samples to the selected laboratory;
- Conformance with specified holding times;
- Accuracy of spiked samples within the laboratory's acceptable range (typically 70-130% for inorganic contaminants and greater for some organic contaminants);
- Field and laboratory duplicates and replicate samples will have a precision average of +/- 30% relative percentage difference (RPD) for inorganic analytes and +/- 50% RPD for organic analytes; and
- Rinsate samples will show that the sampling equipment is free of introduced contaminants, i.e. the analytes show that the rinsate is within the normal range for deionised water.

9.6 Validation Plan Minimum Requirements

The validation plan will be prepared based on an assessment of the data quality objectives for the validation assessment. The validation plan will include the requirements for:

- Site inspections;
- On-site testing, sampling and analysis; and
- Documentation and reporting.

Validation will include:

- Be conducted by an appropriately experienced and qualified environmental consultant;
- A photographic record of the remediation and validation work;
- Laboratory analysis (if required) conducted by a NATA accredited laboratory.

9.7 Reporting

As a minimum the following reports (to be prepared by the Environmental Consultant) will be required:

- Supplementary investigation report, detailing the methods and results of the investigation required in Section 5;
- Waste Classification report(s) (may be included in the supplementary investigation report);
- Remediation work method statement(s) (if remediation/ management required);
- Validation report (if remediation/ management required);
- Long term environmental management plan (if contaminated soils to be contained on site)

Additional interim reports/ letters may also be prepared, such as interim clearance advice.

10. Site Management Plan

10.1 Preparation and Implementation

The Contractor will prepare and implement a Site Management Plan (SMP) for the remediation works, including a Construction Environmental Management Plan (CEMP).

The SMP/CEMP will include, *inter alia*, plans on:

- site management and operation;
- induction requirements;
- roles and responsibilities of organisations and personnel involved in the works;
- work health and safety (WHS);
- emergency response;
- environmental management;
- water management and off-site disposal;
- soil management and off-site disposal;
- noise control;
- dust control;
- odour control;
- contingency measures for environmental incidents; and
- unexpected finds protocol.

The contractor will ensure that the site works comply with the following conditions:

- all works are conducted in accordance with the regulatory requirements and site management plan. This will include obtaining any required approvals or licences prior to commencement;
- any waste disposed from the site will be assessed and disposed in accordance the POEO Act and other applicable regulations;
- any soil imported onto the site will be assessed and imported in accordance the POEO Act;
- fugitive dust leaving the confines of the site is minimised;
- no water containing suspended matter or contaminants leaves the site in a manner which could pollute the environment;
- vehicles will 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 comply with the legislative requirements.

10.2 Regulation

Works will comply with all legislative requirements including, *inter alia*, those set out under the following Acts (and their subsequent amendments and regulations):

- Environmentally Hazardous Chemicals Act, 1985;
- Hazardous Chemicals Act, 1985;
- Environmental Offences and Penalties Act, 1989;
- Protection of the Environment Operations Act, 1997 (POEO Act);
- Contaminated Land Management Act, 1997 (CLM Act); and
- Work Health and Safety Act, 2011 (WHS Act).

10.3 Site Operations

Access to the site will be restricted to approved persons. Approved persons will include people working on the project. Appropriate fencing and security will be in place to prevent unauthorised access to the site.

All persons entering the site will either undergo a full site induction, or for one off short visits may undergo an abridged induction subject to their full time supervision by a fully inducted person.

Any remediation works will be restricted to the hours as may be set in the Consent Conditions.

It is the PRs responsibility to ensure appropriate personnel are appointed to manage and conduct any remediation and validation works.

The Contractor will be responsible for preparing a list of contacts for the works, including emergency contacts for the site operations and provision of signage at the site to allow the public to contact nominated site personnel out of hours.

10.4 Soil Management, Importation and Disposal

10.4.1 Importation of Soil

Any soil, rock or recycled aggregate to be imported onto the site must meet the following requirements:

- They must be legally able to be imported onto the site in accordance with the *Protection of the Environment Operations (Waste) Regulation* 2014 and any required consent approvals;
- The soils must meet the remediation acceptance criteria and investigation levels for the site (refer to Section 6.2);
- The soils must meet the geotechnical requirements for their proposed use;
- The soils must be classified as Virgin Excavated Natural Material (VENM), Excavated Natural Material (ENM) or other materials legally able to be imported onto the site based on a Resource Recovery Exemption. Where available VENM should be imported in preference to ENM. Soils must be assessed in accordance with the EPA requirements;
- Prior to importation appropriate documentation needs to be provided to, and approved by, the Environmental Consultant and the materials must be inspected at the source site to confirm that there are no signs of contamination;
- The material must be inspected during importation by the Contractor, and any materials not meeting the description given in the provided documentation or displaying signs of contamination will be rejected. The Environmental Consultant will also conduct inspection(s) during and/ or following importation to check the same;
- Additional testing of the imported material may be required, as recommended by the Environmental Consultant, commensurate with the documentation and the material type/ classification; and
- Any recycled materials such as crushed concrete or mulch imported onto the site will also require assessment, including laboratory testing, following importation onto the site (the assessment is to include, inert alia, asbestos).

10.4.2 Stockpiling of Contaminated Material

Stockpiles should be managed to minimise the risk of dust generation, erosion and leaching. The measures required to achieve this will depend on the materials in the stockpile and the length of time the stockpile is to remain on site, but should include:

- Restrict the height of stockpiles to reduce dust generation;
- Construct erosion, sediment and runoff control measures;
- Cover stockpiles of contaminated soils to be left on site more than 24 hours, or if windy conditions are expected;
- Keep temporary stockpiles moist, by using water spray where required; and
- Manage the potential for leaching from stockpiles (where required) by placing on a low permeability base. Where this is a potential issue, specific advice should be sought from the Environmental Consultant.

10.4.3 Waste Disposal

All off-site disposal of wastes, where required, will be undertaken in accordance with the POEO Act.

All soil and rock to be removed from the site will be classified in accordance with either:

- The EPA *Waste Classification Guidelines* 2014; or
- A General or Specific Exemption under the *Protection of the Environment Operations (Waste) Regulation* 2014.

No soils will leave the site without a formal waste classification.

10.4.3.1 Assessment of Soil

A waste classification/ exemption assessment will be required for any soils to be disposed off-site. Assessment works will be undertaken by the Environmental Consultant based on previous analytical data, field observation, and where required, additional testing results.

This will include an assessment of acid sulphate soil (ASS) which may be present in some materials at the site.

The process of assessment will comprise:

- Inspection for signs of concern (e.g. asbestos-containing materials, staining, odours);
- Determination of the source of the material to determine what previous results may be relevant;
- Review of previous results to determine if they are applicable to the subject soils (i.e. materials are of similar description, there are no additional signs of concern which need to be assessed) and if sufficient testing results are available;
- Additional testing and analysis if considered necessary based on the previous results and the material type/ condition. Any testing will need to characterise the subject material appropriately (e.g. including sampling from depth in stockpiles);
- Provision of a report to the Contractor and Principal clearly stating the classification of the subject material; and
- Inspection of the material during excavation and loading and separation of any materials observed to have signs of concern not observed during the classification process.

Based on the results the Environmental Consultant will provide advice on the appropriate disposal/re-use options for the material.

10.4.3.2 Hazardous Waste Management

This plan caters for the storage, treatment and disposal of excavated spoil which fails to meet the criteria for direct disposal to a landfill (i.e. Hazardous Waste). Any suspected hazardous waste materials should have their classification confirmed by the Environmental Consultant, including additional sampling and analysis as appropriate.

Hazardous waste will be handled as follows:

- Materials of the same spoil category/ contamination issue will be excavated and placed as separate stockpiles at demarcated and contained locations. The categorisation would be done on the basis of on-site observations and the contaminant exceedances detected;
- Stockpiles of excavated materials will be appropriately bunded with hay bales/sandbags and covered with anchored geotextile or impermeable plastic sheeting, or alternatively placed in an appropriate container e.g. waste skip, with appropriate cover. Materials considered to have the potential to produce contaminated leachate will be stockpiled in an area with an appropriate leachate collection system;
- Where required, additional sampling and analysis of segregated stockpiles may be conducted to determine the concentrations of the target parameters in the excavated materials (e.g. leachability of the contaminants of concern, treatability studies);
- Should the sampling and testing confirm the hazardous waste category and the material is to be disposed of off-site, a treatment methodology will be determined. Appropriate applications will be made to the EPA, and agreement as to the appropriateness of the treatment and disposal method will be obtained from the EPA prior to the removal of such wastes from the site. The treatment may be conducted on- or off-site; and
- An appropriately licensed hazardous waste contractor will be appointed to treat, manage the dispose of the waste in accordance with the methodology agreed with the EPA.

10.4.3.3 Loading and Transport of Spoil

All transport of waste and disposal of materials must be conducted in accordance with the requirements of the POEO Act. All licences and approvals required for disposal of the material will be obtained prior to removal of the materials from the site.

Removal of waste materials from the site shall only be carried out by a licensed contractor holding appropriate licence, consent and/ or approvals to dispose of the waste materials according to the assigned waste classification, and with the appropriate approvals obtained from the EPA, if required.

Details of all soils removed from the site (including VENM) shall be documented by the Contractor with copies of weighbridge slips, trip tickets and consignment disposal confirmation (where appropriate) provided to the Environmental Consultant and the PR. A site log shall be maintained by the Contractor to track disposed loads against on-site origin.

Transport of spoil shall be via a clearly delineated, pre-defined haul route. The proposed waste transport route will be notified to the local Council and truck dispatch shall be logged and recorded by the Contractor for each load leaving the site. A record of the truck dispatch will be provided to the PR.

10.4.3.4 Disposal of Material

All materials excavated and removed from the site shall be disposed in accordance with the POEO Act to a facility/site legally able to accept the material. Copies of all necessary approvals from the receiving site shall be given to the PR prior to any contaminated material being removed from the site. A record of the disposal of materials will be maintained.

All relevant analysis results, as part of waste classification reports, shall be made available to the Contractor and proposed receiving site/ waste facility to enable selection of a suitable disposal location.

Copies of all consignment notes for the transport, receipt and disposal of all materials (including VENM) will be maintained as part of the site log and made available to the Environmental Consultant for inspection and reporting purposes upon request.

10.5 Water Management and Disposal

10.5.1 Management

Management of water should include the following:

- Potentially contamination (e.g. groundwater, run off water which has been in contact with contaminated soil/ water) and likely clean water (e.g. run off water which has not been in contact with contaminated) should be kept separate to reduce disposal costs;
- Separate storage and disposal systems should be in place for “contaminated” and “clean” water;
- The potential for run-off water to become contaminated should be minimised by good on-site stormwater management including diverting surface water away from uncovered contaminated materials; and
- Whilst quantities of water stored at the site should be minimised where possible, sufficient storage capacity for stormwater will be required to allow appropriate testing prior to disposal.

