Contamination | Remediation | Geotechnical

CORVAS PTY LTD

Remediation Action Plan

1-5 Chester Street, Annandale NSW

E23467.E06_Rev0
31 July 2017

Document Control

Report Title:	Remediation Action Plan
Report No:	E23467.E06_Rev0

Copies	Recipient
1. Soft Copy (PDF – Secured, issued by email)	Mr Alex Sicari Corvas Pty Ltd Level 2, 210 Clarence Street, Sydney NSW 2000
2. Original (Saved to Digital Archives)	EI Australia Suite 6.01, 55 Miller Street, Pyrmont NSW 2009

Author	Technical Reviewer
	N. Foster
CARMEN YI **Environmental Engineer**	**NATHAN FOSTER** **Senior Environmental Scientist**

Revision	Details	Date	Amended By
0	Original	31 July 2017	-

Table of contents

Page Number

Schedule of Tables

Appendices

FIGURES

Executive summary

Corvas Pty Ltd engaged EI Australia (EI) to prepare a Remediation Action Plan (RAP) for the property identified as 1-5 Chester Street, Annandale NSW ('the site'). The purpose of this RAP is to guide remediation works required to make the site suitable for the proposed residential land use. It is understood that this RAP will form part of a development application (DA) to Inner West Council.

At the time of report preparation, the site was occupied by a car spray painting workshop, which comprised a one-storey warehouse, a workshop area with metal awning, a brick office building and a concrete-paved open air carparking area. EI understand that the site is proposed for rezoning for residential use, and redevelopment into a multi-storey residential apartment building with a one-level basement carpark. The proposed development is considered meeting the definition of HIL-B land use (Residential with minimal opportunities for soil access) as defined in NEPM (2013).

This RAP continues from a Preliminary Site Investigation (Aargus, 2017). The PSI identified a number of areas of potential environmental concern at the site, including the presence of an underground storage tank (UST), potential hydrocarbon impact in groundwater and asbestos in soils. Based on findings from the PSI and re-assessment of laboratory analytical results against the criterial correspond to the proposed land use, site remediation is required to render the site suitable for the proposed residential land use.

This RAP outlines the procedures and requirements for the following investigation and remediation works to be implemented in stages:

- Stage 1 – Site preparation
- Stage 2 – Building demolition
- Stage 3 – UPSS decommissioning, remedial excavation and validation
- Stage 4 – Groundwater investigation
- Stage 5 – Data gap closure soil investigation
- Stage 6 – Remediation of asbestos-impacted soils
- Stage 7 – Waste classification and bulk excavation
- Stage 8 – Site validation
- Stage 9 – Validation report preparation

In conclusion, and with consideration of the Statement of Limitations in **Section 10**, EI consider that the site can be made suitable for HIL-B land use through implementation of the works described in this RAP.

1. Introduction

1.1 Background and purpose

Corvas Pty Ltd engaged EI Australia (EI) to prepare a Remediation Action Plan (RAP) for the property identified as 1-5 Chester Street, Annandale NSW (‘the site’). The site is located about 3.2 km southwest of the Sydney Central Business District, within the Local Government Area of Inner West Council. The site is legally identified as Lot 11 in DP 499846 and has a total area of 1,307 m^2. A site locality plan is presented as **Figure 1** and a site layout plan is presented as **Figure 2**.

EI understand that when preparing this RAP, the site was occupied by a car spray painting workshop, which comprised a one-storey warehouse, a workshop area with metal awning, a brick office building and a concrete-paved open air car parking area. A Preliminary Site Investigation (PSI) was previously conducted by Aargus (2017) on the site. The PSI identified a number of areas of potential environmental concern, including the presence of an underground storage tank (UST), potential hydrocarbon impact in groundwater and asbestos in soils. The PSI recommended that further assessment and remediation to be undertaken if the site is proposed for redevelopment. The investigation works and findings reported in the PSI are reviewed in this RAP in **Section 3**.

EI understand that the site is currently proposed for rezoning and conversion from commercial / industrial to a more sensitive residential land use, HIL-B (*Residential with minimal opportunities for soil access*) as defined in NEPM (2013). With reference to the findings presented in the PSI, site remediation will be required in order to render the site suitable for the proposed residential land use.

The purpose of this RAP is to guide remediation works required to make the site suitable for the proposed land use. It is understood that this RAP will form part of a development application (DA) to Inner West Council.

1.2 Proposed development

When preparing this RAP, final architectural drawings had not been supplied to EI for assessment. Based on information supplied by the Client and the Urban Design Report prepared for the site (AE Design Partnership, 2017), EI understand that the site is proposed for rezoning for residential uses and redevelopment. The proposed development involves demolition of all existing site structures, followed by construction of a multi-storey residential apartment building with a one-level basement carpark. The proposed basement footprint covers the majority of the site. Some deep soil areas will be present along the site perimeter.

The basement level is proposed to have a finished floor level of RL 2.65 m above Australian Height Datum (mAHD) towards the northern end, which is equivalent to approximately 5.5 m of excavation from the existing ground level based on the current site survey plan (RGM, 2017).

The development is considered meeting the definition of HIL-B Development – *Residential with minimal opportunities for soil access*, as defined in NEPM (2013).

Extracted development drawing from the Urban Design Report and the site survey plan are attached in **Appendix B**.

1.3 Regulatory framework

The following regulatory framework and guidelines were considered during the preparation of this report:

Legislation

- *Contaminated Land Management Act 1997*;
- *Protection of the Environment Operations Act 1997*, and associated regulations including UPSS Regulation 2014 and Waste Regulation 2014*;*
- State Environment Protection Policy 55 (SEPP 55) – Remediation of Land under the *Environmental Planning and Assessment Act 1997*, and
- *Work Health and Safety Act 2011* and associated regulations and codes of practice.

Guidelines

- ANZECC & ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*;
- DEC (2007) *Guidelines for the Assessment and Management of Groundwater Contamination*;
- DEC (2006) *Guidelines for the NSW Site Auditor Scheme (2nd Edition)*;
- DECCW (2009) *Guidelines for Implementing the Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008;*
- NSW EPA (1995) *Sampling Design Guidelines*;
- NEPM (2013) *Schedule B(1) Guideline on Investigation Levels for Soil and Groundwater*;
- NEPM (2013) *Schedule B(2) Guideline on Site Characterisation*;
- DECCW (2010a) *UPSS Technical Note - Site Validation Reporting*;
- NSW EPA (2014c) *Technical Note: Investigation of Service Station Sites;*
- OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites*;
- WorkCover (2014) *Managing Asbestos In or On Soil*.

1.4 Project objectives

The main objective of this RAP is to inform and guide the site remediation and validation assessment process by:

- Providing detailed procedures on how to carry out remediation works in a safe and environmentally friendly manner, while minimising impacts to human health (including site workers and the general public) and the environment; and
- Providing a preliminary sampling and analytical quality plan to be used for site validation.

1.5 Scope of works

In order to achieve the above objectives, and in accordance with EI's agreement with the Client (EI proposal P14586.1) on 10 July 2017, the scope of works was as follows:

- Review and assessment of the available data relevant to the remediation of the site and provided in the previous investigation report for the site;
- Definition of remediation goals and acceptance criteria;
- Review and assessment of the latest technical literature on remediation technologies relevant to the site and relevant case studies;
- Technical assessment of alternative remediation technologies;
- Evaluation of available remediation options and selection of the most appropriate remedial strategy (or combination of strategies) for the site;
- Provision of information so that remedial works may be carried out in accordance with relevant laws and regulations;
- Provision of guidance on approvals and licences required for the remedial works, under current legislation (e.g. SEPP 55);
- Provision of information to assist the contractor in their preparation of a Work Health and Safety Plan and other site management/planning documents;
- Development of a sampling, analysis and quality strategy for post-remedial validation.

This RAP also outlines measures for the excavation, stockpiling, management and disposal of spoil, water and sediment controls, as well as a contingency plan to handle any additional contamination that may be identified during the additional investigations and/or site remedial works. The measures provided in this RAP are brief and are designed to accompany site-specific management plans, including a Construction Environment Management Plan (CEMP). These measures do not replace any other requirements for the site as a whole. A complete set of site-specific management plans should be developed and adhered to. An outline of management measures to be addressed is provided in **Section 7**.

1.6 Deviations from this RAP

While it may be possible to vary the sequence and/or details of the actual site remediation and validation works to meet site constraints, a qualified Environmental Scientist performing the roles of Environmental Management Coordinator and Remediation Supervisor should be appointed to the project to ensure that:

- Critical stages of the site remediation/validation process (including, but not limited to, proper site induction of site personnel in relation to contamination hazards and environmental management issues, marking of remediation areas, inspection of environmental monitoring systems, implementation of specified control measures and required data gap closure and validation sampling), are appropriately supervised, implemented and documented, with the relevant data collected for environmental reporting purposes; and
- Any deviations from the works specified in this RAP are properly documented and approved, as required under the OEH (2011)*Guidelines for Consultants Reporting on Contaminated Sites*.

Performing remedial works without the presence of a qualified environmental engineer/scientist when necessary may lead to project delays and extra costs due to additional environmental investigation requirements imposed by a Qualified Independent Consultant or the appointed Site Auditor, to confirm the environmental status of the site.

In worst case scenarios, waste materials removed from the site without proper characterisation and/or waste classification assessment, may lead to regulatory action and potential penalties, as described under the *Waste Regulation* (NSW EPA, 2014b) and the *Protection of the Environment Operations Act 1997*.

2. Site description

2.1 Property identification, location and physical setting

The site identification details and associated information are presented in **Table 2-1**. The site locality is shown in **Figure 1**.

Table 2-1 Site identification, location and zoning

Attribute	Description
Street Address	1-5 Chester Street, Annandale NSW
Location Description	The site is bounded by Chester Street to the east, Johnstons Creek to the north and the west, and commercial / industrial and residential properties to the south. Approximate coordinates for the northern corner of the site under GDA94-MGA56 are: Easting: 331134.495, Northing: 6249136.038 (Source: https://maps.six.nsw.gov.au/).
Site Area	1,307 m^2
Site Owner	Peter John Fitzhenry
Lot and Deposited Plan (DP)	Lot 11 DP 499846
State Survey Marks	The nearest state survey mark (SS114238D) is located approximately 26 m north of the site across Johnstons Creek, on the western side of Douglas Grant Park.
Local Government Authority	Inner West Council
Parish	Petersham Parish
County	Cumberland County
Current Zoning	IN2 – Light Industrial (Leichhardt Municipal Council, 2013)
Recent Land Uses	The site was used as a car spray painting workshop at the time of the PSI (Aargus, 2017).

2.2 Surrounding land use

The site is situated in an area of mixed uses. Current uses of surrounding lands are described in **Table 2-2**.

Table 2-2 Surrounding land uses

Direction Relative to Site	Land Use Description
West to Northwest	Johnstons Creek is located immediately west to northwest of the site. Beyond Johnstons Creek are a public recreational parkland (Douglas Grant Park) and low-rise residential dwellings.
Northeast	Chester Street then an open air carpark, which is associated with a commercial warehouse further east.
South	Residential units then commercial warehouses and offices. Commercial warehouses are located southeast of the site

Sensitive human receptors in the vicinity of the site are the neighbouring residents and recreational park users. Other sensitive land uses such as schools and childcare centres are not identified within 100 m of the site.

Johnstons Creek is considered a sensitive environmental receptor to the site.

2.3 Regional setting

Regional topography, geology, soil landscape and hydrogeological information pertaining to the site are summarised in **Table 2-3**.