10.5.2 Assessment

If required, assessment of water quality for off-site disposal will be undertaken by the Environmental Consultant. This could include a review of potential for the water to be impacted by various contaminants, possible disposal options, and determination of a suitable sampling and analysis program. Analysis may include total suspended solids (TSS) and/or turbidity, pH, filterable iron, TRH (total petroleum hydrocarbons, as a screening test for TPH, PAH, BTEX and metals. The Environmental Consultant will provide written advice of the results to the PR and Contractor, including comments on potential disposal options.

10.5.3 Disposal of Water

Based on the results of the assessment the Contractor will determine the appropriate disposal method(s). Following determination of the disposal method, disposal will be conducted in accordance with the POEO Act. Record of the disposal will be kept by the Contractor and provided to the PR and Environmental Consultant.

In general, disposal options for liquids include:

- On-site absorption. This option is generally suitable for water with contaminant levels at background quality for the site, and comprises discharge of water onto the ground surface in an area where it will be absorbed into the underlying soils and groundwater. TSS would not be an

issue of concern for this method of disposal. This is generally not an acceptable option if there is a potential to mobilise soil or groundwater contaminants;

- Disposal to stormwater. This option is suitable for uncontaminated waters, with low turbidity. All water to be disposed to stormwater needs to meet the requirements of the owner of the stormwater system, which is City of Sydney, and will require their consent. This option may be suitable for rainwater which has not come into contact with contaminated soils or water;
- Disposal to sewer under a Trade Waste Agreement. This method of disposal would require a Trade Waste Agreement with Sydney Water;
- Disposal as a liquid waste to a licensed liquid waste contractor in accordance with the POEO Act. This method is likely to be costly, however, it allows for off-site treatment and is therefore suitable for wastes with high levels of contaminants; and
- On-site treatment followed by disposal by one of the above methods. If direct disposal by one of the above methods is considered unsuitable due to the water quality or cost, on-site treatment could be conducted prior to disposal. On-site treatment may include for example removal of suspended solids and pH adjustment which are standard requirements for construction sites water prior to disposal to stormwater or sewer.

11. Unexpected Finds Protocol and Contingency Plan

11.1 Unexpected Finds Protocol

All site personnel will be inducted into their responsibilities under this Unexpected Finds Protocol (UFP), which should be included in the Contractors Site Management Plan.

All site personnel are required to report the following to the Site Manager if observed during the course of their works:

- Signs of unexpected environmental concern, e.g. presence of unexpected fibre cement, petroleum, or other chemical odours, unnatural staining, potential contamination sources (such as buried drums or tanks) or chemical spills.

Should signs of concern be observed, the Contractor will, as soon as practical:

- Place barricades around the affected area (the potential area of environmental concern – PAEC) and cease work in that area;
- Notify authorities needed to obtain emergency response for any health or environmental concerns (e.g. fire brigade);
- Notify the PR of the occurrence;
- Notify any of the authorities that the Contractor is legally required to notify (e.g. EPA, Council); and
- Notify the Environmental Consultant.

The PR will notify any of the authorities which the Principal is legally required to notify (e.g. EPA, Council).

Following the immediate response in the UFP, the following contingency plan will be implemented.

11.2 Contingency Plan

The contingency plan for the site is as follows:

- The Environmental Consultant will inspect the PAEC and determine the nature of the issue, whether it comprises an area of environmental concern (AEC), and the appropriate approach to assessing or (if appropriate) managing the issue;
- The Environmental Consultant will undertake an assessment considered necessary to determine the management strategy for the AEC;
- If contamination is found and remediation action is considered necessary, the Environmental Consultant will prepare a RWMS for the AEC; and
- The Contractor will implement the RWMS, with validation by the Environmental Consultant.

12. Conclusions

It is considered that the site can be rendered suitable for the proposed development subject to appropriate further investigation and remediation/ management (if required) in accordance with this RAP.

13. References

1. Australian and New Zealand Environment and Conservation Council (ANZECC) / Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (2000) (ANZECC, 2000)
2. City of Sydney *Local Environmental Plan* 2012
3. City of Sydney *Managing Asbestos Policy* 2013
4. City of Sydney *Managing Asbestos Guidelines* 2013
5. City of Sydney *Contaminated Land Development Control Plan* 2004
6. DP *Report on Geotechnical Investigation, Discovery Village, Darling Harbour*, DP Report 9710, dated July 1986
7. DP *Report on Geotechnical Investigation, Discovery Village, Darling Harbour*, DP Report 9710-2, dated March 1987
8. DP *Report on Geotechnical Investigation, Theatre Development, Darling Harbour*, DP Project 19013, dated November 1992
9. DP *Report on Geotechnical Desktop Study, The Ribbon, 31 Wheat Road Darling Harbour*. Ref: 73201.00/Rev 1, November 2012

10. DP *Report on Phase 1 Contamination Assessment, IMAX Theatre, 31 Wheat Road Darling Harbour*. Ref: 73201.01, February 2013 (DP, 2013a)
11. DP *Report on Detailed Site Investigation, Proposed "The Ribbon" Development, 31 Wheat Road Darling Harbour*. Ref: 73201.02, September 2013 (DP, 2013b)
12. National Environment Protection Council (NEPC) *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013)* (NEPC, 2013)
13. NSW *Contaminated Land Management Act* 1997 *(as amended 2008)* (the CLM Act)
14. NSW Department of Environment and Conservation (DEC) *Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination* (2007) (DEC, 2007)
15. NSW Department of Environment and Conservation (DEC) *Contaminated Sites: Guidelines for the NSW Site Auditor Scheme 2nd edition* (2006) (DEC, 2006)
16. NSW Department of Environment and Climate Change (DECC) *Contaminated Sites: Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997* (2009) (DECC, 2009)
17. NSW Department of Environment, Climate Change and Water (DECCW) *Vapour Intrusion: Technical Practice Note* September 2010 (DECCW, 2010)
18. NSW *Environmental Planning and Assessment Act* 1979. Of particular relevance is the State Environmental Planning Policy (SEPP) 55 – *Remediation of Land* (SEPP55)
19. NSW Environmental Protection Authority (EPA) *Contaminated Sites: Sampling Design Guidelines* (1995) (EPA, 1995)
20. NSW Environmental Protection Authority (EPA) *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases* (2012) (EPA, 2012)
21. NSW Environmental Protection Authority (EPA) *Waste Classification Guidelines* (2014) (EPA, 2014)
22. NSW Office of Environment and Heritage (OEH) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (reprinted 2011) (OEH, 2011)
23. NSW *Protection of the Environment Operations Act* 1997 (the POEO Act)
24. NSW *Waste Avoidance and Resource Recovery Act* 2001
25. NSW *Work Health and Safety Act, 2011* (the WHS Act)

14. Limitations

Douglas Partners (DP) has prepared this report (or services) for this project at 31 Wheat Road, Darling Harbour NSW in accordance with DP's proposal dated 23 March 2016 and acceptance received from Mr Justin Clark of Grocon Group. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Grocon Group for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at

its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Douglas Partners Pty Ltd

Appendix A

About This Report

Site Drawings

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

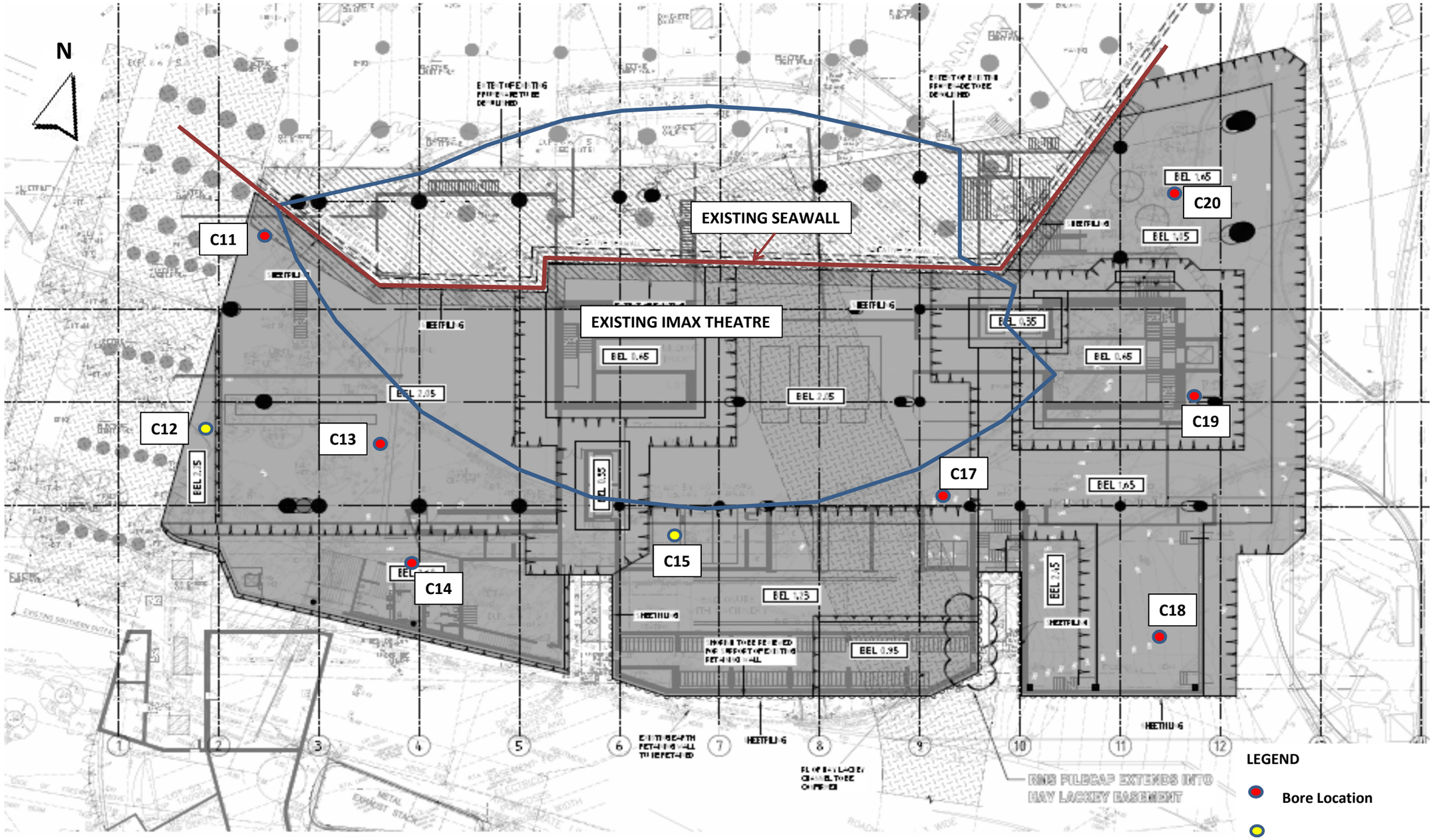
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Grocon Constructions		
OFFICE:	Sydney	DRAWN BY:	PG
SCALE:	As shown	DATE:	Mar 2016