Table 2-3 Regional setting information

Attribute	Description
Topography	The site is generally flat with site elevation levels generally between RL 7.7 to 7.9 mAHD. A steep descent from the site to Johnstons Creek is observed along the north-western boundary, from approximately RL 7.9 mAHD at the site to RL 1.2 mAHD at the centre of the creek channel. Surrounding lands slopes to the north at about 5 to 10% towards Johnstons Creek.
Site drainage	The entire site was sealed by concrete hardstand at the time of the PSI. The main stormwater drainage pathway is expected to be overland flows to Johnstons Creek.
Regional geology	The site lies at a contact of mf/Qha (man-made fill over Quaternary Holocene alluvial) and Rh (Hawkesbury Sandstone) as mapped on the Sydney 1:100,000 Geological Sheet 9130 (Herbert, 1983). Qha is described as silty to peaty quartz sand, silt and clay, with ferruginous and humic cementation in places, and commonly with shell layers. Rh is described as Medium to coarse-grained quartz sandstone, with very minor shale and laminite lenses.
Soil landscapes	The site lies in a region mapped as Gymea (gy) erosional landscape and borders an area mapped as Disturbed Terrain (xx) to the north (Chapman & Murphy, 1989). Gymea landscape typically includes undulating to rolling rises and low hills on Hawkesbury Sandstone. Local relief is typically 20-80 m with slopes at 10-25%. Soils of the Gymea landscape are typically described as shallow to moderately deep (0.3 to 1 m) yellow earths and earthy sands on crests and inside of benches; shallow (<0.2 m) siliceous sands on leading edges of benches; localised gleyed pozolic soils and yellow Podzolic soils on shale lenses; shallow to moderately deep (<1m) siliceous sands and leached sands along drainage lines. Disturbed terrains are extensively disturbed by human activity including complete disturbance, removal or burial of soil, and could range from level plan to hummocky terrain. Local relief is typically <10 m with slopes <30%. Landfill materials can include soil, rock, building and waste materials.
Acid sulfate soil risk	The site lies within the map class description of "*Disturbed Terrain"* (Murphy, 1997). The corresponding map class description is "disturbed terrain may include filled areas, which often occur during reclamation of low lying swamps for urban development. Other disturbed terrain includes areas which have been mined or dredged, or have undergone heavy ground disturbance through general urban development or construction of dams or levees. Soil investigations are required to assess these areas for acid sulfate potential". The Leichhardt LEP 2013 Acid Sulfate Soils Map (Sheet ASS_009) shows that the site lies in an area mapped as "*Class 3 Acid Sulfate Soils*". For Class 3 ASS area, development consent is required for carrying out works at more than 1 m below the natural ground surface and works by which the water table is likely to be lowered more than 1 m below the natural ground surface.

Attribute	Description
Likelihood & depth of filling	Fill materials are expected to be present underneath the existing concrete slab based on the local topography. Previous intrusive investigation in the northern part of the site (Aargus, 2017) observed site filling to 4.7 m below existing ground level (mBEGL).
Typical soil profile	The typical subsurface profile at the site likely comprises fill materials of various constituents, underlain by natural silty clay and sandy clay materials with sandstone bedrock at depth.
Depth to Groundwater	Groundwater was observed at about 4.68 m below the existing ground level (mBGL) during previous intrusive investigation (Aargus, 2017).
Aquifer types	Intermittent seepage zones may be present in the fill layer and perch above the less permeable clay layers. A deeper aquifer is present in the natural clay layer which appeared to be unconfined based on previous field observations (Aargus, 2017).
Nearest surface water feature	Johnstons Creek located immediately north and northwest of the site. Johnstons Creek flows to Rozelle Bay which is approximately 1.5 km north of the site.
Groundwater flow direction	Inferred to be in a north-westerly direction towards Johnstons Creek.
Groundwater uses in local area	There was no registered groundwater bores identified within 500 m of the site from a search of the groundwater works database maintained by NSW Department of Primary Industries (http://allwaterdata.water.nsw.gov.au/water.stm) on 27 July 2017. In view of the highly urbanised environment in the locality, and the fact that a reticulated water supply system is available, beneficial uses of groundwater for domestic purposes are unlikely to be present. Other groundwater uses such as industrial and recreational uses might exist, and the associated exposure risks will be considered in future assessment as a prudent approach.

3. Site characterisation

3.1 Previous investigation

A Preliminary Site Investigation (PSI) was previously conducted on the site, titled "*Preliminary Site Investigation, 1-5 Chester Street, Annandale NSW",* prepared by Aargus Pty Ltd, reference ES6874 Rev0, dated 8 June 2017 (Aargus, 2017). The scope of works and key findings of the PSI are summarised in **Table 3-1**.

Table 3-1 Summary of previous investigation findings

Attribute/Item	Description
Scope of works	The scope of works undertaken in the Preliminary Site Investigation was: ▪ Review of physical site setting and site conditions based on a site inspection; ▪ Review available historical information including land title information, groundwater bore searches, EPA notices, anecdotal evidence, site survey and site records on waste management practices; ▪ Development of a conceptual site model; ▪ A program of intrusive investigation at the site, comprising - BH1 was drilled to 7.98 mBGL and terminated in natural sandy clay layer; - BH2 to BH7 were drilled to 0.5 mBGL and terminated in fill layer. - Soil samples were collected from both fill and natural soil horizons. Soil headspace samples were field screened with a calibrated photo-ionisation detector; - The monitoring well was installed to 7.98 mBGL, with the screening interval set at 4.68 m to 7.98 mBGL, within the natural clay horizon; - Groundwater level in the monitoring well was gauged prior to sampling. The monitoring well was purged and sampled using low flow techniques. - Selected soil and groundwater samples were assigned for laboratory analysis.
Site inspection findings	The PSI report documented the following observations during site inspection: ▪ *"The site was approximately triangular in shape;* ▪ *The site was used as a car spray painting workshop;* ▪ *The site was occupied by a warehouse constructed of brick with metal roof and sealed concrete floor in the south eastern section of the site, a workshop area with metal awning in the south west and western section of the site and a small brick building used as office with a shed next to it in the north section of the site;* ▪ *The main access to the site was along eastern boundary from Chester Street.* ▪ *Site was completely sealed with concrete.* ▪ *Cracks and oil staining observed within the entire site.* ▪ *Cars were parked under the awning and in the north portion of the site.* ▪ *The site boundaries were defined by Johnston Creek along western and northern boundary, a commercial building along southern boundary and Chester Street along the eastern boundary.* ▪ *Vegetation (grass) was observed in the western and northern boundaries of the site. No stress to vegetation was observed.* ▪ *No surface standing water was noticed at the site."*

Attribute/Item	Description
Site history and surrounding land use history	The PSI reported the following findings pertaining to the site use history and surrounding land use history: ▪ The site was owned by a number of different individuals and organisations between 1916 to 1977. Identified historical corporate owners of the site were: - Grace Bros Pty Ltd (a department store brand) between 1920 and 1923, and 1938 – 1943; - Electric Control Ltd /Engineering Limited between 1943 and 1968; - In 1977 the site ownership was transferred to the current site owner Peter John Fitzhenry. ▪ The site was not identified in the EPA records of contaminated sites, or the list of NSW contaminated sites notified to EPA, which are maintained under Sections 58 and 60 in the Contaminated Land Management Act 1997, respectively. The site was not identified on the POEO register. ▪ The PSI reported that product manufacturing on site was unlikely to have occurred, based on site inspection and history review findings. ▪ One UST was identified on site, at the location shown on **Figure 2**. The PSI indicated that there was also a possible UST present in a separate area, although this area was not outlined in the PSI. A small amount of chemicals were kept within the workshop and spray painting booths. ▪ Adjacent lands had been used primarily for residential / commercial developments according to anecdotal sources.
Intrusive investigation (field observations)	Soil investigation in the PSI was conducted on 13 May 2017. Seven boreholes (BH1 to BH7) were drilled using solid flight augers. A groundwater monitoring well was installed in BH1 after completion of drilling. A groundwater monitoring event (GME) was conducted subsequently on 18 May 2017. The PSI reported the following observations from the intrusive investigation: ▪ The observed subsurface profile was described as a layer of fill / topsoil (clayey sand, silty sand and gravelly sand) overlying natural residual soil (silty clay and sandy clay), with sandstone bedrock at depth. ▪ Some hydrocarbon staining was observed on concrete surfaces across the site; ▪ No hydrocarbon odours were noted within any of the borehole locations; ▪ No fibre-containing fragments or sheeting were observed in any of the borehole samples; ▪ PID readings of screed soil headspace samples ranged between 0.1 ppm and 0.6 ppm. ▪ Groundwater seepage was observed at 4.68 mBGL during drilling. No phase-separated hydrocarbons (PSH) were observed in the monitoring well during drilling. ▪ Groundwater level was observed at 4.68 mBGL during the GME. PSH was not observed in the monitoring well during the GME. ▪ The groundwater encountered in the GME was reported to be slightly alkaline, slightly brackish, oxidising and with low level of dissolved oxygens.

Attribute/Item	Description
Intrusive investigation (laboratory analytical results)	The soil and groundwater analytical results were assessed against the following: **Soil** ▪ HIL-D and HSL criteria (commercial / industrial) in NEPM 2013 for human health risks assessment; and ▪ ESLs for ecological risk assessment. **Groundwater** ▪ ANZECC/ARMCANZ (2000) trigger values for the 95% level of protection of freshwaters ecosystems. 99% trigger values were applied for potentially bio-accumulative contaminants. ▪ Recreational water quality and aesthetic concerns. Criteria were derived by applying a multiplication factor of 10 to Australian Drinking Water health guidelines. The analytical results indicated the following: ▪ Heavy metals, TRH, benzene, toluene, ethylbenzene, xylene, PAH, OCP and PCB concentrations in tested soils samples were below the adopted soil criteria for commercial and industrial land use. ▪ Asbestos was identified in one fill sample (BH2, 0.2-0.3m). ▪ Heavy metal concentrations in the groundwater sample (GW1) were mostly below the assessment criteria with the exception of: - Copper at 836 µg/L, above the freshwater GIL of 1.4 µg/L; - Nickel at 18 µg/L, above the freshwater GIL of 11 µg/L; - Zinc at 577 µg/L, above the freshwater GIL of 8 µg/L. TRH, BTEX and PAH concentrations were below the adopted assessment criteria. It was noted that F1-TRH was detected at a concentration of 3,380 µg/L, and F2-TRH was detected at a concentration of 310 µg/L. Both analytes were within the adopted assessment criteria.
Data gaps	The data gaps were identified as : ▪ "*The lateral and/or vertical extent of BH2 is currently unknown and an appropriate remediation strategy should be devised as part of the remediation works to be carried out in the future for any proposed development.* ▪ *The contamination status below the USTs and associated infrastructure."*
Conclusions and recommendations	The PSI concluded that "*…the risks to human health and the environment associated with soil contamination at the site are low to moderate within the context of the current commercial land use.*" The following recommendations were provided: "*…if the site is proposed to be re-developed in the future, the following requirements need to be considered in relation to making the site suitable for its intended land use:* ▪ *Re-assessment of investigative results under the proposed future land use 'HIL' guidelines.* ▪ *An appropriate remedial / management strategy is developed, culminating in preparation of a Remedial Action Plan in accordance with EPA guidelines, in regards to the abovementioned soil exceedance locations BH2 as well as the USTs and associated infrastructure.* ▪ *Another round of groundwater testing following remediation*; ▪ *Any soil requiring removal from the site, as part of future site works, should be classified in accordance with the "Waste Classification Guidelines, Part 1: Classifying Waste" NSW EPA (2014)*".

3.2 Re-assessment of PSI findings for the proposed land use

As the site is proposed for a change of use from commercial / industrial to residential, the analytical results documented in the PSI was re-assessed for human health and ecological risks for a different land use scenario (HIL-B). The criteria adopted for re-assessment are presented in **Section 4.2**.