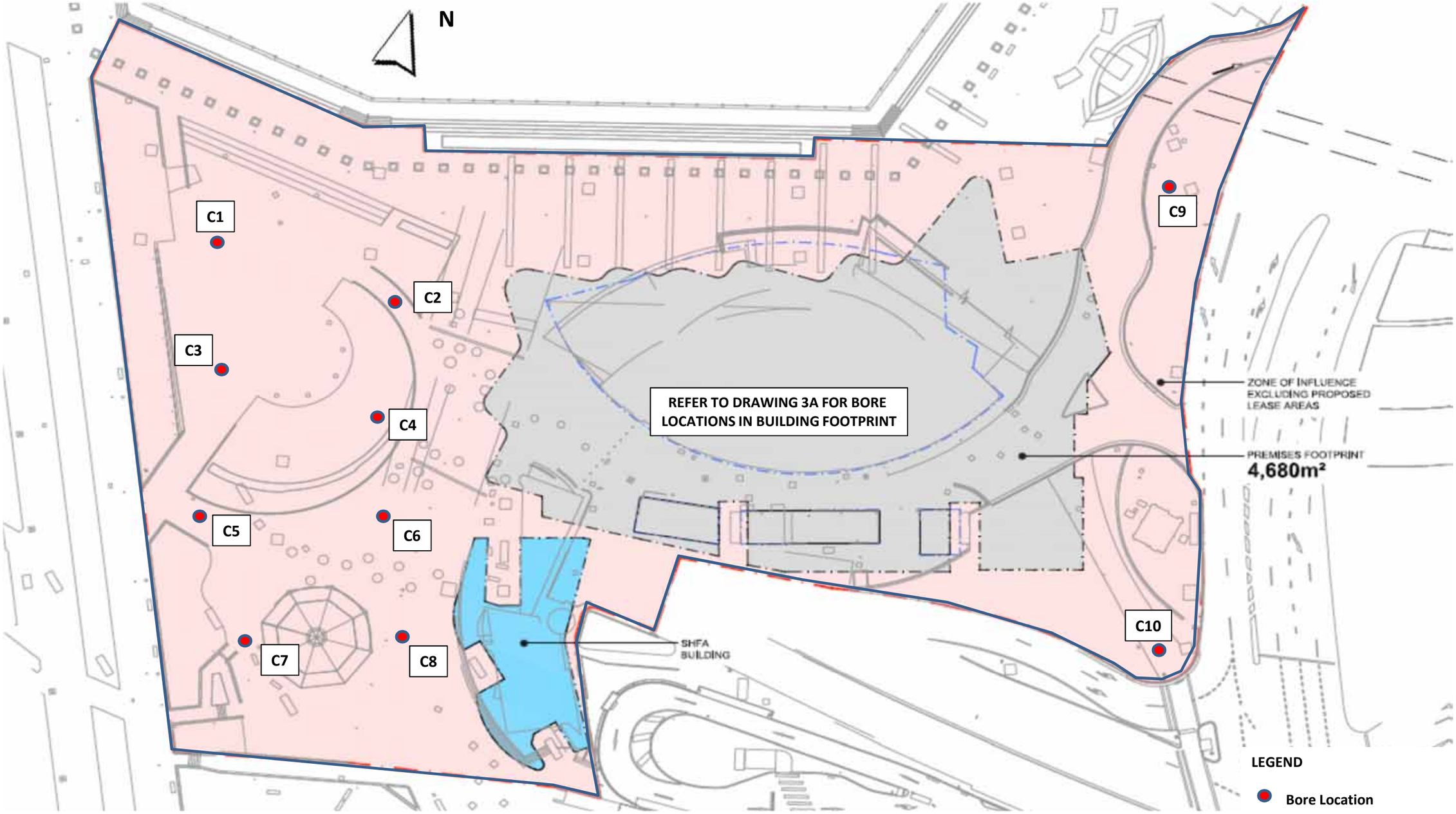
TITLE: **Proposed Works**
"The Ribbon" Development
31 Wheat Road, Darling Harbour

PROJECT No:	73201.04
DRAWING No:	1
REVISION:	0

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Grocon Constructions		TITLE: **Site Locality and Boundary**	PROJECT No:	73201.04
	OFFICE: Sydney	DRAWN BY: PG	**"The Ribbon" Development**	DRAWING No:	2
	SCALE: NTS	DATE: Mar 2016	**31 Wheat Road, Darling Harbour**	REVISION:	0



Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Grocon Constructions		TITLE:	**Location of Tests - Proposed Building Footprint** **"The Ribbon" Development** **31 Wheat Road, Darling Harbour**	PROJECT No: 73201.02
	OFFICE: Sydney	DRAWN BY: PG			DRAWING No: 3A
	SCALE: As shown	DATE: Sep 2013			REVISION: 0



Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Grocon Constructions		TITLE: **Location of Tests** "The Ribbon" Development 31 Wheat Road, Darling Harbour	PROJECT No:	73201.02
	OFFICE: Sydney	DRAWN BY: PG		DRAWING No:	3B
	SCALE: As shown	DATE: Sep 2013		REVISION:	0

Appendix B

Previous Borehole Log Results

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Soil Descriptions

Douglas Partners

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 1993. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index $Is_{(50)}$ MPa	Approx Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	M	0.3 - 1.0	6 - 20
High	H	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and loner sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq \text{100 mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Symbols & Abbreviations

Douglas Partners

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core Drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete


Filling

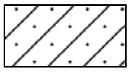
Soils


Topsoil

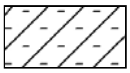

Peat


Clay

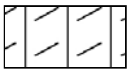

Silty clay

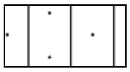

Sandy clay

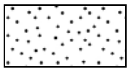

Gravelly clay

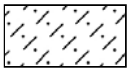

Shaly clay

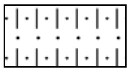

Silt


Clayey silt


Sandy silt

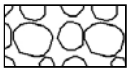

Sand

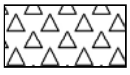

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

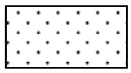

Talus

Sedimentary Rocks

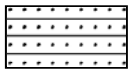

Boulder conglomerate

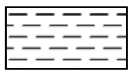

Conglomerate


Conglomeratic sandstone

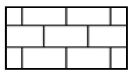

Sandstone


Siltstone


Laminite

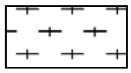

Mudstone, claystone, shale

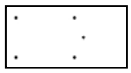

Coal


Limestone

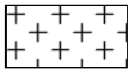
Metamorphic Rocks

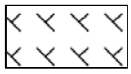

Slate, phyllite, schist

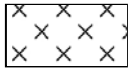

Gneiss

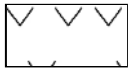

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C1
PROJECT No: 73201.02
DATE: 20/8/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.12	CONCRETE SLAB							
		FILLING - yellow, medium grained sand filling with irregular gravel		U	0.15				
					0.25				
	0.4	FILLING - dark brown, medium grained sand filling with some irregular gravel		U	0.3		PID=1		
					0.5				
	0.6	FILLING - grey sandy clay filling with sandstone pieces							
	0.9	FILLING - brown sandy gravel filling							
1									1
	1.1	FILLING - concrete pieces							
	1.2	FILLING - yellow and white extremely weathered sandstone with medium grained sand filling			1.3				
				U			PID=1		
					1.5				
	1.6	FILLING - yellow, orange dark brown sandy clay filling with some gravel and sandstone intrusions							
2									2
	2.1	FILLING - yellow and white extremely weathered sandstone filling with medium grained sand							
	2.2	FILLING - orange sandy clay filling			2.3				
	2.4	FILLING - grey and brown silty clay filling with some irregular gravel		U			PID<1		
	2.5	FILLING - light brown silty clay filling			2.5				
3	3.0	FILLING - brown gravelly sand filling							3
	3.1	FILLING - orange and white silty clay filling							
	3.3	FILLING - dark brown silty clay filling with some gravel and ash			3.3			▼ 20-08-13	
				U			PID<1		
	3.7				3.5				
	3.8	FILLING - orange sandy clay filling with sandstone inclusions							
4		FILLING - grey silty clay filling							4
	4.3	FILLING - orange and brown sandy clay filling with irregular gravel			4.3				
				U			PID=2		
	4.6				4.5				
		FILLING - grey sandy clay filling with some irregular gravel							
	5.0								

Bore discontinued at 5.0m- target depth reached

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**

TYPE OF BORING: Diatube 0.0-0.12m; push tube 0.12-5.0m

WATER OBSERVATIONS: Free ground water observed at 3.5m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C10
PROJECT No: 73201.02
DATE: 15/8/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.06	PAVERS							
	0.1	FILLING - yellow and orange sandy filling		U	0.1		PID<1		
		FILLING - light brown mediuim grained sand filling with brick and sandstone pieces			0.2				
					0.3		PID<1		
				U	0.4				
	0.6	FILLING - white sand filling							
	0.8	FILLING - white sand stone filling							
	0.9	FILLING- brown mottled white sand filling with some sandstone pieces							
	1.1	CONCRETE							
	1.9	Bore discontinued at 1.9m- refusal on concrete							

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**
TYPE OF BORING: Push tube 0.0-.1.1m; solid flight auger 1.1-1.9m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C11
PROJECT No: 73201.02
DATE: 16/8/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.06	PAVERS							
	0.1	FILLING- orange medium grained sand filling with some gravel		*U	0.1 0.2		PID<1		
		FILLING- brownand grey medium grained clayey sand filling with some gravel		U	0.4 0.5		PID<1		
	0.5	FILLING- orange medium grained clayey sand filling							
	0.6	FILLING- white and brown medium grained sandstone filling							
	0.8	FILLING- grey medium grained clayey sandstone filling							
1									1
	1.1	CONCRETE							
	1.2	Bore discontinued at 1.2m- refusal on concrete							
2									2
3									3
4									4

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**

TYPE OF BORING: Push tube 0.6-1.1m; solid flight auger 1.1-1.2m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *BD1/160813

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C12
PROJECT No: 73201.02
DATE: 16/8/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.06	PAVERS							Flush gatic cover
		FILLING- white and brown medium grained sand filling		U	0.1		PID<1		
					0.3				
	0.4	FILLING- light brown medium grained sand filling		*U			PID<1		
					0.5				
	0.7	SAND - yellow medium grained sand (possible fill)							
	1								1 Bentonite
				U	1.3		PID<1		
					1.5				
	2								2
				U	2.3		PID<1	▼ 16-08-13	
					2.5				Gravel
	3								3 Machine slotted PVC screen
				U	3.3		PID<1		
	3.5	SAND - grey black clayey sand (possible fill)			3.5				
	3.8	SAND - grey and black clayey sand with sandstone inclusions (possible fill)							
	4								4
	4.1	SAND - yellow medium grained sand							
	5.0	Bore discontinued at 5.0m							Conical end cap

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**

TYPE OF BORING: Push tube 0.6-4.0m; solid flight auger 4.0-5.0m

WATER OBSERVATIONS: Free ground water observed at 2.4m

REMARKS: *BD2/160813

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C13
PROJECT No: 73201.02
DATE: 21/8/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.06	PAVERS							
	0.2	FILLING - orange medium grained sand filling		U	0.1–0.2		PID<1		
		FILLING - brown clayey sand filling with irregular gravel			0.3				
	0.4	CONCRETE PIECES		U			PID=2		
	0.5	FILLING - brown clayey sand filling with irregular gravel			0.5				
1									1
	1.1	FILLING - dark brown sandy clay filling with irregular gravel							
	1.2								
	1.3	FILLING - white medium grained sandstone filling			1.3				
		FILLING - white and orange sandy clay filling with some irregular gravel		U	1.5		PID<1		
	1.6	FILLING - white extremely weathered sandstone filling							
	1.8	FILLING- white and orange sandy clay filling							
	1.9	FILLING- brown clayey sandy filling							
2	2.0	FILLING - white extremely weathered sandstone filling							2
					2.3				
	2.4	FILLING - orange silty clay filling		U	2.5		PID<1		
	2.8	FILLING - orange sandy clay filling							
3								21-08-13	3
					3.3				
	3.5	FILLING - grey sandy clay filling		U	3.5		PID=37		
4	4.0	SAND - yellow, medium grained sand							4
	4.2	SAND - grey medium grained clayey sand with shell fragments			4.3				
				U	4.5		PID<1		
	5.0								

Bore discontinued at 5.0m- target depth reached

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**

TYPE OF BORING: Push tube 0.06-5.0m

WATER OBSERVATIONS: Free ground water observed at3.0m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C14
PROJECT No: 73201.02
DATE: 15/8/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	ASPHALTIC CONCRETE							
		ROADBASE							
	0.3	FILLING - light brown sandy clay filling		U	0.3		PID<1		
					0.5				
	0.6	FILLING- dark brown gravelly sand filling with gravel							
	0.7	FILLING - light brown medium grained sand filling with some gravel							
1									1
	1.2	FILLING - orange medium grained sand filling			1.3				
	1.4	FILLING - yellow medium grained sandy clay filling		U			PID<1		
	1.5	FILLING - orange medium grained sandy clay filling			1.5				
	1.8	FILLING - orange medium grained sand filling							
	1.9	FILLING - orange, extremely weathered sandstone filling							
2									2
	2.3	FILLING - orange and brown medium grained sandstone filling with trace gravel		U	2.3		PID<1	15-08-13	
					2.5				
	2.6	FILLING - orange medium grained sand filling							
3	3.0	FILLING - black gravel with medium grained sand filling							3
				U	3.3		PID=1		
					3.5				
	3.6	FILLING - white medium grained sand filling							
	3.8	SAND - yellow medium grained sand filling with shell inclusions							
	3.9	SANDY CLAY - dark brown sandy clay with shell fragments							
4									4
				U	4.3		PID<1		
					4.5				
	5.0								

Bore discontinued at 5.0m

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**

TYPE OF BORING: Solid flight auger 0.0-0.3m; push tube 0.3-.5.0m;

WATER OBSERVATIONS: Free ground water observed at 2.3m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C15
PROJECT No: 73201.02
DATE: 16/8/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.01	ASPHALTIC CONCRETE							Flush gatic cover
		ROADBASE							
	0.3	FILLING - grey clay sand filling with gravel		U	0.3		PID<1		Bentonite
					0.5				
	0.6	FILLING - yellow medium grained sand filling							
1									1
	1.2	FILLING - brown clayey sand filling with some gravel							
	1.3	FILLING - yellow medium grained sand filling		U	1.3		PID<1		
					1.5				
	1.7	FILLING - white and orange medium grained sandstone filling							
	1.8	FILLING - orange medium grained sand filling						▼ 16-08-13	
2	2.0	FILLING - brown medium grained extremely weathered sandstone							2 Gravel
	2.3	SANDSTONE - orange medium grained extremely weathered sandstone filling		U	2.3		PID<1		
	2.5	SANDSTONE - light orange medium grained extremely weathered sandstone			2.5				
3									3 Machine slotted PVC screen
4	4.0	Bore discontinued at 4.0m- target depth reached							4 Conical end cap

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**

TYPE OF BORING: Solid flight auger 0.0-0.3m; push tube 0.3-2.8m; solid flight auger 2.8-4.0m

WATER OBSERVATIONS: Free ground water observed at 1.9m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C17
PROJECT No: 73201.02
DATE: 15/8/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.01	ASPHALTIC CONCRETE							
		ROADBASE							
	0.6	FILLING - brown clayey sand filling with some gravel		U	0.6 0.7		PID<1		
	1								
	1.2	Bore discontinued at 1.2m- refusal on concrete							
	2								
	3								
	4								

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**
TYPE OF BORING: Solid flight auger 0.0-0.6m; push tube 0.6-0.8m; solid flight auger 0.8-1.2m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C18
PROJECT No: 73201.02
DATE: 15/8/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	TOPSOIL (filling)							
		FILLING - dark brown silty sand filling		U	0.1–0.2		PID<1		
	0.3	FILLING - orange and brown medium grained sand filling with pieces of sandstone		U	0.4–0.5		PID<1		
	0.8	FILLING - white medium grained sand filling with sandstone pieces							
1	1.0	FILLING - brown medium grained sand filling							1
	1.3	FILLING G - orange medium grained sand filling		U	1.3–1.5		PID<1		
	1.7	FILLING - brown medium grained sand filling with some irregular gravel and slag							
2									2
	2.4	FILLING - orange medium grained sand filling with brick pieces		U	2.3–2.5		PID=2		
	2.7	FILLING - white medium grained sand filling							
	2.8	FILLING - orange medium grained sand filling							
3									3
	3.2	SANDSTONE - white and light orange extremely weathered sandstone							
	3.8	SANDSTONE - white and light orange highly weathered sandstone							
4	4.05	Bore discontinued at 4.05m							4

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**
TYPE OF BORING: Push tube 0.0-.3.2m; solid flight auger 3.2-4.0m; SPT 4.0-4.05m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C19
PROJECT No: 73201.02
DATE: 21/8/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.14	CONCRETE							
	0.2	FILLING - gravel							
		CONCRETE							
	1.05	Bore discontinued at 1.05m- refusal on concrete							

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**

TYPE OF BORING: Diatube 0.0-0.14m; solid flight auger 0.14-.0.2m; diatube 0.2-1.05m

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C2
PROJECT No: 73201.02
DATE: 20/8/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.06	PAVERS							
	0.07	CONCRETE							
		Bore discontinued at 0.07m							
	1								
	2								
	3								
	4								

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**
TYPE OF BORING: Pushtube 0.06-0.07m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C20
PROJECT No: 73201.02
DATE: 15/8/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.06	PAVERS							
		ROADBASE		U	0.1 0.2		PID<1		
	0.2								
	0.3	FILLING - brown gravelly sand							
	0.4	FILLING - yellow medium grained sand							
		Bore discontinued at 0.4m- refusal on concrete							
	1								
	2								
	3								
	4								

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**
TYPE OF BORING: Diatube 0.06-0.4m; SPT 0.4m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C3
PROJECT No: 73201.02
DATE: 20/8/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.13	CONCRETE							
		FILLING - brown clayey sand filling with irregular gravel		*U	0.15 / 0.25		PID=2		
	0.3	FILLING - dark brown clayey sand filling with irregular gravel		U	0.3 / 0.5		PID<1		
1									1
	1.1	CONCRETE							
	1.2	FILLING- light brown sandy clay filling with irregular gravel			1.3				
	1.3	FILLING - white extremely weathered sandstone filling with medium grained sand		U	1.5		PID<1		
	1.4	FILLING - brown sandy clay filling with irregular gravel							
	1.6	FILLING - white extremely weathered sandstone filling with medium grained sand							
	1.8	FILLING - red clayey sand filling with some irregular gravel							
2	1.9	FILLING - orange silty clay filling with some irregular gravel							2
	2.3	FILLING - grey silty clay filling with ironstone inclusions			2.3				
	2.4	FILLING - orange silty clay filling with ironstone inclusions		U	2.5		PID<1		
	2.7	FILLING - white sandy clay filling with some irregular gravel with trace of ash							
	2.8	FILLING - light grey silty clay filling							
3									3
				U	3.3 / 3.5		PID<1		
	3.7	FILLING - black silty clay filling							
	3.8	FILLING - orange sandy clay filling							
	3.9	FILLING - red white silty clay filling with irregular gravel							
4									4
	4.3	FILLING- red and white extremely weathered sandstone filling with medium grained sand			4.3				
	4.4	FILLING- dark grey clayey sand filling		U	4.5		PID<1		
	4.8	FILLING - dark grey clayey sand filling							
	5.0	Bore discontinued at 5.0m- target depth reached							

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**

TYPE OF BORING: Diatube 0.0-0.13m; push tube 0.13-5.0m

WATER OBSERVATIONS: Free ground water observed at 4.3m

REMARKS: *BD1/200813

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C4
PROJECT No: 73201.02
DATE: 20/8/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILLING - brown sandy clay filling with some gravel			0.01				
				U			PID=3		
					0.2				
					0.3				
				U			PID=2		
					0.5				
	1								1
	1.05	Bore discontinued at 1.05m- refusal on concrete							
	2								2
	3								3
	4								4

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**
TYPE OF BORING: Push tube 0.1-1.05m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C5
PROJECT No: 73201.02
DATE: 19/8/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.06	PAVERS							
	0.2	FILLING- light brown and brown sandy clay filling with some gravel		U	0.1		PID=1		
	0.3	FILLING - white clayey sand filling		U	0.3		PID<1		
		FILLING- sandy clay filling with irregular gravel			0.5				
	0.7	FILLING - brown clayey sand filling with irregular gravel							
1									1
	1.3	FILLING - light brown sandy clay filling with sandstone inclusions		U	1.3		PID=4.5		
	1.5	FILLING - brown clay sandy filling with some irregular gravel			1.5				
	1.6	Bore discontinued at 1.6m- refusal on concrete							
2									2
3									3
4									4

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**
TYPE OF BORING: Push tube 0.06-.1.6m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C6
PROJECT No: 73201.02
DATE: 20/8/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.06	PAVERS							
	0.1	FILLING- orange medium grained sand filling		U	0.1		PID=2		
					0.2				
		FILLING- grey, medium grained sand filling with irregular gravel			0.3				
	0.4	FILLING- orange and grey sandy clay filling with irregular gravel		U			PID=1		
					0.5				
	0.8	FILLING- dark brown sandy clay filling with irregular gravel							
1									1
					1.3				
				U			PID=2		
					1.5				
	1.7	Bore discontinued at 1.7m- refusal on concrete							
2									2
3									3
4									4