The re-assessment showed:

- The concentrations of the following screened analytes in soil samples were within HIL-B and HSL-B criteria:
    - eight priority metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc),
    - total cyanide,
    - total polychlorinated biphenyls (PCB),
    - organochlorine pesticides (OCP),
    - Phenolic compounds,
    - polycyclic aromatic hydrocarbons (PAHs),
    - total recoverable hydrocarbons (TRH), and
    - benzene, toluene, ethylbenzene, xylene and naphthalene (BTEXN).
- Lead concentration (757 mg/kg) in one fill sample (BH3 0.2-0.3) exceeded the HIL-C criterion (600 mg/kg). Benzo(α)pyrene concentration (3.1 mg/kg) in one fill sample (BH6 0.2-0.3) exceeded the HIL-C criterion (3.1 mg/kg).
- The asbestos identified in BH2 was identified as chrysotile loose fibres/fragments of asbestos containing materials (ACM) smaller than 7 mm diameter.
- Preliminary assessment showing a number of exceedances of EILs and ESLs in the soil samples:
    - Copper in BH1 0.2-0.4, BH2 0.2-0.3, BH3 0.2-0.3, BH6 0.2-0.3, BH7 0.2-0.3 and SS1 (a field duplicate of BH1 0.2-0.4) at concentrations from 94 mg/kg to 1,300 mg/kg, above the EIL of 90 mg/kg;
    - Nickel in BH6 0.2-0.3 at 43 mg/kg, above the EIL of 35 mg/kg;
    - Zinc in BH3 0.2-0.3, BH6 0.2-0.3, BH7 0.2-0.3 and SS1 at concentrations from 265 mg/kg to 1,090 mg/kg, above the EIL of 190 mg/kg; and
    - Benzo(α)pyrene in BH1 0.2-0.4, BH6 0.2-0.3 and D1 (a field duplicate of BH1 0.2-0.4) at concentrations of 1 mg/kg, 1.9 mg/kg and 0.9 mg/kg respectively, above the ESL of 0.7 mg/kg.

Based on the re-assessment results, EI consider the main drivers for site remediation requirements are the identified UST and asbestos-impacted soils on site. While a number of exceedances of HIL-C, EILs and ESLs are identified, a more site-specific assessment on theses exceedances will be required upon finalisation of the development layout.

3.3 Conceptual Site Model (CSM)

To aid in the assessment of data collection for the site, a conceptual site model (CSM) assessing plausible pollutant linkages between potential contamination sources, migration pathways and receptors was developed by EI for the site. The CSM provides a framework for the review of the reliability and useability of the data collected and to identify data gaps in the existing site characterisation.

3.3.1 Subsurface conditions

The subsurface profile provided in **Table 3-2** was derived from the PSI findings (Aargus, 2017). Borehole logs from the PSI are included in **Appendix A**.

Table 3-2 Generalised subsurface profile

Layer	Description	Observed depth to top & bottom of layer (approximate.)	
		Top (mBGL)	Bottom (mBGL)
Surface Cover	Concrete slab between 100 to 200 mm thick.	0.0	0.1 – 0.2
Fill	Fill materials comprising clayey sand, silty sand, gravelly sand and silty clay materials, occasional inclusions of grass and metals. Fill materials were reported to be consisting of four distinct layers.	0.1 – 0.2	4.7
Residual Clay	Silty clay and sandy clay, medium to high plasticity, red/orange.	4.7	Observed to 7.6 m+

Notes:
+ Termination depth of borehole

3.3.2 Chemical hazards and contamination sources

On the basis of previous investigation findings, EI consider the potential chemical hazards and onsite contamination sources on site comprise the following:

- Fill soils present beneath the existing concrete slab across the site;
- Presence of an underground storage tank and possibly other yet-unidentified underground infrastructure, which may had been used for the storage of fuel or oil;
- Impacts from long term commercial and industrial activities at the site, including the use of the car wash bay and spray booth on site;
- Leakage and spillage of oil and fuel from motor vehicle parked on site;
- Weathering of building structures (i.e. painted surfaces, metallic structures, etc.);
- Hazardous materials, including potential asbestos-containing materials (ACM) from building products;
- Potential residues from pesticide uses underneath building footprints; and
- Deeper, natural soils and groundwater containing residual impacts, representing potential secondary sources of contamination.

3.3.3 Contaminants of concern

Based on the findings of the site contamination appraisal, the contaminants of concern (COC) at the site are considered to be:

- Soil – heavy metals (HMs), total recoverable hydrocarbons (TRH), polycyclic aromatic hydrocarbons (PAHs), the monocyclic aromatic hydrocarbon compounds *benzene, toluene, ethylbenzene and xylenes* (BTEX), organochlorine and organophosphate pesticides (OCP/ OPP), polychlorinated biphenyls (PCB), volatile organic compounds (VOC), phenols and asbestos.
- Groundwater – HMs, TRH, BTEX, Phenols and VOCs.

3.3.4 Potential sources, exposure pathways and receptors

Potential contamination sources, exposure pathways and human and environmental receptors that were considered relevant for this assessment are summarised along with a qualitative assessment of the potential risks posed by complete exposure pathways in **Table 3-3**.

Table 3-3 Conceptual site model

Impacted Media	Chemicals of Potential Concern	Transport mechanism	Exposure pathway	Potential receptor	Likelihood of exposure and rationale
Soil	HM, TRH, PAH, BTEX, OCP, OPP, PCB, VOC, phenols and asbestos	Disturbance of surficial and subsurface soils during site redevelopment, future site maintenance and future use of the site post redevelopment	▪ Ingestion; ▪ Dermal contact; ▪ Inhalation of asbestos fibres and dust particulates	▪ Current commercial occupants at the site ▪ Construction and maintenance workers ▪ End users of the site post redevelopment	**Unlikely for current site occupants** The entire site is sealed by building slab. **Likely during site redevelopment** If site redevelopment commences and involves ground-breaking works. **Unlikely post redevelopment** If the site has been successfully remediated before conclusion of the redevelopment works.
		Atmospheric dispersion from soil to outdoor air spaces	▪ Inhalation of asbestos fibres and dust particulates		**Unlikely for current site occupants** The entire site is sealed by building slab. **Likely during site redevelopment** If uncontrolled demolitions of site structures cause release of asbestos-containing materials (ACM) to surficial soils, and lead to possible exposure to mobilised asbestos dust during site works. **Unlikely post redevelopment** If the site has been successfully remediated before conclusion of the redevelopment works.
	BTEX and VOCs	Volatilisation of contamination from soil and diffusion to indoor air spaces	▪ Inhalation of vapours from VOC impacted soil.		**Possible** Risk of vapour intrusion into indoor air spaces may require further assessment if major volatile contamination is identified. Vapour intrusion risk in outdoor areas is considered low due to high level of ventilation.
	HM, TRH, PAH, BTEX, OCP, OPP	Plant uptake of contamination present in root zone	▪ Plant uptake	▪ Future ecological receptors (e.g. site vegetation post redevelopment)	**Unlikely** If the site has been successfully remediated before conclusion of the redevelopment works.

Impacted Media	Chemicals of Potential Concern	Transport mechanism	Exposure pathway	Potential receptor	Likelihood of exposure and rationale
Groundwater	HMs, TRH, BTEXN, phenols and VOCs	Interception of water table during excavation Potential seepage into deep basement intercepting water table (both on site and off site)	▪ Dermal contact; ▪ Ingestion; ▪ Inhalation of vapours	▪ Construction and maintenance workers ▪ Basement users post redevelopment ▪ Offsite users of constructed basements that are not water tight	**Possible** If basement construction intercepts groundwater table **Low likelihood for offsite structures** It is anticipated that groundwater from the site drains to Johnstons Creek adjacent to the site and unlikely be intercepted by off-site basement structures.
		Migration of dissolved phase impacts in groundwater	▪ Contaminants arriving at receiving surface waterbodies could lead to ingestion and dermal contact	▪ Aquatic ecosystems ▪ Recreational water users	**Possible** Johnstons Creek drains to Parramatta River and considerations are to be given for the protection of aquatic ecosystems and recreational water uses.
			▪ Contact with groundwater if extracted beneficial -uses	▪ Offsite unregistered groundwater bore users	**Low likelihood** Domestic uses of groundwater are unlikely, although other uses of groundwater (recreational and industrial) may be possible.
	BTEXN and VOCs	Volatilisation of contamination from groundwater to indoor or outdoor air spaces	▪ Inhalation of vapours	▪ End users of the site	**Possible** Risk of vapour intrusion into indoor air spaces may require further assessment if major volatile contamination is identified. Vapour intrusion risk in outdoor areas is considered low due to high level of ventilation.
Building fabrics containing hazardous materials	Lead, PCB and asbestos	Release of hazardous materials during uncontrolled demolition of building fabrics	▪ Ingestion; ▪ Dermal contact; ▪ Inhalation of airborne contaminants	▪ Construction and maintenance workers	**Possible** If uncontrolled demolitions of site structures cause release of hazardous materials. Risk can be reduced by carrying out Hazardous Materials Survey to identify possible hazardous materials, and removing hazardous materials by a qualified person in accordance with SafeWork NSW (formerly WorkCover NSW) requirements using appropriate WH&S measures.

3.4 Data gaps

EI identified the following data gaps requiring closure in subsequent investigation works:

- The site was used as a car spray paint workshop and use of paint and solvent is expected. Volatile organic compounds (VOCs) are considered a potential contaminant of concern and require assessment
- The extent of asbestos impact near BH2 requires delineation;
- The thickness of fill across the majority of site requires confirmation. Fill materials on site also require further characterisation in order to enable waste classification of the materials for off-site disposal, to make way for the proposed development;
- Conditions and content of the identified UST require verification;
- The potential existence of other yet-unidentified underground contaminating infrastructure on site;
- The TRH concentrations found in groundwater in the PSI suggest potential hydrocarbon impact. While the UST appeared to be the nearest potential contaminating source, further groundwater characterisation including investigation at additional locations is considered warranted, in order to:
  - Ascertain the source(s), degree and extent of the potential impact;
  - Enable assessment of potential risks to identified receptors.
- Further characterisation of soils to be retained in deep soil zones to allow evaluation of human health and ecological risks for the proposed development.
- The potential presence of acid sulfate soils (ASS) at the site needs to be assessed.

3.5 Extent of remediation required

Based on existing site characterisation data, the site areas requiring remediation are:

- UPSS – the identified UST requires appropriate decommissioning, removal and destruction in accordance with NSW SafeWork (formerly WorkCover) regulations.
- Hydrocarbon-impacted soils – soils in the vicinity of UPSS may be contaminated by hydrocarbon. Soils with hydrocarbon concentrations exceeding the relevant land use criteria require remediation followed by validation assessment.
- Asbestos-impacted soils – asbestos impacted soils will require further assessment and delineation, in order to enable more robust assessment of the risks, which may be followed by remediation and validation assessment if necessary.

4. Remediation goals and criteria

4.1 Remediation goals

The remediation goals for this RAP are consistent with NSW EPA guidelines, SEPP 55 and Council's contaminated land policy, and include:

- Rendering the site suitable for the proposed land use(s);
- Demonstrating that the proposed remediation strategy for the site is environmentally justifiable practical and technically feasible;
- Adopting clean-up criteria appropriate for the future use of the site to mitigate possible impacts to human health and the environment;
- Mitigating possible off-site migration of contaminants (including migration in existing utilities such as the sewer, stormwater and other subsurface pipes or service trenches);
- Consideration of the principles of ecologically sustainable development in line with Section 9 of the *Contaminated Land Management Act 1997*;
- Minimising waste generation under the *Waste Avoidance and Resource Recovery Act 2001*;
- To remediate all contamination at the site so there are no unacceptable risks to off-site receptors;
- To remediate the site to a condition where any residual contamination does not require long-term management using an EMP; and
- Demonstrating that the plans for site management of remediation work consider work health and safety, environmental management, community relations and site contingencies.

4.2 Soil remediation criteria

Soil remediation (validation) criteria adopted in this RAP for tier 1 assessment are sourced from NEPM (2013) *Schedule B1 Guideline on Investigation Levels for Soil and Groundwater* and NSW EPA endorsed guidelines, with reference to the proposed development scope. Adopted criteria and rationale for the selection are provided in **Table 4-1**.