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**
TYPE OF BORING: Push tube 0.6-.1.7m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C7
PROJECT No: 73201.02
DATE: 19/8/2013
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.06	PAVERS			0.01				
	0.2	FILLING- brown sandy clay filling with irregular gravel and slag		U	0.2		PID<1		
	0.4	FILLING - grey sandy clay filling with irregular gravel			0.3				
	0.5	FILLING - orange extremely weathered filling with some irregular gravel and slag		U	0.5		PID<1		
		FILLING - dark grey sandy clay filling with some irregular gravel and slag							
	0.9								
1	1.0	FILLING- yellow red brown gravel and filling with some irregular gravel							1
	1.2	FILLING - dark brown sandy clay filling with some irregular gravel							
	1.3	FILLING - orange, medium grained clayey sand filling			1.3				
		FILLING - orange sandy clay filling		U					
	1.5	FILLING- grey sandy clay filling with some irregular gravel			1.5				
	1.9								
2		FILLING - dark brown sandy clay filling with some irregular gravel							2
	2.2								
	2.3	FILLING - orange, medium grained sand filling with irregular gravel			2.3				
		FILLING - grey sandy clay filling with irregular gravel		U			PID=2.5		
	2.5	FILLING - red sandy clay filling with irregular gravel			2.5				
3	3.0	FILLING- brown sandy clay filling with irregular gravel							3
					3.3				
				U			PID=3	▼	
	3.5	FILLING - grey sandy clay filling with some slag			3.5			19-08-13	
4	4.0	FILLING- brown andy clay filling with irregular gravel							4
					4.3				
				U			PID=1		
	4.5	FILLING - grey sandy clay filling with brick pieces and slag			4.5				

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**

TYPE OF BORING: Push tube 0.06-9.5m

WATER OBSERVATIONS: Free ground water observed at 3.5m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C7
PROJECT No: 73201.02
DATE: 19/8/2013
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILLING - grey sandy clay filling with brick pieces and slag *(continued)*							
				U	5.3		PID=2.5		
					5.5				
6									6
	6.1	FILLING - grey sandy clay filling with irregular gravel and sandstone pieces							
					6.3				
				U			PID=1.5		
					6.5				
7									7
					7.3				
				U			PID=2.5		
					7.8				
8									8
	8.1	FILLING- ash							
	8.2	FILLING - grey sandy clay clay filling with irregular gravel							
					8.3				
				U			PID=3.5		
					8.5				
	8.9	SAND - yellow and brown coarse grained sand							
9									9
					9.3				
				U			PID=11		
	9.5	Bore discontinued at 9.5m- target depth reached			9.5				

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**

TYPE OF BORING: Push tube 0.06-9.5m

WATER OBSERVATIONS: Free ground water observed at 3.5m

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C8
PROJECT No: 73201.02
DATE: 19/8/2013
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.06	PAVERS							
	0.1	FILLING- orange, medium grained sand filling		*U	0.1 0.2		PID<1		
	0.3	FILLING- brown clayey sand filling with irregular gravel			0.3				
		FILING- orage sandy clay filling with irregular gravel and ash		U	0.5		PID<1		
	0.8	FILLING - red sandy clay filling with irregular gravel							
	0.9	FILLING- white extremely weathered sandstone filling with							
1									1
	1.2	FILLING- grey sandy clay filling with irregular gravel			1.3				
	1.4	FILLING- orange sandy clay filling with some ash		U	1.5		PID<1		
	1.7	FILLING- grey sandy clay filling with some irregular gravel							
2									2
				U	2.3 2.5		PID<1		
	2.9	FILLING - white extremely weathered sandstone filling							
3									3
	3.4	FILLING - white extremely weathered sandstone filling		U	3.3		PID<1		
	3.5	FILLING - red and orange mottled white silty clay filling			3.5				
	3.7	FILLING- red mottled white silty clay filling							
4									4
	4.2	FILLING- grey silty clay filling			4.3				
				U	4.5		PID<1		
	4.8	FILLING - white extremely weathered sandstone filling with orange orange clayey sand							
	5.0								

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**

TYPE OF BORING: Push tube 0.06-.7.0m

WATER OBSERVATIONS: Free ground water observed at 5.5m

REMARKS: *BD1/200813 0.1-.2m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C8
PROJECT No: 73201.02
DATE: 19/8/2013
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILLING - brown and grey sandy clay filling							
	5.3	FILLING - white extremely weathered sandstone filling		U	5.3		PID<1		
	5.5	FILLING - grey sandy clay filling			5.5			19-08-13	
6									6
				U	6.3		PID<1		
					6.5				
7									7
				U	7.3		PID<1		
	7.5	SAND - brown coarse grained clayey sand with shell present			7.5				
8	8.0	Bore discontinued at 8.0m- target depth reached							8
9									9

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**
TYPE OF BORING: Push tube 0.06-.7.0m
WATER OBSERVATIONS: Free ground water observed at 5.5m
REMARKS: *BD1/200813 0.1-.2m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Grocon Constructions
PROJECT: Waste Classification & Detailed Site Investigation
LOCATION: The Ribbon, Darling Harbour

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: C9
PROJECT No: 73201.02
DATE: 21/8/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILLING- dark brown clayey sand filling with some gravel and rootlets and styrofoam pieces			0.1				
				*U	0.2		PID<1		
	0.3	FILLING - yellow sandy clay filling			0.3				
				*U			PID<1		
					0.5				
	1								1
	1.1	FILLING - brown clayey sand filling with some sand							
	1.2	CONCRETE							
	1.5	Bore discontinued at 1.5m- refusal on concrete							
	2								2
	3								3
	4								4

RIG: Comacchio 305 **DRILLER:** Terratest **LOGGED:** RJL **CASING:**

TYPE OF BORING: Push tube 0.0-.1.2m; solid flight auger 1.2-1.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *BD1/210813

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix C

Previous Summary of Laboratory Results

Appendix C

Previous Summary of Laboratory Results

			Metals												Asbestos
			Arsenic	Cadmium	Chromium (III+VI)		Copper	Lead		Mercury		Nickel		Zinc	Asbestos
			mg/kg	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/L	mg/kg	mg/L	mg/kg	mg/L	mg/kg	-
EQL			4	0.4	1	0.01	1	1	0.1	0.1	0.01	1		1	
Location	**Sample Depth Range**	**Sampled Date**													
C1	0.3-0.5	20/08/2013	<4	<0.4	4	-	11	21	-	0.2	-	7	-	30	NAD
C1	1.3-1.5	20/08/2013	<4	<0.4	**940**	<0.01	61	8	-	<0.1	-	64	<0.02	13	-
C1	3.3-3.5	20/08/2013	8	<0.4	8	-	22	14	-	<0.1	-	3	-	11	-
C3	0.15-0.2	20/08/2013	<4	<0.4	10	-	21	33	-	<0.1	-	15	-	46	-
BD1/200813[a]		20/08/2013	<4	<0.4	8	-	21	12	-	<0.1	-	6	-	23	-
C3	0.3-0.5	20/08/2013	<4	<0.4	8	-	9	10	-	<0.1	-	11	-	21	NAD
C4	0.3-0.5	20/08/2013	<4	<0.4	8	-	10	12	-	<0.1	-	13	-	24	NAD
C5	0.3-0.5	19/08/2013	9	<0.4	9	-	35	61	-	0.2	-	8	-	84	NAD
C6	0.3-0.5	20/08/2013	7	<0.4	11	-	44	180	0.5	0.3	-	7	-	78	NAD
C6	1.3-1.5	20/08/2013	7	<0.4	8	-	45	220	2.2	0.4	-	6	-	87	-
C7	0.3-0.5	19/08/2013	25	0.4	11	-	67	90	-	0.2	-	19	-	140	NAD
C7	1.3-1.5	19/08/2013	9	<0.4	8	-	51	46	-	0.1	-	6	-	69	-
C8	0.1-0.2	19/08/2013	<4	<0.4	10	-	49	7	-	<0.1	-	88	88	40	-
BD1/190813[a]		19/08/2013	<4	<0.4	11	-	57	4	-	<0.1	-	120	40	43	-
C8	0.3-0.5	19/08/2013	6	<0.4	20	-	62	20	-	<0.1	-	66	0.2	61	NAD
C8	2.3-2.5	19/08/2013	9	<0.4	7	-	19	41	-	0.2	-	5	-	49	-
C9	0.3-0.5	21/08/2013	<4	<0.4	7	-	2	15	-	<0.1	-	2	-	19	NAD
C10	0.1-0.2	15/08/2013	<4	<0.4	12	-	16	57	-	0.1	-	4	-	45	-
C10	0.4-0.5	15/08/2013	4	<0.4	13	-	150	93	-	0.2	-	7	-	130	NAD
C11	0.1-0.2	16/08/2013	<4	<0.4	9	-	72	6	-	<0.1	-	82	0.2	41	NAD
C11	0.4-0.5	16/08/2013	<4	<0.4	7	-	22	15	-	<0.1	-	27	-	50	-
C12	0.3-0.5	16/08/2013	<4	<0.4	6	-	12	12	-	<0.1	-	<1	-	9	NAD
BD1/160813		16/08/2013	4.4	<0.4	9	-	23	26	-	<0.05	-	23	-	92	-
BD2/160813[a]		16/08/2013	<4	<0.4	4	-	1	4	-	<0.1	-	<1	-	5	NAD
C12	2.3-2.5	16/08/2013	4	<0.4	2	-	<1	<1	-	<0.1	-	<1	-	5	-
C13	0.1-0.2	21/08/2013	<4	<0.4	10	-	68	4	-	<0.1	-	110	0.3	45	-
C13	0.3-0.5	21/08/2013	<4	<0.4	24	-	19	14	-	<0.1	-	38	-	31	NAD
C13	2.3-2.5	21/08/2013	<4	<0.4	11	-	39	25	-	<0.1	-	<1	-	19	-
C14	0.3-0.5	15/08/2013	<4	<0.4	5	-	35	80	-	0.1	-	2	-	25	NAD
C14	1.3-1.5	15/08/2013	4	<0.4	10	-	36	44	-	0.1	-	2	-	29	-
C14	2.3-2.5	15/08/2013	4	<0.4	9	-	18	53	-	0.2	-	2	-	110	-
C15	0.3-0.5	16/08/2013	<4	<0.4	6	-	32	10	-	<0.1	-	47	-	35	NAD
C15	1.3-1.5	16/08/2013	<4	<0.4	5	-	12	24	-	<0.1	-	11	-	**11,000**	-
C15 triplicate	1.3-1.5	16/08/2013	<4	<0.4	5	-	12	16	-	<0.1	-	16	-	**3,100**	-
C17	0.6-0.7	15/08/2013	<4	<0.4	8	-	18	19	-	<0.1	-	18	-	36	NAD
C17 - Triplicate	0.6-0.7	15/08/2013	<4	<0.4	13	-	36	30	-	<0.1	-	36	-	47	-
C18	0.4-0.5	15/08/2013	<4	<0.4	23	-	13	13	-	<0.1	-	21	-	40	-
C18	1.3-1.5	15/08/2013	<4	<0.4	9	-	2	22	-	<0.1	-	2	-	27	NAD
C18	2.3-2.5	15/08/2013	8	<0.4	10	-	42	370	0.2	6.5	-	7	-	300	-
Soil Assessment Criteria															
NEPC (2013) HIL C (0 - <1m, sand profile)			**300**	**90**	**300**	**-**	**17,000**	**600**	**-**	**80**	**-**	**1,200**	**-**	**30,000**	**-**
NEPC (2013) HIL D (0 - <1m, sand profile)			**3,000**	**900**	**3,600**	**-**	**240,000**	**1,500**	**-**	**730**	**-**	**6,000**	**-**	**400,000**	**-**
NEPC (2013) HSL C, VI (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL D, VI (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL IMW VI (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL C, DC (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL D, DC (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL IMW DC (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) Management Limits			-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) ESL - Urban Residential / Open Space			-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) ESL - Commercial / Industrial			-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) EIL - Urban Residential / Open Space			**100**	-	**410**	-	**240**	**1,100**	-	-	-	**320**	-	**980**	-
NEPC (2013) EIL - Commercial / Industrial			**160**	-	**680**	-	**340**	**1,800**	-	-	-	**550**	-	**1,500**	-
Waste Classification Guidelines															
General Solid Waste (CT1)			**100**	**20**	**100**	-	-	**100**	-	**4**	-	**40**	-	-	-
General Solid Waste (SCC1 & TCLP1)			**500**	**100**	**1500**	**5**	-	**1500**	**5**	**50**	-	**1050**	**2**	-	-