Table 4-1 Adopted soil remediation (validation criteria)

Adopted guidelines	Rationale
Soil Health-based Investigation Levels (HILs) HIL-B Soil Health-based Screening Levels (HSLs) HSL-A&B for vapour intrusion Soil HSL for asbestos – HSL-B (NEPM 2013)	The proposed development includes a multi-storey residential apartment building overlying a one-level basement. Some deep soil areas will be -present along the site perimeter. EI assumes that the deep soil areas will be limited to communal landscaping uses only and no private gardens. The development land use meets the definition of NEPM 2013 HIL-B residential with minimal opportunities for soil access. HIL-B thresholds therefore are adopted as soil remediation criteria. HSL-A&B vapour intrusion thresholds for residential sites will be applied to assess potential human health impacts from residual vapours resulting from petroleum, BTEX & naphthalene. (Note: subject to the final development layout HSL-D threshold may be used if the proposed basement carpark underlies residential areas. i.e. where the situation described in Note 1, Table 1A(3), Schedule B1 NEPM 2013 applies.)Soil asbestos results will be assessed against the NEPM 2013 Soil HSL thresholds for “all forms of asbestos”, and HSL-B for “Bonded ACM”.
Soil Health-based Investigation Levels (HILs) HIL-C Soil HSL for asbestos – HSL-C	Retained deep soil areas to be used for communal landscaping or recreational purposes within a high-density development are to be assessed against HIL-C (Schedule B7, NEPM 2013).
Ecological Investigation Levels (EILs)	EILs for arsenic, copper, chromium (III), nickel, lead, zinc, DDT and naphthalene will be adopted as soil remediation criteria for areas planned as communal, deep soil landscaping areas. EILs only apply to the top 2 m of soil (root zone).
Ecological Screening Levels (ESLs)	ESLs for selected petroleum hydrocarbons & TRH fractions for protection of terrestrial ecosystems will be adopted as soil remediation criteria for areas planned as communal, deep soil landscaping areas. ESLs only apply to the top 2 m of soil (root zone).

The contaminant threshold values relating to the adopted soil remediation criteria are tabulated in **Appendix C, Table C-1**.

Conformance with the soil remediation criteria will be deemed to have been attained when:

- All soil samples show contaminant concentrations are below the specified criteria;
- Or, as a minimum, the 95% upper confidence limit (UCL) of the arithmetic mean concentration values of each contaminant in the soil remediation areas are below the respective remediation criteria.

4.3 Groundwater remediation criteria

Table 4-2 summarises the groundwater assessment criteria will be applied for data gap closure and validation assessments and the rationale for selection.

Table 4-2 Adopted groundwater remediation (validation) criteria

Adopted guidelines	Rationale
NEPM, 2013 GILs for Fresh Waters	NEPM 2013 provides GILs for typical, slightly-moderately disturbed aquatic ecosystems, which are based on the ANZECC & ARMCANZ 2000 Trigger Values for the 95% level of protection of aquatic ecosystems; however, the 99% TVs were applied for the bio-accumulative metals *cadmium* and *mercury*. The fresh waters criteria were considered relevant as the surface water receptor is identified to be Johnstons Creek, which is considered a Fresh Waters ecosystem. Where a criterion is not provided for Fresh Waters ecosystem, the Marine Waters trigger values in ANZECC/ARMCANZ (2000) will be considered.
Groundwater HSL-A&B for Vapour Intrusion	HSL-A&B vapour intrusion thresholds for residential sites will be applied to assess for potential human health impacts from residual vapours resulting from petroleum, BTEX & naphthalene, in view of the proposed land use. (Note: subject to the final development layout HSL-D threshold may be used if the proposed basement carpark underlies residential areas. i.e. where the situation described in Note 1, Table 1A(4), Schedule B1 NEPM 2013 applies.)
GILs for Recreational Uses	GILs for recreational uses are considered for protection of potential non-domestic groundwater users in the local area. The recreational GILs are derived from by applying a factor of 10 to the Australian Drinking Water Guidelines (NHMRC, 2008 and 2016).

Conformance with the groundwater remediation criteria will be deemed to have been attained when:

- All groundwater samples show that contaminant concentrations are below the specified criteria;
- If the concentrations exceed the specified criteria, it can be demonstrated the levels are consistent with the regional background concentrations;
- If the concentrations are elevated from the regional background levels, it can be demonstrated that the levels do not constitute unacceptable human-health and ecological risks to both on and off site receptors.

4.4 Waste criteria

All materials excavated and to be disposed off-site should be classified in accordance with the EPA (NSW EPA, 2014d) *Waste Classification Guidelines*.

The total contaminant threshold and leachate thresholds tested using TCLP methodology for relevant contaminants from NSW EPA (2014d), are presented in **Appendix C, Tables C-3** and **C-4**. In accordance with the *NSW Waste Regulation 2014*, waste soils must only be disposed to a waste facility that is appropriately licenced to receive the incoming waste. It is therefore recommended that confirmation be obtained from the waste facility prior to the materials being removed from the site.

Should the analytical results exceed the SCC2 and/or TCLP2 thresholds specified in the *Waste Classification Guidelines*, materials will be classifiable as *Hazardous Waste*. In such cases, and subject to EPA approval, material stabilisation or other treatment may be required prior to offsite disposal. Unexpected material may need to be segregated depending on the source of the waste, prior to conducting waste classification assessment. This approach is discussed in more detail under *Remedial Contingencies* in **Section 6.5**.

Virgin Excavated Natural Material (VENM) is a material that has been pre-classified as general solid waste (non-putrescible) under the *Protection of the Environment Operations Act 1997* (POEO Act) and is:

- ‘Natural material (such as clay, gravel, sand, soil or rock fines) that:
  - (a) that has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial, mining or agricultural activities and
  - (b) that does not contain any sulfidic ores or soils or any other waste

  and includes excavated natural material that meets such criteria for virgin excavated natural material as may be approved for the time being pursuant to an EPA Gazettal notice.’

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

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

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

Classification of Excavated Natural Materials should be in accordance with the NSW EPA waste orders and exemptions (http://www.epa.nsw.gov.au/wasteregulation/orders-exemptions.htm) including:

- The excavated natural material order 2014
- The excavated natural material exemption 2014

5. Remediation Technology

5.1 Regulatory overview

In order to attain an environmental-friendly outcome, the NEPM 2013 guidelines (Volume 1 Section 16) indicates when assessing contamination, the preferred hierarchy for site remediation options and/or management should consider:

- On-site treatment of the contamination so that it is destroyed or the associated risk is reduced to an acceptable level; and
- Off-site treatment of excavated soil, so that the contamination is destroyed or the associated risk is reduced to an acceptable level, after which soil is returned to the site; or, if the above are not practicable:
  - Consolidation and isolation of the soil on site by containment with a properly designed barrier; and
  - Removal of contaminated material to an approved site or facility, followed by, where necessary, replacement with appropriate material; or,
  - Where the assessment indicates remediation would have no net environmental benefit or would have a net adverse environmental effect, implementation of an appropriate management strategy.

When deciding which option to choose, the sustainability (environmental, economic and social) of each option should be considered, in terms of achieving an appropriate balance between the benefits and effects of undertaking the option.

Other consideration as outline by the DEC (2007) to mitigate groundwater contamination measures may include, but are not limited to:

- Notifying of the affected property (under the CLM Act, 1997) and the downgradient receptors;
- Containment of the contamination plume;
- Active or passive clean-up of contaminated groundwater (this may include the concept of Clean-up to the extent practicable or CUTEP) which may include ongoing monitoring of groundwater, and/or contingency plans and management plans to mitigate risks; and
- Legislative control through restricting groundwater use in and down-gradient of the contaminant plume.

For the site, a number of remediation options were reviewed to examine the suitability of each method, the surrounding properties, geological and hydrogeological limitations and the following considerations:

- Development requirements (residential, with accessible soils);
- Prioritisation of works in areas of most concern;
- Ability of remedial method to treat contamination with respect to material and infrastructure limitations;
- Remedial timetable;

- Defensible method to ensure the site is remediated to appropriate levels / validation criteria; and
- Regulatory compliance.

5.2 Remedial technologies review

A number of soil remediation option were reviewed to examine the suitability of each method, with due regard for the surrounding land uses, as well as the geological and hydrogeological limitations.

As the groundwater conditions at the site require further investigation at the time of RAP preparation, groundwater remediation options have not been reviewed as part of this RAP. An addendum to the RAP should be prepared if groundwater remediation is considered warranted following the proposed data gap closure investigations.

Brief discussion on the various remediation technology options is provided in **Appendix D**. Each of the available remediation technologies, except ones not commonly used in Australia (for instance in-situ thermal or steam injection), are summarised in **Table 5-1** in terms of their suitability for treatment of soils.

Table 5-1 Remedial technology review - soils

Remediation methodology	Description	Advantages	Disadvantages	Suitability
No Action	'No Action' can be considered if: ▪ There is no measurable contamination; ▪ Contaminant concentrations are below assessment guidelines; ▪ Contaminants are not mobile; or ▪ Exposure to contaminated soils is unlikely.	No remediation costs Creates minimal disturbance to the site Retains material on-site	Not applicable to the kind of contamination encountered at the site. Contamination would remain *in situ* allowing potential vapour intrusion and off-site migration of contamination and impacts on groundwater. Would pose limitations on land use options. Requires an Environmental Management Plan and ongoing monitoring.	**Not Suitable** The UST on site and surplus soils from excavation will require removal to make way for the proposed development.
On-site bioremediation	Excavated soils are thoroughly broken down and aerated, mixed with microorganisms and nutrients, stockpiled and aerated in above ground enclosures.	Cost effective if soils are utilised on-site. Lower disposal costs. Limited requirement to import fill material to site. Retains material on-site.	Significant area of site required to land farm material. Undefined remediation timeframe. Potential for odour problems. Uncertainty of successful results, particularly for PAHs. Not suitable for metals and asbestos contamination.	**Possible** This option may be adopted as a contingency where amenable soil contamination is identified and the impacted materials need to be retained on site.
In-situ treatment	*In-situ* treatment of impacted soils within the smear zone and saturated zone using *in-situ* treatment methods such as SVE, steam stripping, ISCO or injection of oxygen releasing compounds.	Creates minimal disturbance to the site (no excavation). Cost effective for large scale site remediation projects of light to mid-weight petroleum hydrocarbons. Potential to simultaneously remediate dissolved phase hydrocarbons in site groundwater.	Undefined remediation timeframe. Expensive establishment costs. Potential for odour problems. Uncertainty of successful results, particularly for PAHs. Requires detailed design, pilot trials and management. Not suitable for metals and asbestos contamination.	**Possible** This option may be adopted as a contingency where amenable soil contamination is identified at depths where ex-situ treatment is not practical or warranted.

Remediation methodology	Description	Advantages	Disadvantages	Suitability
Cap and containment	Risk minimisation approach where impacted soils are managed on-site by capping the ground surface with a clean, impermeable layer of fill material.	Effectively removes risk to human health by eliminating exposure pathways.	Importation of capping materials. Contamination would remain in situ allowing potential off-site migration of contamination and impacts on groundwater. Would pose limitations on land use options. Requires additional earthworks to create spaces for containment. Requires a long-term Environmental Management Plan and ongoing monitoring.	**Possible** While this approach is not in line with one of the remediation goals (remediating the site to an extent that a long-term environmental management plan is not required), this approach may be used as contingency should contaminants cannot be removed from the site or destroyed on site.
Excavation and off-site disposal	Excavate impacted materials. Transport directly to a licensed landfill facility. Re-instate site with imported clean fill material if required.	Fast – impacted material removed immediately, significantly reducing potential for impact to groundwater. No storage or treatment problems. Reduced vapour/odour issues as impacted materials removed from site. Minimal design and management costs. Compatible with the proposed development (soil removal is part of the development scope).	Transfer of waste to another location (licensed waste facility). High costs associated with the disposal of waste soils and importation of clean backfill Requires waste classification prior to disposal, keeping of thorough waste records, waste tracking and reporting. Sustainability issues related with disposal to landfill.	**Suitable** This approach is compatible with the proposed development and allows speedy removal of contamination sources from the site.
Monitored Natural attenuation	Allowing the contaminants to biodegrade naturally following removal of the contamination source.	No remedial excavation of site. Retains materials on site. Sustainable, cost effective remediation method.	Slow process. Potential for contamination to further impact on the groundwater aquifer and nearby environmental receptors. Would require Environmental Management Plan and ongoing monitoring until contamination is proved reduced to an acceptable level.	**Possible** This method may be adopted as a contingency where active clean-up of the site is not feasible.