			PAH/Phenols																			
			Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene		Benzo(b)&(k)fluoranthene	Benzo(g,h,i)perylene	B(a)P TEQ	Carcinogenic PAHs as B(a)P TEQ	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	Phenanthrene	Phenolics Total	Pyrene	PAHs (Sum of total)	
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L
EQL			0.1	0.1	0.1	0.1	0.05	0.001	0.2	0.1	0.5		0.1	0.1	0.1	0.1	0.1	0.1	0.1	5	0.1		
Location	**Sample Depth Range**	**Sampled Date**																					
C1	0.3-0.5	20/08/2013	<0.1	<0.1	<0.1	0.1	0.2	-	0.3	0.1	<0.5	0.32	0.1	<0.1	0.1	<0.1	0.1	<0.1	<0.1	<5	0.2	1.4	-
C1	1.3-1.5	20/08/2013	<0.1	<0.1	<0.1	<0.1	<0.05	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	0	-
C1	3.3-3.5	20/08/2013	<0.1	<0.1	<0.1	0.1	0.13	-	0.2	<0.1	<0.5	0.32	0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	-	0.3	1.1	-
C3	0.15-0.2	20/08/2013	<0.1	<0.1	<0.1	0.1	0.12	-	0.2	<0.1	<0.5	0.32	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	-	0.2	0.85	-
BD1/200813[a]		20/08/2013	<0.1	<0.1	<0.1	<0.1	<0.05	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	0	-
C3	0.3-0.5	20/08/2013	<0.1	<0.1	<0.1	<0.1	<0.05	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	0	-
C4	0.3-0.5	20/08/2013	<0.1	<0.1	<0.1	<0.1	<0.05	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	0	-
C5	0.3-0.5	19/08/2013	<0.1	0.1	0.2	0.8	**0.94**	-	1.4	0.5	1	1.2	0.6	<0.1	1.5	<0.1	0.6	<0.1	0.5	<5	1.5	8.7	-
C6	0.3-0.5	20/08/2013	0.2	0.3	0.5	1.5	**1.7**	<0.001	2.4	0.8	2	2.35	1.2	0.1	2.8	0.2	0.8	<1 - 0.3	1.4	<5	3.1	18	<0.001
C6	1.3-1.5	20/08/2013	<0.1	0.2	0.3	0.9	**1.1**	<0.001	1.5	0.5	1	1.25	0.7	0.1	1.7	0.1	0.5	<1 - 0.2	0.9	-	1.9	11	<0.001
C7	0.3-0.5	19/08/2013	<0.1	0.1	0.2	1	**1.1**	<0.001	1.7	0.6	2	2.28	0.9	0.1	1.8	<0.1	0.6	<0.1	0.8	<5	1.9	11	<0.001
C7	1.3-1.5	19/08/2013	<0.1	<0.1	<0.1	0.4	0.47	-	0.7	0.3	1	1.13	0.3	<0.1	0.7	<0.1	0.3	<0.1	0.3	-	0.8	4.3	-
C8	0.1-0.2	19/08/2013	<0.1	<0.1	<0.1	<0.1	<0.05	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	0	-
BD1/190813[a]		19/08/2013	<0.1	<0.1	<0.1	<0.1	<0.05	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	0	-
C8	0.3-0.5	19/08/2013	<0.1	<0.1	<0.1	0.2	0.33	-	0.5	0.2	<0.5	0.34	0.2	<0.1	0.5	<0.1	0.2	<0.1	0.2	<5	0.5	2.9	-
C8	2.3-2.5	19/08/2013	<0.1	0.2	0.3	1.1	**1.2**	<0.001	1.8	0.7	2	2.29	0.8	0.1	2.2	0.1	0.6	<0.1	1.2	-	2.2	13	<0.001
C9	0.3-0.5	21/08/2013	<0.1	<0.1	<0.1	<0.1	<0.05	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	0	-
C10	0.1-0.2	15/08/2013	<0.1	<0.1	<0.1	<0.1	<0.05	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	0	-
C10	0.4-0.5	15/08/2013	<0.1	<0.1	<0.1	0.2	0.21	-	0.3	0.1	<0.5	0.33	0.2	<0.1	0.2	<0.1	0.1	<0.1	0.1	<5	0.3	1.7	-
C11	0.1-0.2	16/08/2013	<0.1	<0.1	<0.1	<0.1	0.07	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	0.1	0.18	-
C11	0.4-0.5	16/08/2013	<0.1	<0.1	<0.1	<0.1	0.05	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	0.05	-
C12	0.3-0.5	16/08/2013	<0.1	<0.1	<0.1	<0.1	0.09	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<5	0.1	0.37	-
BD1/160813		16/08/2013	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	0.6	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	-
BD2/160813[a]		16/08/2013	<0.1	<0.1	<0.1	<0.1	<0.05	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	0	-
C12	2.3-2.5	16/08/2013	<0.1	<0.1	<0.1	<0.1	<0.05	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	0	-
C13	0.1-0.2	21/08/2013	<0.1	<0.1	<0.1	<0.1	<0.05	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	0	-
C13	0.3-0.5	21/08/2013	<0.1	<0.1	<0.1	<0.1	0.09	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	0.1	0.19	-
C13	2.3-2.5	21/08/2013	<0.1	<0.1	<0.1	<0.1	<0.05	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	0	-
C14	0.3-0.5	15/08/2013	<0.1	<0.1	<0.1	0.2	0.25	-	0.4	0.1	<0.5	0.33	0.2	<0.1	0.2	<0.1	0.1	<0.1	<0.1	<5	0.3	1.8	-
C14	1.3-1.5	15/08/2013	<0.1	<0.1	<0.1	0.4	0.52	-	0.8	0.3	1	1.12	0.4	<0.1	0.6	<0.1	0.3	<0.1	0.2	-	0.6	4.1	-
C14	2.3-2.5	15/08/2013	0.1	0.7	2.9	5.7	**4.9**	<0.001	7.4	1.9	7	**8.36**	4.5	0.5	14	1	2.3	<1 - 0.2	12	-	12	69	<0.001
C15	0.3-0.5	16/08/2013	<0.1	<0.1	<0.1	<0.1	<0.05	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	0	-
C15	1.3-1.5	16/08/2013	<0.1	<0.1	<0.1	<0.1	0.06	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.4	-	0.1	0.58	-
C15 triplicate	1.3-1.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C17	0.6-0.7	15/08/2013	<0.1	<0.1	0.2	0.8	**0.9**	<0.001	1.7	0.7	1	1.27	0.8	0.1	2.1	<0.1	0.7	<0.1	0.8	<5	1.8	11	0.001
C17 - Triplicate	0.6-0.7	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C18	0.4-0.5	15/08/2013	<0.1	<0.1	<0.1	<0.1	<0.05	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	0	-
C18	1.3-1.5	15/08/2013	<0.1	<0.1	<0.1	<0.1	<0.05	-	<0.2	<0.1	<0.5	<0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	0	-
C18	2.3-2.5	15/08/2013	<0.1	<0.1	<0.1	0.1	0.15	-	0.3	<0.1	<0.5	0.32	0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	-	0.2	1	-
Soil Assessment Criteria																							
NEPC (2013) HIL C (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	**3**	-	-	-	-	-	-	-	-	-	**300**	-
NEPC (2013) HIL D (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	**40**	-	-	-	-	-	-	-	-	-	**4,000**	-
NEPC (2013) HSL C, VI (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**NL**	-	-	-	-	-
NEPC (2013) HSL D, VI (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**NL**	-	-	-	-	-
NEPC (2013) HSL IMW VI (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**NL**	-	-	-	-	-
NEPC (2013) HSL C, DC (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**1,900**	-	-	-	-	-
NEPC (2013) HSL D, DC (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**11,000**	-	-	-	-	-
NEPC (2013) HSL IMW DC (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**29,000**	-	-	-	-	-
NEPC (2013) Management Limits			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) ESL - Urban Residential / Open Space			-	-	-	-	**0.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) ESL - Commercial / Industrial			-	-	-	-	**1.4**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) EIL - Urban Residential / Open Space			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**170**	-	-	-	-	-
NEPC (2013) EIL - Commercial / Industrial			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**370**	-	-	-	-	-
Waste Classification Guidelines																							
General Solid Waste (CT1)			-	-	-	-	**0.8**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
General Solid Waste (SCC1 & TCLP1)			-	-	-	-	**10**	**0.04**	-	-	-	-	-	-	-	-	-	-	-	-	-	**200**	**NA**

			BTEX						TRH														
			Benzene	Ethylbenzene	Toluene	Xylene (m & p)	Xylene (o)	Xylene Total	C6-C10 less BTEX (F1)	C10-C16	C16-C34	C34-C40	>C10-C16 less Naphthalene (F2)	C6 - C9	C10 - C14	C15 - C28	C29-C36	+C10 - C36 (Sum of total)	C6-C10	1,1,1,2-tetrachloroethane	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL			0.2	1	0.5	2	1		25	50	100	100	50	25	50	100	100		25	1	1	1	1
Location	**Sample Depth Range**	**Sampled Date**																					
C1	0.3-0.5	20/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C1	1.3-1.5	20/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C1	3.3-3.5	20/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C3	0.15-0.2	20/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
BD1/200813[a]		20/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C3	0.3-0.5	20/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C4	0.3-0.5	20/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C5	0.3-0.5	19/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	120	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C6	0.3-0.5	20/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	110	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C6	1.3-1.5	20/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	240	<100	<50	<25	<50	160	110	295	<25	-	-	-	-
C7	0.3-0.5	19/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	250	<100	<50	<25	<50	130	150	305	<25	-	-	-	-
C7	1.3-1.5	19/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	470	850	<50	<25	<50	160	520	705	<25	-	-	-	-
C8	0.1-0.2	19/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
BD1/190813[a]		19/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C8	0.3-0.5	19/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C8	2.3-2.5	19/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C9	0.3-0.5	21/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C10	0.1-0.2	15/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	<1	<1	<1	<1
C10	0.4-0.5	15/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C11	0.1-0.2	16/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	<1	<1	<1	<1
C11	0.4-0.5	16/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C12	0.3-0.5	16/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
BD1/160813		16/08/2013	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3	<20	<50	<100	<100	<50	<20	<20	<50	<50	<50	<20	-	-	-	-
BD2/160813[a]		16/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C12	2.3-2.5	16/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C13	0.1-0.2	21/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C13	0.3-0.5	21/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	130	320	<50	<25	<50	<100	210	285	<25	-	-	-	-
C13	2.3-2.5	21/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C14	0.3-0.5	15/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C14	1.3-1.5	15/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C14	2.3-2.5	15/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	370	<100	<50	<25	<50	270	130	425	<25	-	-	-	-
C15	0.3-0.5	16/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C15	1.3-1.5	16/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	510	440	<50	<25	<50	250	420	695	<25	-	-	-	-
C15 triplicate	1.3-1.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C17	0.6-0.7	15/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	<1	<1	<1	<1
C17 - Triplicate	0.6-0.7	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C18	0.4-0.5	15/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C18	1.3-1.5	15/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
C18	2.3-2.5	15/08/2013	<0.2	<1	<0.5	<2	<1	<3	<25	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-	-	-
Soil Assessment Criteria																							
NEPC (2013) HIL C (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HIL D (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL C, VI (0 - <1m, sand profile)			**NL**	**NL**	**NL**	-	-	**NL**	**NL**	-	-	-	**NL**	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL D, VI (0 - <1m, sand profile)			**3**	**NL**	**NL**	-	-	**230**	**260**	-	-	-	**NL**	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL IMW VI (0 - <1m, sand profile)			**77**	**NL**	**NL**	-	-	**NL**	**NL**	-	-	-	**NL**	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL C, DC (0 - <1m, sand profile)			**120**	**5,300**	**18,000**	-	-	**15,000**	-	**38,000**	**53,000**	**7,400**	-	-	-	-	-	-	**5,100**	-	-	-	-
NEPC (2013) HSL D, DC (0 - <1m, sand profile)			**430**	**27,000**	**99,000**	-	-	**81,000**	-	**20,000**	**27,000**	**38,000**	-	-	-	-	-	-	**26,000**	-	-	-	-
NEPC (2013) HSL IMW DC (0 - <1m, sand profile)			**430**	**85,000**	**120,000**	-	-	**130,000**	-	**62,000**	**85,000**	**120,000**	-	-	-	-	-	-	**82,000**	-	-	-	-
NEPC (2013) Management Limits			-	-	-	-	-	-	-	**1,000**	**2,500**	**10,000**	-	**700**		-	-	-	-	-	-	-	-
NEPC (2013) ESL - Urban Residential / Open Space			**50**	**70**	**85**	-	-	**105**	**180**	**120**	**300**	**2,800**	-	**700**	-	-	-	-	-	-	-	-	-
NEPC (2013) ESL - Commercial / Industrial			**75**	**165**	**135**	-	-	**180**	**215**	**170**	**1,700**	**3,300**	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) EIL - Urban Residential / Open Space			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) EIL - Commercial / Industrial			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Waste Classification Guidelines																							
General Solid Waste (CT1)			**10**	**600**	**288**	-	-	**1000**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
General Solid Waste (SCC1 & TCLP1)			**18**	**1080**	**518**	-	-	**1800**	-	-	-	-	-	**650**	-	-	-	**1000**	-	-	-	-	-

Notes:

a	Replicate of sample listed above
C	Recreational land use
D	Commercial / Industrial land use
NAD	No asbestos detected at the laboratory reporting limit
IMW	Intrusive Maintenance Worker
VI	Vapour Intrusion
DC	Direct Contact
NL	Not Limiting
0.9	exceeds SAC

BOLD	Results detected above practical quantitiation limit
*	EILs derived from pH value 9.3 and CEC value 26

			Chlorinated Hydrocarbons																									
			1,1-dichloroethane	1,1-dichloroethene	1,1-dichloropropene	1,2,3-trichloropropane	1,2-dibromo-3-chloropropane	1,2-dichloroethane	1,2-dichloropropane	1,3-dichloropropane	2,2-dichloropropane	Bromochloromethane	Bromodichloromethane	Bromoform	Carbon tetrachloride	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-dichloroethene	cis-1,3-dichloropropene	Dibromomethane	Hexachlorobutadiene	Trichloroethene	Tetrachloroethene	trans-1,2-dichloroethene	trans-1,3-dichloropropene	Vinyl chloride
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Location	**Sample Depth Range**	**Sampled Date**																										
C1	0.3-0.5	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C1	1.3-1.5	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C1	3.3-3.5	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C3	0.15-0.2	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD1/200813[a]		20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C3	0.3-0.5	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C4	0.3-0.5	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C5	0.3-0.5	19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C6	0.3-0.5	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C6	1.3-1.5	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C7	0.3-0.5	19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C7	1.3-1.5	19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C8	0.1-0.2	19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD1/190813[a]		19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C8	0.3-0.5	19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C8	2.3-2.5	19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C9	0.3-0.5	21/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C10	0.1-0.2	15/08/2013	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
C10	0.4-0.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C11	0.1-0.2	16/08/2013	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
C11	0.4-0.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C12	0.3-0.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD1/160813		16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD2/160813[a]		16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C12	2.3-2.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C13	0.1-0.2	21/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C13	0.3-0.5	21/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C13	2.3-2.5	21/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C14	0.3-0.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C14	1.3-1.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C14	2.3-2.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C15	0.3-0.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C15	1.3-1.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C15 triplicate	1.3-1.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C17	0.6-0.7	15/08/2013	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
C17 - Triplicate	0.6-0.7	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C18	0.4-0.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C18	1.3-1.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C18	2.3-2.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil Assessment Criteria																												
NEPC (2013) HIL C (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HIL D (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL C, VI (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL D, VI (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL IMW VI (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL C, DC (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL D, DC (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL IMW DC (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) Management Limits			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) ESL - Urban Residential / Open Space			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) ESL - Commercial / Industrial			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) EIL - Urban Residential / Open Space			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) EIL - Commercial / Industrial			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Waste Classification Guidelines																												
General Solid Waste (CT1)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
General Solid Waste (SCC1 & TCLP1)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

			Halogenated Benzenes										Halogenated Hydrocarbons			
			1,2,3-trichlorobenzene	1,2,4-trichlorobenzene	1,2-dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	2-chlorotoluene	4-chlorotoluene	Bromobenzene	Chlorobenzene	Hexachlorobenzene	1,2-dibromoethane	Bromomethane	Dichlorodifluoromethane	Trichlorofluoromethane
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL			1	1	1	1	1	1	1	1	1	0.1	1	1	1	1
Location	**Sample Depth Range**	**Sampled Date**														
C1	0.3-0.5	20/08/2013	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-
C1	1.3-1.5	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C1	3.3-3.5	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C3	0.15-0.2	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD1/200813[a]		20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C3	0.3-0.5	20/08/2013	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-
C4	0.3-0.5	20/08/2013	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-
C5	0.3-0.5	19/08/2013	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-
C6	0.3-0.5	20/08/2013	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-
C6	1.3-1.5	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C7	0.3-0.5	19/08/2013	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-
C7	1.3-1.5	19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C8	0.1-0.2	19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD1/190813[a]		19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C8	0.3-0.5	19/08/2013	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-
C8	2.3-2.5	19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C9	0.3-0.5	21/08/2013	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-
C10	0.1-0.2	15/08/2013	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	<1	<1	<1	<1
C10	0.4-0.5	15/08/2013	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-
C11	0.1-0.2	16/08/2013	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.1	<1	<1	<1	<1
C11	0.4-0.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C12	0.3-0.5	16/08/2013	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-
BD1/160813		16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD2/160813[a]		16/08/2013	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-
C12	2.3-2.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C13	0.1-0.2	21/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C13	0.3-0.5	21/08/2013	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-
C13	2.3-2.5	21/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C14	0.3-0.5	15/08/2013	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-
C14	1.3-1.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C14	2.3-2.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C15	0.3-0.5	16/08/2013	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-
C15	1.3-1.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C15 triplicate	1.3-1.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C17	0.6-0.7	15/08/2013	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.1	<1	<1	<1	<1
C17 - Triplicate	0.6-0.7	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C18	0.4-0.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C18	1.3-1.5	15/08/2013	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-
C18	2.3-2.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil Assessment Criteria																
NEPC (2013) HIL C (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HIL D (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL C, VI (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL D, VI (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL IMW VI (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL C, DC (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL D, DC (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL IMW DC (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) Management Limits			-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) ESL - Urban Residential / Open Space			-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) ESL - Commercial / Industrial			-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) EIL - Urban Residential / Open Space			-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) EIL - Commercial / Industrial			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Waste Classification Guidelines																
General Solid Waste (CT1)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
General Solid Waste (SCC1 & TCLP1)			-	-	-	-	-	-	-	-	-	-	-	-	-	-