5.3 Preferred remediation option

Based on the technology review outcomes, the preferred remedial option for the site is:

- Decommissioning and removal of the UPSS and other associated infrastructure;
- Remedial excavation of hydrocarbon contaminated soils in the vicinity of UPSS and validation of the excavation limits;
- Further investigation to close identified data gaps. This will involve groundwater investigation, delineation assessment for the identified asbestos impact near BH2 and further fill and soil characterisation to enable waste classification;
- Remediation of asbestos-impacted soils by remedial excavation and validate the excavation limits;
- Waste classification and off-site disposal of spoils from remedial excavations that are not suitable for on-site reuse;
- Waste classification and off-site disposal of surplus soils from bulk excavation of the site; and
- Use of on-site bioremediation, in-situ treatment, cap and containment, and /or monitored natural attenuation as contingency measures for residual contamination (if required).

5.4 Site preparation, license and approvals

5.4.1 Consent requirements

In accordance with SEPP 55 (1998) – *Remediation of Land*, the category of remediation works defines whether consent is required prior to the commencement of the works. Under SEPP 55, works where there is the potential for significant environmental impact are classed as Category 1 works and require development consent. Category 2 works pose a low potential for environmental impact and do not therefore require prior standalone consent. The determination for the subject site is outlined in **Table 5-2**.

Table 5-2 Remediation works category determination

Significant Environment Impact	Yes/No	Category
Designated Development or State Significant Development	No	2
Critical or threatened species habitat	No	2
Have significant impact on threatened species, populations, ecological communities or their habitats	No	2
In area identified environmental significance such as scenic areas, wetlands (see list*)	No	2
Comply with a policy made under the contaminated land planning guidelines by the council.	Yes	2
Is work ancillary to designated development	Yes	2

Notes:
* Environmental significance list -coastal protection, conservation or heritage conservation, habitat area, habitat protection area, habitat or wildlife corridor, environment protection, escarpment, escarpment protection or escarpment preservation, floodway, littoral rainforest, nature reserve, scenic area or scenic protection, or wetland.

Based on the above assessment the remediation works for the site are considered as Category 2 remediation works and will not require separate development consent. Category 2 works do however require notification to the consent authority; therefore, Council should be notified 30 days before commencement of the works. The 30-day limit does not prevent Council intervention after that time for a breach of the *Environmental Planning and Assessment Act 1979* or non-compliance with SEPP 55. The notification also serves as the basis for updating Council records on properties in the local government area and must:

- Be in writing;
- Provide contact details for the notice;
- Briefly describe the remediation work;
- Show why the work is considered Category 2 remediation work;
- Specify the property description and street address on which the remediation work is to be carried out;
- Provide a location map; and
- Provide estimates for commencement and completion dates of the work.

Provision of this RAP, as well as an indication of commencement and completion dates of the works in writing, is usually sufficient to meet the requirements of this notification.

5.4.2 Development consent & control plans

All works should be in accordance with the Inner West Council Development Control Plan and any development consent issued by Council for the development.

5.4.3 Other licence requirements

The appointed site contractor should prepare an appropriate Construction Environmental Management Plan (CEMP), health and safety plans and other plans required by the Council DA and DCPs. Where asbestos removal is required, the contractor must be appropriately licensed to perform such works.

6. Remediation works

6.1 Remediation strategy

Following approvals and site establishment, the main site remediation works will include, but not be limited to:

- Stage 1 – Site preparation and hazardous materials survey
- Stage 2 – Building demolition
- Stage 3 – UPSS decommissioning, remedial excavation and validation
- Stage 4 – Groundwater investigation
- Stage 5 – Data gap closure soil investigation
- Stage 6 – Remediation of asbestos-impacted soils
- Stage 7 – Waste classification and bulk excavation
- Stage 8 – Site validation
- Stage 9 – Validation report preparation

Contingent action

Should unexpected finds be discovered during the course of site remediation, or if any phase of validation assessment identify residual contamination requiring additional remediation, then the Unexpected Finds Protocol (**Section 7.6**) and the Validation Plan (**Section 8**) will be implemented, until the site remediation goals have been achieved and the site is deemed suitable for the intended land use.

6.2 Remediation methodology

6.2.1 Stage 1 – Site preparation

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

The site itself will be prepared in accordance with the requirements of the Site Management Plan outlined in **Section 7**. Establishment of environmental controls, site access, security, fencing, warning signage and preparation of a Health Safety and Environment Plan is required prior to works commencement. A project plan should also be developed to outline engineering design for excavation support (if required), water treatment requirements and design, staging of excavation works, stockpiling, waste stabilisation, waste material loading, traffic management and waste tracking.

As part of the site preparation phase, a remediation workshop should be conducted with the appointed contractors and environmental consultant, to develop remedial measures, excavation plans and environmental management requirements. The site contractor is to prepare a staging or project plan that outlines the basic stages of the remediation works. The staging plan should include, but not be limited to:

- Staging of areas to be excavated;
- Areas designated for waste segregation, screening and storage (stockpiling), amenities, soil and groundwater treatment (if required);

- Truck movement to allow loading to mitigate impacts to surrounding land users and council infrastructure; and
- Proposed environmental mitigation measures.

A Hazardous Materials Survey (HAZMAT survey) is to be undertaken on site structures prior to any demolition activities. The HAZMAT survey should identify the hazardous building products used in site structures, including asbestos-containing materials. The survey report should outline the procedures and management measures required for removing the identified hazardous materials.

6.2.2 Stage 2 – Building demolition

All demolition works should be undertaken by suitably qualified licensed contractors, in accordance with NSW SafeWork regulations, with appropriate environmental management and occupational health and safety plans, monitoring and systems in place. The demolition, management and subsequent waste disposal works should include:

- Mobilisation to site (including community consultation);
- Institution of environmental controls and monitoring locations;
- Implementation of site security arrangements;
- Assessment, removal and disposal of asbestos containing materials;
- Demolition of buildings to ground level;
- Installation of temporary retention systems and diversion of underground services (such as the sewer or other utilities)
- Segregation and stockpiling of concrete;
- Recycling of reusable demolition materials;
- Site monitoring;
- Removal and disposal of rubbish;

All identified asbestos containing materials should be removed prior to demolition works commencing. Removal of non-friable and friable asbestos should be undertaken in accordance with NSW SafeWork *Asbestos at Work (http://www.safework.nsw.gov.au/health-and-safety/safety-topics-a-z/asbestos/asbestos-at-work)*, the Safe Work Australia *How to Safely Remove Asbestos: Code of Practice 2011 of non-friable asbestos* and the Hazardous Materials Survey report to be prepared for the site. Appropriately licenced asbestos removal contractors (under the *WHS Act and Regulations 2011*) should be engaged for asbestos removal works, and notifications should be submitted to NSW SafeWork prior to site works.

After site demolition but prior to removal of the concrete surface cover, a thorough walkover inspection of the site should be undertaken by a qualified person to confirm the site surface is free of hazardous building products, including residual Asbestos-Containing Materials (ACM) from demolition activities.

It is recommended that the existing concrete hardstand be retained at this stage, which may be used for temporary storage of the excavated UST and stockpiles from remedial excavations.

6.2.3 Stage 3 – UPSS decommissioning, remedial excavation & validation

UPSS decommissioning

One UST was identified at the site at the location outlined in **Figure 2**. The UST and other yet-unidentified associated infrastructure (e.g. additional UST, fuel feed lines, bowser foundations, vent pipes etc.) will require decommissioning and removal as part of the site remediation program.

The proposed decommissioning procedure is described below:

- Any liquid remaining in the UST (e.g. residual fuel and flammable liquids, or fuel/solvent/water mixtures) should firstly be drained, and classified for disposal purposes as defined in NSW EPA (2014d). The liquid waste should be removed from site by a licensed liquid waste transporter and disposed to a suitably licensed liquid waste facility. The contractor shall provide appropriate documentation for waste disposal.
- A SafeWork licensed and experienced tank removal contractor must be engaged to manage the tank and infrastructure removal process. UPSS decommissioning should be carried out in accordance with Australian Standard for the removal and disposal of underground petroleum storage tanks (AS4976 – 2008), SafeWork guidelines and the Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2014 (NSW EPA, 2014a).
- SafeWork NSW should be notified within 7 days of the removal of UPSS.
- The contractor should record the condition of the UST and associated infrastructure, and provide documentary evidence on destruction of the UST for final validation report.

Remedial excavations

Following UPSS removal, contaminated soils may be found in the vicinity of the UST footprint. Such materials will require separate management from the remainder of the site via remedial excavations. Materials that are unsuitable or not proposed for on-site reuse are to be classified and dispose off-site to appropriately licensed facilities.

The general procedure for remedial excavation is described below:

1. Any underground infrastructure, residual product and liquid in the excavation area should be removed in accordance with the UPSS decommissioning procedure described above. Localised deep excavations (sumps) may be created within the area to allow any perched water to drain to the sumps. The accumulated liquid will be removed by an appropriately licenced liquid waste removal contractor for appropriate disposal and /or recycling, after on-site treatment (if necessary);
2. “Chase-out” excavation of walls and base of the area, with regular field screening of soil headspace samples using a calibrated Photo-ionisation Detector (PID). Materials exhibiting unusual odour, staining and / or PID reading > 30 ppm will be stockpiled separately for waste classification. Excavation should not jeopardise the stability of adjoining properties and structures. The open excavation pits should be clearly demarcated with star pickets and tapes.
3. “Chase-out” excavation should continue until all walls and base of the excavation are observed to be free of odour and staining, and PID reading of soil headspace sample are less than 30 ppm. Validation samples for laboratory analysis will be collected from the base and side walls of the excavation in accordance with NSW EPA (2014a) *Technical Note: Investigation of Service Station Sites.* Further details on validation are discussed in **Section 8.**
4. Spoils from remedial excavations are to be stockpiled separately from other site fill / soils, for *ex-situ* waste classification assessment. General management requirements of stockpiles on site are described in **Section 7.2**.
5. Stockpiles resulting from remedial excavations will be visually inspected, sampled and analysed for material characterisation in accordance with Schedule B2 in NEPM (2013) at the following frequency:

- For stockpiles < 250 m^3, collection of one sample per 25 m^3 of stockpiled materials. A minimum of three samples will be collected for any stockpile.
- For stockpiles > 250 m^3 but < 2,000 m^3 in size, a statistical analysis approach may be used with the collection of minimum 10 samples.

Analytical suite will include:

- Eight priority metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc); TRH; BTEX; PAH; OCP; OPP; PCB and asbestos, and any additional contaminants of concern that may be identified during site remediation.

6. Stockpiles should either be waste classified in accordance with NSW EPA (2014d) *Waste Classification Guidelines* for off-site disposal, or validated as suitable for reuse on site;
7. Waste classification certificates will be prepared for stockpiles to be disposed off-site. Waste disposal documentation will be maintained by the site contractor and provided to the environmental consultant for reporting purposes.

6.2.4 Stage 4 – Groundwater investigation

A groundwater monitoring event (GME) should be undertaken in order to assess the groundwater conditions at the site and inform any additional remediation and management measures that may be required. Groundwater investigation should be conducted prior to the commencement of site bulk excavation or dewatering works (if required).

A Sampling, Analytical and Quality Plan for this groundwater investigation is provided in **Table 6-1**.

Table 6-1 SAQP for groundwater investigation

Item	Description
Proposed investigation location and methodology	The groundwater investigation will include at least three groundwater monitoring wells at the following locations: ▪ One existing monitoring well BH1/GW1 installed by Aargus adjacent to the UST. A replacement monitoring well will need to be installed should the existing installation be destroyed prior to investigation; ▪ One near the north-western site boundary; ▪ One near the south-eastern site boundary; The three proposed locations are also indicated on **Figure 3**. If any other UPSS are identified on site, additional monitoring well(s) will be installed downgradient to the infrastructure to assess potential impact to groundwater. These monitoring wells should be installed to sufficient depths for assessment of potential impact from the UPSS on site. Nominally the wells will have 2 m of the screening interval set below groundwater table and 1 m of the screening interval set above the water table. The new monitoring wells should be constructed and sampled in accordance with NSW EPA endorsed standards, such as *Groundwater Sampling Guidelines* (VIC EPA, 2000). Low-flow groundwater sampling method should be used where possible.

Item	Description
Rationale	Groundwater at the site is inferred flowing northerly to north-westerly based on local topography. The proposed sampling program was derived on the basis of the following: ▪ The wells near the north-western boundaries are located downgradient of the identified UST footprint and near the downgradient site boundary, which allow assessment of groundwater quality as existing the site, and potential influence from the site and UPSS. ▪ The well located near the south-eastern boundary is located near the inferred up-gradient boundary, which enables evaluation of groundwater quality as entering the site and provides information on the likely regional background levels; ▪ The three proposed monitoring locations will allow confirmation of groundwater flow direction. ▪ The proposed screening intervals will allow observations of light non-aqueous phase liquid (LNAPL) if exists.
Well development	All newly constructed monitoring wells should be developed prior to sampling in accordance with *Groundwater Sampling Guidelines* (VIC EPA, 2000).
Groundwater analytical suite	8 priority metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc); TRH; BTEX; VOC including CVOCs and total phenols.
Sample handling, transport and tracking	▪ Sample containers will be labelled with individual and unique identification including Project No., Sample No., date and time of sampling; ▪ Collected sample will be stored in chilled, enclosed and secure containers for transport to laboratories; and ▪ Chain of custody documentation should be completed to ensure that sample tracking and custody can be cross-checked at any point in the transfer of samples from the field to the environmental laboratory.
Sample containers & holding times	Sample handling, transportation and tracking should be in accordance with NEPM (2013) and typically will comprise: ▪ TRH ($>C_{10}$-C_{40}) and phenols – 1 litre amber glass / acid-washed and solvent-rinsed bottle / refrigeration 4°C / 7 days ▪ TRH (C_6-C_{10}), VOCs and BTEX – two, 40ml glass vials / pre-preserved with dilute hydrochloric acid, Teflon-sealed / refrigeration 4°C / 14 days; and ▪ Metals – one, 250mL, HDPE bottle / pre-preserved with dilute nitric acid (1 mL) / refrigeration 4°C / 6 months. Samples for metals analysis will be field filtered with 0.45 µm pore-size filters.
Field QA/QC sampling	Appropriate sampling procedures will be undertaken to prevent cross contamination, in accordance with NEPM (2013) and VIC EPA (2000) *Groundwater Sampling Guidelines*. Field QA/QC sampling will include one pair of intra-laboratory and inter-laboratory duplicates to be tested every 20 primary samples (5% duplicate ratio), as well as VOC trip blank and trip spike samples and equipment wash (rinsate) blank sample per sample batch.
Laboratory quality assurance and quality control	All samples will be analysed by NATA-accredited laboratories. The contract laboratory will conduct in-house QA/QC procedures involving the routine analysis of: ▪ Method blanks; ▪ Spike recoveries; ▪ Laboratory duplicates; ▪ Calibration standards and blanks; ▪ QC statistical data; and ▪ Control standards and recovery plots.
Achievement of data quality objectives and indicators	Data quality indicators to be achieved are listed in **Table 6-3**. An assessment of the overall data quality should be presented in the final validation report, in accordance with the DEC (2006) *Guidelines for the NSW Site Auditor Scheme*.

Subject to the findings from this groundwater investigation, installation of additional monitoring wells and further groundwater assessment may be necessary to achieve site validation.

6.2.5 Stage 5 – Data gap closure soil investigation

A number of data gaps related to site soils (outlined in **Section 3.4**) will require closure. The data gap investigation will be carried out after remediation of the UPSS area and demolition of the site-wide concrete hardstand, to minimise potential cross contamination and enable access to areas of environmental concern. Results from the data gap investigation will also be utilised for in-situ waste classification assessment of surplus soils from site excavation for off-site disposal.

A SAQP for the proposed soil investigation and waste classification is provided in **Table 6-2**.

Table 6-2 SAQP for supplementary soil investigation and waste classification

Item	Description
Soil investigation methodology	After removal of the concrete surface cover, a thorough walkover inspection of the site should be undertaken by a qualified environmental consultant to assess for potential presence of residual Asbestos-Containing Materials (ACM) in soil. Should asbestos be identified, the asbestos assessment procedure described in **Section 7.6** should be followed. Soil investigation will be by test pitting to enable inspection of the subsurface soil profile.
Soil investigation locations	Proposed soil sampling locations are shown in **Figure 3**. A total of 7 additional sampling locations are proposed, to be distributed in a systematic grid pattern across the site. Variation of sampling locations may be required due to site access constraints at the time. Such variations should be documented and reported in the final site validation report.
Investigation Depth	The investigation should extend to a minimum of 0.5 m into natural soils. Soil samples will be collected from both fill and natural soil horizons at each location. Samples will be collected from each distinct fill layer, within natural soils immediately below the fill/natural soil boundary, and/or at every 1 m within each layer.
Rationale	The proposed sampling design aims enable delineation of the identified asbestos impacts near BH2, by increasing soil sampling density at the site and inspection of subsurface profile during test pitting. The additional 7 samples along with the previous 7 investigation boreholes by Aargus will achieve twice of the minimum sampling density for the site (WA DOH, 2009).
Analytical suite	▪ All soil samples should be field screened for soil vapour with a calibrated Photo-ionisation Detector (PID), or analysed in laboratory for VOCs. ▪ Samples exhibiting high PID readings will be analysed in the laboratory for VOCs. ▪ **Analytical suite to be used for fill samples are**: Eight priority metals (arsenic, cadmium chromium, copper, lead, mercury, nickel and zinc), TRH, PAH, BTEX, OCP, OPP, PCB, total phenols and Asbestos (presence / absence screening). ▪ **Analytical suite to be used for natural samples are**: Eight priority metals (arsenic, cadmium chromium, copper, lead, mercury, nickel and zinc), TRH, PAH, BTEX, total phenols and Asbestos (presence / absence screening). Additional chemicals of concern identified during site remediation may be added to the above suite. Selected natural soil samples will be analysed in laboratory, subject to investigation findings in the overlying fill horizon.

Item	Description
Sampling, handling, transport and tracking	▪ Stainless steel sampling equipment or disposable gloves dedicated to each sampling locations will be used; ▪ All sampling equipment to be washed in a 3% solution of phosphate free detergent (Decon 90), followed by a rinse with potable water prior to each sample being collected. ▪ Direct transfer of the sample into new glass jars or plastic bags is preferred, with each jar and plastic bag individually sealed to eliminate cross contamination during transportation to the laboratory; ▪ Label sample containers individually with unique identification including Project No., Sample No., Sampling depth, date and time of sampling; ▪ Place sample containers into a chilled, enclosed and secure container for transport to the laboratory; and ▪ Provide 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 the environmental laboratory.
Sample containers & holding times	▪ Metals – 250g glass jar / refrigeration 4ºC / 6 months (maximum holding period); ▪ TRH, BTEX, Phenols, PAHs, OCPs, OPPs, and PCBs – 250g glass jar / refrigeration 4ºC / 14 days (maximum holding period); ▪ Asbestos – double resealable plastic (polyethylene) bags / no refrigeration / indefinite holding time.
Field QA/QC sampling	Appropriate sampling procedures will be undertaken to prevent cross contamination, in accordance with EI's Standard Operating Procedures Manual. Field QA/QC will include one pair of intra-laboratory and inter-laboratory duplicates to be tested every 20 primary samples (5% duplicate ratio), as well as one VOC trip blank, one VOC trip spike and one equipment wash (rinsate) blank sample per sample batch. No QA/QC samples are required for asbestos sampling.
Laboratory quality assurance and quality control	All samples will be analysed by NATA-accredited laboratories. The contract laboratory will conduct in-house QA/QC procedures involving the routine analysis of: ▪ Method blanks; ▪ Spike recoveries; ▪ Laboratory duplicates; ▪ Calibration standards and blanks; ▪ QC statistical data; and ▪ Control standards and recovery plots.
Achievement of data quality objectives and indicators	Data quality indicators to be achieved are listed in **Table 6-3.** An assessment of the overall data quality should be presented in the final validation report, in accordance with the DEC (2006) *Guidelines for the NSW Site Auditor Scheme*.

Upon review of the data gap closure investigation results, if additional contamination requiring remediation is identified, the remedial contingencies outlined in **Section 6.5** should be adopted.

In addition, a program of acid sulfate soils investigation should be undertaken by an appropriately qualified consultant prior to site excavation and dewatering works, in order to:

- Confirm the presence or absence of acid sulfate soils at the site; and
- Inform the selection and implementation of any necessary management measures for acid sulfate soils during site redevelopment.

6.2.6 Stage 6 – Remediation of asbestos-impacted soils

Asbestos contaminated soils at former borehole BH2 and any other areas where asbestos-impacted soils that may be identified post concrete slab removal and in the data gap closure investigation will be remediated and validated, with strict adherence to *Managing Asbestos In or On Soil* (WorkCover, 2014). The adopted approach will include the following tasks:

1. Isolation of impacted soils by placement of warning tape around areas of asbestos contamination;
2. Selective excavation of asbestos-impacted soils using small machinery and appropriate dust controls during excavation and truck loading, with asbestos air monitoring as required;
3. Removal of all asbestos contaminated waste from site to suitably licensed waste facilities by Licensed Asbestos Removal Contractor, in accordance with the Waste Regulations (NSW EPA, 2014b); and
4. A validation assessment to confirm that all asbestos-contaminated fill has been effectively removed from the site. Validation will include a detailed site inspection of the exposed ground surface by a competent environmental consultant after the completion of remediation works, to assess for evidence of visible contamination, such as asbestos. The inspection will be undertaken in accordance with the NEPM (2013) requirements for a detailed asbestos site inspection.
5. If fill materials will be retained on site post site remediation, these fill materials will be validated in accordance with **Section 8** for asbestos impact.

6.2.7 Stage 7 – Waste classification and bulk excavation

Waste classification

One or more waste classification(s) may be established for materials to be removed from the site, subject to findings of the proposed additional soil investigation. Materials of different waste classifications should be kept separate throughout the process of excavation, stockpiling, load out and transportation in accordance with the POEO (Waste) Regulation 2014 (NSW EPA, 2014b). A waste classification certificate will be prepared for materials of different classification classes to enable off-site disposal to appropriately licensed waste landfill facilities.

If materials contain concentrations that exceed the disposal guidelines for *Restricted Solid Waste* (i.e. the materials are classifiable as *Hazardous Waste*), they will be isolated and held on-site pending the determination of alternative disposal arrangements and/or on-site treatment. If required, disposal consent will be sought from NSW EPA prior to transport. Contingency measures to handle and manage the disposal of materials that fail to meet landfill threshold criteria are provided in **Section 6.5**.