			MAH																
			1,2,4-trimethylbenzene	1,3,5-trimethylbenzene	Isopropylbenzene	n-butylbenzene	n-propylbenzene	p-isopropyltoluene	sec-butylbenzene	Styrene	tert-butylbenzene	4,4-DDE	a-BHC	b-BHC	d-BHC	Aldrin	Aldrin + Dieldrin	Chlordane (cis)	Chlordane (trans)
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL			1	1	1	1	1	1	1	1	1	0.1	0.1	0.1	0.1	0.1		0.1	0.1
Location	**Sample Depth Range**	**Sampled Date**																	
C1	0.3-0.5	20/08/2013	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
C1	1.3-1.5	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C1	3.3-3.5	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C3	0.15-0.2	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD1/200813[a]		20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C3	0.3-0.5	20/08/2013	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
C4	0.3-0.5	20/08/2013	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
C5	0.3-0.5	19/08/2013	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
C6	0.3-0.5	20/08/2013	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
C6	1.3-1.5	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C7	0.3-0.5	19/08/2013	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
C7	1.3-1.5	19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C8	0.1-0.2	19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD1/190813[a]		19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C8	0.3-0.5	19/08/2013	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
C8	2.3-2.5	19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C9	0.3-0.5	21/08/2013	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
C10	0.1-0.2	15/08/2013	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-	-	-	-	-	-
C10	0.4-0.5	15/08/2013	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
C11	0.1-0.2	16/08/2013	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
C11	0.4-0.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C12	0.3-0.5	16/08/2013	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
BD1/160813		16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD2/160813[a]		16/08/2013	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
C12	2.3-2.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C13	0.1-0.2	21/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C13	0.3-0.5	21/08/2013	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
C13	2.3-2.5	21/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C14	0.3-0.5	15/08/2013	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
C14	1.3-1.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C14	2.3-2.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C15	0.3-0.5	16/08/2013	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
C15	1.3-1.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C15 triplicate	1.3-1.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C17	0.6-0.7	15/08/2013	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
C17 - Triplicate	0.6-0.7	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C18	0.4-0.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C18	1.3-1.5	15/08/2013	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
C18	2.3-2.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil Assessment Criteria																			
NEPC (2013) HIL C (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	**10**	**70**	
NEPC (2013) HIL D (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	**45**	**530**	
NEPC (2013) HSL C, VI (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL D, VI (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL IMW VI (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL C, DC (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL D, DC (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL IMW DC (0 - <1m, sand profile)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) Management Limits			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) ESL - Urban Residential / Open Space			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) ESL - Commercial / Industrial			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) EIL - Urban Residential / Open Space			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) EIL - Commercial / Industrial			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Waste Classification Guidelines																			
General Solid Waste (CT1)			-	-	-	-	-	-	-	-	-								
General Solid Waste (SCC1 & TCLP1)			-	-	-	-	-	-	-	-	-								

Notes:

a	Replicate of sample listed above
C	Recreational land use
D	Commercial / Industrial land use
NAD	No asbestos detected at the laboratory repo
IMW	Intrusive Maintenance Worker
VI	Vapour Intrusion
DC	Direct Contact
NL	Not Limiting
0.9	exceeds SAC
BOLD	Results detected above practical quantitiatic
*	EILs derived from pH value 9.3 and CEC va

			Organochlorine Pesticides													Organophosphorous Pesticides								Polychlorinated Biphenyls							Solvents	Inorganics
			DDD	DDT	DDT+DDE+DDD	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Methoxychlor	Bromophos-ethyl	Chlorpyrifos	Chlorpyrifos-methyl	Diazinon	Dimethoate	Ethion	Fenitrothion	Ronnel	Arochlor 1016	Arochlor 1221	Arochlor 1232	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	Cyclohexane	pH (aqueous extract)
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	pH_Units
EQL			0.1	0.1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	
Location	**Sample Depth Range**	**Sampled Date**																														
C1	0.3-0.5	20/08/2013	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
C1	1.3-1.5	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C1	3.3-3.5	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C3	0.15-0.2	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD1/200813[a]		20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C3	0.3-0.5	20/08/2013	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
C4	0.3-0.5	20/08/2013	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
C5	0.3-0.5	19/08/2013	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
C6	0.3-0.5	20/08/2013	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
C6	1.3-1.5	20/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C7	0.3-0.5	19/08/2013	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
C7	1.3-1.5	19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C8	0.1-0.2	19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD1/190813[a]		19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C8	0.3-0.5	19/08/2013	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
C8	2.3-2.5	19/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C9	0.3-0.5	21/08/2013	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
C10	0.1-0.2	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	-
C10	0.4-0.5	15/08/2013	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	9.3
C11	0.1-0.2	16/08/2013	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	-
C11	0.4-0.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C12	0.3-0.5	16/08/2013	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
BD1/160813		16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD2/160813[a]		16/08/2013	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
C12	2.3-2.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C13	0.1-0.2	21/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C13	0.3-0.5	21/08/2013	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
C13	2.3-2.5	21/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C14	0.3-0.5	15/08/2013	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
C14	1.3-1.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C14	2.3-2.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C15	0.3-0.5	16/08/2013	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
C15	1.3-1.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C15 triplicate	1.3-1.5	16/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C17	0.6-0.7	15/08/2013	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	-
C17 - Triplicate	0.6-0.7	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C18	0.4-0.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C18	1.3-1.5	15/08/2013	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
C18	2.3-2.5	15/08/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil Assessment Criteria																																
NEPC (2013) HIL C (0 - <1m, sand profile)			**-**	**-**	**400**	**-**	**340**		**-**	**20**	**-**	**-**	**10**	**-**	**400**	**-**	**250**	**-**	**-**	**-**	**-**	**-**	**-**	**1**							**-**	**-**
NEPC (2013) HIL D (0 - <1m, sand profile)			**-**	**-**	**3,600**	**-**	**2,000**		**-**	**100**	**-**	**-**	**50**	**-**	**2,500**	**-**	**2,000**	**-**	**-**	**-**	**-**	**-**	**-**	**7**							**-**	**-**
NEPC (2013) HSL C, VI (0 - <1m, sand profile)			**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
NEPC (2013) HSL D, VI (0 - <1m, sand profile)			**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
NEPC (2013) HSL IMW VI (0 - <1m, sand profile)			**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
NEPC (2013) HSL C, DC (0 - <1m, sand profile)			**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
NEPC (2013) HSL D, DC (0 - <1m, sand profile)			**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
NEPC (2013) HSL IMW DC (0 - <1m, sand profile)			**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
NEPC (2013) Management Limits			**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
NEPC (2013) ESL - Urban Residential / Open Space			**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
NEPC (2013) ESL - Commercial / Industrial			**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
NEPC (2013) EIL - Urban Residential / Open Space			**-**	**180**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
NEPC (2013) EIL - Commercial / Industrial			**-**	**640**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Waste Classification Guidelines																																
General Solid Waste (CT1)					**-**											**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
General Solid Waste (SCC1 & TCLP1)					**250**											**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Notes:

a	Replicate of sample listed above
C	Recreational land use
D	Commercial / Industrial land use
NAD	No asbestos detected at the laboratory repo
IMW	Intrusive Maintenance Worker
VI	Vapour Intrusion
DC	Direct Contact
NL	Not Limiting
0.9	exceeds SAC

BOLD	Results detected above practical quantitiatic
*	EILs derived from pH value 9.3 and CEC va

	BTEX						Heavy Metals (dissolved)								PAH/Phenols																Polychlorinated Biphenyls													
	Benzene	Ethylbenzene	Toluene	Xylene (m & p)	Xylene (o)	Xylene Total	Arsenic	Cadmium	Chromium (as Cr III)	Copper	Lead	Mercury	Nickel	Zinc	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(b)&(k)fluoranthene	Carcinogenic PAHs as B(a)P TEQ	Benzo(g,h,i)perylene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	Phenanthrene	Phenolics Total	Pyrene	Arochlor 1016	Arochlor 1221	Arochlor 1232	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	4,4-DDE	a-BHC	Aldrin	Aldrin + Dieldrin	b-BHC	Chlordane
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL	1	1	1	2	1		1	0.1	1	1	1	0.05	1	1	0.1	0.1	0.1	0.1	0.1	0.2		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	50	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.01	0.01	0.01		0.01	0.01
NEPC (2013) GIL MW [1]	500	5 [2]	180 [2]	350	200	-	4.5 [2]	0.7	27	1.3	4.4	0.1	7	15	-	-	0.04 [2]	-	0.2 [2]	-	-	-	-	-	1.4 [2]	-	-	50	2 [2]	400	-	0.009 [2]	1 [2]	0.3 [2]	0.6 [2]	0.03 [2]	0.03 [2]	25 [2]	-	-	0.003 [2]	-	-	0.001 [2]
NEPC (2013) HSL C; Vapour Intrusion; depth 2 to <4m [3]	NL	NL	NL	-	-	NL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NL	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL D; Vapour Intrusion; depth 2 to <4m [4]	5000	NL	NL	-	-	NL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NL	-	-	-	-	-	-	-	-	-	-	-	-	-
Field_ID	**LocCode**	**WellCode**	**Sampled_Date-Time**																																								
MW12	C12		21/08/2013	<1	<1	<1	<2	<1	<3	3	<0.1	<1	<1	<1	<0.05	2	6	<0.1	<0.1	0.1	0.2	1.1	2	1	0.6	0.2	<0.1	0.5	<0.1	0.6	<0.1	0.3	<50	1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MW15	C15		21/08/2013	<1	<1	<1	<2	<1	<3	2	<0.1	<1	5	<1	<0.05	3	37	0.3	0.6	0.9	4.1	5.9	18	9	4.1	3	0.7	7.3	0.4	4.4	0.6	3.2	50	7.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

NOTES

EQL: Laboratory reporting limit
1: National Environment Protection Measure, as amended (NEPM); Groundwater Investigation Levels for the protection of slightly to moderately disturbed marine water ecosystems (typically 95% protection)
2: Low reliability trigger level
3: NEPM Health screening levels for recreational land use; vapour intrusion risk; depth to water of 2 to <4m
4: NEPM Health screening levels for commercial / industrial land use; vapour intrusion risk; depth to water of 2 to <4m
-: Not Available
NL: "Not Limiting" to human health for the proposed land use for vapour intrusion from petroleum hydrocarbons.

	Organochlorine Pesticides														Organophosphorous Pesticides								TRH									
	d-BHC	DDD	DDT	DDT+DDE+DDD	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Methoxychlor	Bromophos-ethyl	Chlorpyrifos	Chlorpyrifos-methyl	Diazinon	Dimethoate	Ethion	Fenitrothion	Ronnel	C6 - C9	C6 - C10	C6 - C10 less BTEX (F1)	C10 - C14	C15 - C28	C29 - C36	+C10 - C36 (Sum of total)	>C10 - C16 less Naphthalene (F2)	<C16 - C34	<C34 - C40
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL	0.01	0.01	0.01		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	10	10	10	50	100	100	50	50	100	100
NEPC (2013) GIL MW [1]	-	-	0.004 [2]	-	-	0.005		-	0.004	-	-	0.0004 [2]	-	0.004 [2]	-	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEPC (2013) HSL C; Vapour Intrusion; depth 2 to <4m [3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NL	-	-	-	-	NL	-	-
NEPC (2013) HSL D; Vapour Intrusion; depth 2 to <4m [4]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	600	-	-	-	-	NL	-	-
Field_ID	**LocCode**	**WellCode**	**Sampled_Date-Tir**																													
MW12	C12		21/08/2013	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	36	36	36	<50	270	<100	420	<50	310	<100
MW15	C15		21/08/2013	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<10	<10	<10	80	1500	1300	2880	140	2300	1200

NOTES

EQL: Laboratory reporting limit
1: National Environment Protection Measure, as a
2: Low reliability trigger level
3: NEPM Health screening levels for recreational
4: NEPM Health screening levels for commercial
-: Not Available
NL: "Not Limiting" to human health for the propose