If stockpile sampling for waste classification is required (such as in cases where additional remedial excavations are necessary), sampling will be conducted in accordance with the following procedure:

- For stockpiles < 250 m^3, collection of one sample per 25 m^3 of stockpiled materials. A minimum of three samples will be collected for any stockpile.
- For stockpiles > 250 m^3 but < 2,000 m^3 in size, a statistical analysis approach may be used with the collection of minimum 10 samples.

  Analytical suite will include:
- Eight priority metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc); TRH; BTEX; PAH; OCP; OPP; PCB and asbestos, and any additional contaminants of concern that may be identified during site remediation. Samples will be field screened for soil vapour with a calibrated Photo-ionisation Detector (PID), or analysed in laboratory for VOCs. Samples exhibiting high PID readings will be analysed in the laboratory for VOCs.
- Sample handling, transportation, tracking procedure and sample containers to be used will be in accordance with **Table 6-2**.

- No QA/QC samples are required for stockpile waste classification sampling.

Bulk excavation

After determination of waste classifications, the classified materials will be excavated and loaded out directly for offsite disposal to appropriately-licensed waste land fill facilities. Where temporary stockpiling is required, the material handling and management requirements in **Section 7.2** should be followed.

In accordance with the Waste Regulation (NSW EPA, 2014b), waste movements will be tracked and disposal receipts (dockets) will be maintained by the appointed contractor and copies are to be provided to the environmental consultant for final reporting purposes.

6.2.8 Stage 8 – Site validation

Remedial excavations

After completion remedial excavations, the excavated area will be validated in accordance with the validation plan outlined in **Section 8**. Where results of the validation samples fail the adopted remediation criteria, this will trigger further chase-out excavations until all validation results on final excavation limits meet the adopted site validation criteria.

Additional spoil from the chase-out excavations will be stockpiled and assessed for waste classification, followed by off-site disposal in accordance with the procedure outlined in **Section 6.2.7**.

Imported backfill soils

Should reinstatement of remedial excavations require importation of backfill soils from offsite source(s), the imported backfill materials must be certified as meeting the NSW EPA Virgin Excavated Natural Material (VENM) classification, prior to importation to the site. To deem soils suitable for reuse on the subject site, the following confirmation procedure should be undertaken:

- All imported soils brought to the site should be certified as VENM by the supplier; and
- NO soil or rock is to be imported onto the site for backfilling purposes, unless the supporting documentation is approved, and the materials are inspected by the appointed Environmental Project Manager.
- Where certification cannot be provided, the imported materials must be validated in accordance with the procedure outlined in **Section 8**.

6.2.9 Stage 9 – Validation report preparation

A site validation report will be prepared in accordance with the NSW EPA (2011) *Guidelines for Consultants Reporting on Contaminated Sites* and NSW DEC (DEC, 2006) *Guidelines for the NSW Site Auditor Scheme*, as described in **Section 8.2**.

6.3 Data quality indicators

The Data Quality Indicators to be assessed in additional groundwater and soil investigations are outlined in **Table 6-3**.

Table 6-3 Data quality indicators (additional investigations)

QA/QC Measures	Data Quality Indicators
Precision – A quantitative measure of the variability (or reproducibility) of data	Data precision will be assessed by reviewing the performance of field duplicate sample sets, through calculation of relative percentage differences (RPD). Data precision will be deemed acceptable if RPDs are found to be less than 30%. RPDs that exceed this range may be considered acceptable where: ▪ Results are less than 10 times the limits of reporting (LOR); ▪ Results are less than 20 times the LOR and the RPD is less than 50%; or ▪ Heterogeneous materials or volatile compounds are encountered. In cases where RPD value is considered unacceptable, the analytical results of primary and duplicate samples will be both reviewed against the adopted assessment criteria. If the review indicates the variations in data between the primary and duplicate samples will result in a different conclusion (i.e. the higher concentration is failing the assessment criteria), the higher concentration will be used for assessment.
Accuracy – A quantitative measure of the closeness of reported data to the “true” value	Data accuracy will be assessed through the analysis of: ▪ Field trip blank samples to assess potential cross contamination; ▪ Laboratory method blanks, which are analysed for the analytes targeted in the primary samples; ▪ Laboratory matrix spike and matrix spike duplicate sample sets; ▪ Laboratory control samples; ▪ Calibration of instruments against known standards; and ▪ Variation in results reported by the primary and secondary laboratories for primary and duplicate samples.
Representativeness – The confidence (expressed qualitatively) that data are representative of each medium present onsite	To ensure the data produced by the laboratory is representative of conditions encountered in the field, the following QA/QC assessment will be carried out: ▪ Field trip spike samples to assess potential volatile loss during sample transportation. The acceptance criterion is 70% - 130% recovery for trip spike samples; ▪ Blank samples will be run in parallel with field samples by the laboratory to confirm there are no unacceptable instances of laboratory artefacts; ▪ Review of relative percentage differences (RPD) values for field and laboratory duplicates to provide an indication that the samples are generally homogeneous, with no unacceptable instances of significant sample matrix heterogeneities; ▪ The appropriateness of collection methodologies, handling, storage and preservation techniques will be assessed to ensure/confirm there was minimal opportunity for sample interference or degradation (i.e. volatile loss during transport due to incorrect preservation / transport methods); and ▪ Consistency between field vapour screening information and laboratory results.
Completeness – A measure of the amount of useable data from a data collection activity	Analytical data sets acquired during the assessment will be evaluated as complete, upon confirmation that: ▪ Standard operating procedures for sampling protocols are adhered to; ▪ Copies of all COC documentation are presented, reviewed and found to be properly completed; ▪ It can therefore be considered whether the proportion of “useable data” generated in the data collection activities is sufficient for the purposes of the land use assessment; and ▪ The actual sampling densities are generally consistent with the densities proposed in the RAP.

QA/QC Measures	Data Quality Indicators
Comparability – The confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event	Given that a reported data set can comprise several data sets from separate sampling episodes, issues of comparability between data sets are reduced through adherence to standard operation procedure and regulator-endorsed or published guidelines and standards on each data gathering activity. ▪ Sampling to be conducted by the same sampler where possible to enhance project continuity and minimise variability in sampling technique; ▪ Standard operation procedures will be adhered to; ▪ Sampling under inclement weather conditions to be avoided to minimise variability contributed by weather conditions; ▪ In addition, the data would be collected by experienced samplers and NATA-accredited laboratory methodologies would be employed in all laboratory testing programs.

6.4 Remediation schedule

An estimated schedule for the proposed remedial works is provided in **Table 6-4**. The proposed schedule is based on the remedial works outlined in this RAP and is dependent on Council approval of any DA and conditions of consent.

Table 6-4 Indicative site remediation schedule

Timeframe	Action
30 days prior to commencement	Notification to be submitted to the local council for intention to start site remediation.
Week 1/2	Stage 1 – site preparation and hazardous materials survey
Week 3/4/5	Stage 2 – building demolition
Week 6/7/8	Stage 3 – UPSS decommissioning, remedial excavation and validation Stage 4 – groundwater investigation
Week 9/10/11	Stage 5 – data gap closure soil investigation and waste classification
Week 12 to 20	Stage 6 – Remediation of asbestos-impacted soils Stage 7 – bulk excavation and removal of surplus fill and natural soils
Week 21	Stage 8 – site validation
Week 22 to 24	Stage 9 – validation report preparation

6.5 Remedial contingencies

Remedial contingencies may be required should the scenarios detailed in **Table 6-5** arise.

Table 6-5 Remedial contingencies

Scenario	Remedial Contingencies/Actions Required
Highly contaminated soils not identified during previous investigation are encountered	Follow the unexpected finds protocol as detailed in **Section 7.6** of this RAP. Work to be suspended until the Environmental Project Manager can further assess impacted soils/ materials and associated risks.

Scenario	Remedial Contingencies/Actions Required
Additional underground tanks are encountered at the site	Systems to be removed and the excavations appropriately validated and backfilled by experienced contractor. Tank removal works reported by appropriate environmental consultant in accordance with NSW EPA (2014c) *Technical Note: Investigation of Service Station Sites* and Australian Standard AS4976 (2008). Follow the unexpected finds protocol as detailed in **Section 7.6** of this RAP.
Highly impacted sludge's are uncovered	The leachability of heavy metals and hydrocarbons will need to be assessed before disposal options are considered. Follow the unexpected finds protocol as detailed in **Section 7.6** of this RAP.
Significant asbestos wastes are encountered	Work to be suspended and asbestos work removed by a suitably qualified contactor, in accordance with SafeWork regulations. Follow the unexpected finds protocol as detailed in **Section 7.6** of this RAP.
Residual soil impacts remain on-site	Review/assess soil conditions. Carry out site-specific second tier risk assessment (if required). Review/assess potential vapour hazard. If there is a vapour risk additional remedial measures may be required including installation of a vapour barrier or passive or active vapour extraction system.
Contaminated groundwater (including LNAPL or DNAPL) encountered	Review of groundwater conditions on site, may require further groundwater investigations / remediation and longer-term management plan. Any dewatering may require approval under the *Water Management Act 2000*. Preparation of an addendum to this RAP to outline additional remedial works required. Potential remedial measures may include source removal, natural attenuation, bioremediation, PSH recovery using active pumping (including hydraulic control), installation of a groundwater permeability barrier or similar or in-situ oxidation or stabilisation.
Groundwater contaminant plume is identified and is migrating off-site or there are increases in concentration due to increased infiltration (following demolition)	Review contaminant increase and analytes. Review active remediation alternatives (if necessary). Ensure down-gradient monitoring is undertaken. Carry out fate and transport modelling (if required) and assess the need for further action.
Contamination is identified near heritage items or significant trees (if identified)	Stop work. Review contaminant concentrations and risks to heritage items / flora. Assess human health and environmental risks if contamination remains in place. Review natural attenuation options.
Changes in proposed excavation depth and extent	Review the remediation works completed for the site.
Changes in proposed future land uses at the site	Review the remediation works completed for the site.

7. Site management

7.1 Responsibilities and contacts

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

Table 7-1 Site management responsibilities

Responsible Party	Details	Responsible for:
Principal project Manager (PPM)	Corvas Pty Ltd	▪ Overall management of the site remedial activities
Property owner	TBC	▪ Management of the site and associated remedial activities, particularly with respect to policy and operational procedures
Environmental management coordinator (EMC)/ Remediation supervisor	TBA	▪ Ensuring that the site remediation works are carried out in an environmentally responsible manner; ▪ Liaising between the appointed Environmental Consultant and Council providing regular updates and informing of any problems encountered; ▪ Ensuring that all environmental protection measures are in place and are functioning correctly during site remediation works; and ▪ Reporting any environmental issues to owner.
Demolition, Earthworks or Remediation Contractor	TBA	▪ Ensuring that all operations are carried out as identified in the RAP (demolition and remediation), as directed by the PPM and EMC; ▪ Inducting all employees, subcontractors and authorised visitors on procedures with respect to site works, WHS and environmental management procedures; ▪ Reporting any environmental issues to EMC; ▪ Maintaining site induction, site visitor and complaint registers; ▪ Ensuring that fugitive emissions and dust potentially leaving the confines of the site are suitably controlled and minimised; ▪ Ensuring that suspended matter or contaminants in water potentially leaving the site are minimised and suitably controlled, so as not to pollute the environment; ▪ Ensuring that vehicles are cleaned and secured so that no mud, soil or water are deposited on any public roadways or adjacent areas; and
Demolition, Earthworks or Remediation Contractor (cont.)	TBA	▪ Ensure that noise and vibration levels at the site boundaries comply with the legislative requirements.
Environmental Consultant	TBA	▪ Ensure that all operations are carried out as identified in the RAP (demolition and remediation); and ▪ Advise the Site Auditor should a scenario arise requiring deviation from the procedures and requirements detailed in this RAP.

Responsible Party	Details	Responsible for:
Qualified Independent Consultant	TBA	▪ Reviewing proposed remediation strategies and ensuring remediation is technically feasible, environmentally justifiable and consistent with relevant legislation and guidelines; ▪ Review of actions taken demolition, earthworks or remediation contractor; ▪ Ensure all works have complied with the RAP and remedial procedures.

7.2 Materials handling and management

Table 7-2 summarises the measures that should be implemented in respect of materials handling during excavation and remediation works at the site.

Table 7-2 Materials handling and management requirements

Item	Description/ requirements
Earthworks contractors	Excavation of fill materials should be completed by a suitably qualified contractor to ensure: ▪ All site staff are aware of the environmental and health and safety requirements to be adhered to; ▪ There is no discernible release of dust into the atmosphere as a consequence of the works; ▪ There is no discernible release of contaminated soil into any waterway as a consequence of the works; and ▪ There are no pollution incidents, health impacts or complaints.
Stockpiling of materials	All stockpiles will be maintained as follows: ▪ Stockpiles should be placed on sealed surfaces such as sealed concrete, asphalt, or high density polyethylene; ▪ If stockpiles are placed on bare soils, these soils should be placed on yet to be remediated areas. Contaminated materials should only be stockpiled in locations that do not pose any environmental risk (e.g. hardstand areas); ▪ Excavated soils should be stored in an orderly and safe condition (≤2m height); ▪ Stockpiles should be battered with sloped angles to prevent collapse. ▪ Stockpiles should be covered after being lightly conditioned by sprinkler to prevent dust blow and control odours; ▪ Should the stockpile remain on site for over 24 hours, silt fences or hay bales should be erected around each stockpile to prevent losses from surface erosion (runoff); and ▪ Stockpiles will be strategically located to mitigate environmental impacts while facilitating material handling requirements. ▪ Any soils with heavy staining and/or exhibiting odours are to be isolated from other excavated materials, for additional waste classification sampling and testing. ▪ Air emission controls should be developed in the Construction Environmental Management Plan for the site. For example, in areas impacted by hydrocarbon, a hydrocarbon mitigation agent such as BioSolve®, Pinkwater®, or Anotech (or equivalent product selected by the contractor) in combination with the fine mist spray should be deployed during disturbance and stockpiling of the materials. Regular boundary monitoring for air emission should be undertaken during remediation works.

Item	Description/ requirements
Loading of material	Loading of stockpiles / materials will be as follows: ▪ Transport of contaminated material off the site is to be via a clearly distinguished haul route designated by the site traffic management plan. ▪ Measures shall be implemented to ensure no contaminated material is spilled onto public roadways or tracked off-site on vehicle wheels. Such measures should include the use of a wheel washing/cleaning facility, placed before the egress point on the site, and should be able to handle all vehicles and plant operating on-site. ▪ Residue from the cleaning facility should be collected, and either dewatered on site in a contained/bunded area or disposed as a slurry to an approved facility. Such residue will be deemed contaminated unless proven otherwise.
Transport of materials	Prior to being assigned to an appropriate waste disposal facility, all waste fill/soils should be classified in accordance with the *Waste Classification Guidelines* (NSW EPA, 2014d). If prior immobilisation treatment of the waste soils is required, disposal consent will be obtained from the NSW EPA prior to spoil transport. ▪ All trucks transporting soils from the site are to be covered with tarpaulins (or equivalent). ▪ All haulage routes for trucks transporting soil, materials, equipment and machinery shall comply with all road traffic rules, minimise noise, vibration and odour to adjacent premises, utilise state roads and minimise use of local road. ▪ All deliveries of soil, materials equipment or machinery should be completed during the approved hours of remediation and exit the site in a forward direction. ▪ Removal of waste materials from the site shall only be carried out by a recognised contractor holding the appropriate EPA NSW licenses, consents and approvals. ▪ Waste must be transported less than 150 km from the source (NSW EPA, 2014b) and landfills are required to be licensed for the category of waste they are scheduled to receive.
Material tracking	Materials excavated from the site should be tracked from the time of their excavation until their disposal. Tracking of the excavated materials should be completed by recording the following: ▪ Origin of material; ▪ Material type; ▪ Approximate volume; and ▪ Truck registration number. Disposal locations will be determined by the remediation contractor. Disposal location, waste disposal documentation (weighbridge dockets) and the above listed information should be provided to the environmental consultant for reporting purposes.
Material visual inspection prior to validation sampling.	Following the completion of remedial works as specified within this RAP, the following applies: ▪ A suitably qualified environmental scientist should undertake a visual inspection of the work area. If visual observations indicate contamination, the earthworks contractors should rectify any issues arising from the inspection (i.e. further excavation or 'chasing out' until soils show no evidence of contamination based on visual inspection and/or odours); and ▪ Following satisfactory completion of the visual inspection, validation sampling of soils should be completed. Validation sampling is discussed in **Section 8**. Only following satisfactory validation, will remedial works be deemed as completed.

7.3 Management measures

All works should be undertaken with due regard to the minimisation of environmental effects and to meet all statutory environmental and safety requirements (**Section 7.5**). A CEMP should be developed for the site works by the site contractor/builder, which takes into account relevant guidance including, but not limited to:

- DA Conditions of Consent;
- Inner West Council Development Control Plan 2013; and
- Managing Urban Stormwater, Soils and Construction, Volume 1: 4th edition (March 2004) – often referred to as the 'blue book'.

Overall site management requirements related to the remedial works are presented in **Table 7-3**.

Table 7-3 Site management measures

Category	Measure
Demolition (including Asbestos Management if required)	Appropriate measures shall be taken to ensure that demolition works are completed in accordance with SafeWork Standards and Codes of Practice. Any asbestos identified within building materials should be managed in accordance with SafeWork Codes of Practice and Australian Standards.
Site Stormwater Management and Control	Appropriate measures shall be taken to ensure that potentially contaminated water does not leave the site. Such measures should include, but not be limited to: ▪ Diversion and isolation of any stormwater from any contaminated areas; ▪ Provision of sediment traps including geotextiles or hay bales; and ▪ Discharge of any water to drains and water bodies must meet the appropriate effluent discharge consent condition under the *Protection of the Environmental Operations Act 1997*.
Soil Management	Appropriate measures shall be taken to ensure soils are excavated using a methodology appropriate to reduce nuisance dust and odours from leaving the boundary, and are disposed of in accordance with the NSW Government *Protection of the Environment Operations (Waste) Regulation* (NSW EPA, 2014b).
Dust and Odour	Control of dust and odour during the course of the remediation works shall be maintained by the contractor to ensure no nuisance dust or odours are received at the site boundary according to requirements of Leichhardt DCP 2013. Action levels and specific control measures would be described in a site construction phase environmental management plan (CEMP) (prepared by the Contractor) and may include, but will not be limited to the following: ▪ Site wide water spraying, as and when appropriate, to eliminate wind-blown dust; ▪ Use of mist sprays, and/or sprinklers on stockpiles, fill screening areas and loaded fill to lightly condition the material; ▪ Use of tarpaulin or tack-coat emulsion or sprays to prevent dust blow from stockpiles or from vehicle loads; ▪ Covering of stockpiles or loads with polythene or geotextile membranes; ▪ Restriction of stockpile heights to ≤ 2m above surrounding site level; ▪ Ceasing works during periods of inclement weather such as high winds or heavy rain; and ▪ Regular checking of the fugitive dust and odour issues to ensure compliance with the CEMP requirements, undertaking immediate remedial measures to rectify any cases of excessive dust or odour (e.g. use of misting sprays or odour masking agent). EI notes the Council Contaminated Land Policy requires that "No odours shall be detected at any boundary of the site during remediation works by an authorised Council Officer relying solely on sense of smell." Should significant odours be detected, during site remediation, additional control measures for odour control may be required under the Leichhardt Municipal Council contaminated land policy, being: ▪ Use of appropriate covering techniques such as plastic sheeting to cover excavation faces; ▪ Use of fine mist sprays / hydrocarbon mitigation agent on the impacted areas/materials (Examples of mitigation agents include BioSolve® Pinkwater®,

Category	Measure
	or Anotech, however a similar product may be selected by the contractor); and ▪ Adequate maintenance of equipment and machinery to minimize exhaust emissions. Records of volatile emissions and odours shall be logged, kept on-site and made available to Council Officers on request.
Noise and Vibration	Noise and vibration will be restricted to reasonable levels. All plant and machinery used on site will be noise muffled to ensure that noise emissions do not breach statutory levels as defined within the Leichhardt DCP 2013.
Hours of Operation	Working hours will be restricted to those specified by Council's DA conditions.
Community Engagement	Community engagement should be carried out in accordance with Schedule B(8) of NEPM (2013). Prior to the commencement of any remediation works at the site, every owner and occupier of any land located either wholly or partly within 100 m of the boundary of the premises (including local council and the RMS) should be notified at least 30 days in advance. The notice should include: ▪ Advice of demolition & excavation work to be carried out on the premises; ▪ State the time and date such work is to commence; ▪ Indicate that the works are being conducted to minimise any risk of site contamination impacting on off-site receptors; ▪ Provide appropriate site signage at an easily readable location on the site fencing, including site contact name and phone number to be contacted should any matter arise; provide the phone number of a person present on the premises whilst remediation works are being undertaken; and ▪ Provide contact information and procedure for registering any complaints.
Incident Management and Community Relations	While various environmental management and occupational safety plans will be developed to protect human health and the environment, incidents may occur which pose a risk to the various stakeholders. To mitigate these risks and ensure that a suitable response is carried out quickly, a response plan to any incident that may occur on site should be prepared and various responsibilities assigned. The site health and safety plan and environmental management plan should document these procedures and responsibilities, and incident contact numbers should be maintained in an on-site register. All other relevant emergency contact numbers such as Police, Fire Brigade, and Hospital should be listed in the Health and Safety Plan and posted on-site for easy access.

7.4 Contingency management

Contingency plans for anticipated problems that may arise on-site during the course of the site preparation works comprising demolition and remediation are presented below in **Table 7-4.**

Table 7-4 Contingency management

Anticipated problems	Corrective actions
Chemical/ fuel spill	Stop work, notify above site project manager. Use accessible soil or appropriate absorbent material on site to absorb the spill (if practicable). Stockpile the impacted material in a secure location, sample and determine the appropriate disposal/treatment option.
Excessive Dust	Use water sprays to suppress the dust or stop site activities generating the dust until it abates.

Anticipated problems	**Corrective actions**
Excessive Noise	Identify the source, isolate the source if possible, modify the actions of the source or erect temporary noise barriers if required.
Excessive Odours/Vapours	Stage works to minimise odours/vapours. If excessive organic odours/vapours are being generated, stop work and monitor ambient air across site for organic vapours with a PID and odours at site boundaries. Implement control measures including respirators for on-site workers, use of odour suppressants, wetting down of excavated material. No nuisance odours shall be detected at any site boundary during remedial works. Should odour emissions be detected at or beyond the site boundary, it is recommended, as part of the CEMP and community consultation procedure, that the Remediation Contractor and the Principal Project Manager: ▪ Notify the owners and occupiers of premises adjoining and across the road from the site regarding potential odour issues. Notification should be in writing. This is also required by the Council Contaminated Land Policy; ▪ In the notification, as well as on street signage, provide contact details of the site personnel for anyone who may be concerned by odour emission during the remediation; ▪ Temporarily pause site works to allow for excess odour to subside to a level acceptable by off-site receptors, should it be necessary, after implementation of the above-listed control measures; and ▪ Record logs for volatile emissions and odours. Such records should be kept on-site and made available for inspection on request. In regard to off-site impact from petroleum vapour, EI notes that odour is generally detected at concentrations much lower than what will constitute a health-based risk. Measures listed above for odour control (**Table 7-3**) may also be applied for vapour control.
Excessive rainfall	Ensure sediment and surface water controls are operating correctly. If possible divert surface water away from active work areas or excavations.
Water in excavations	Collect samples and assess against relevant NSW EPA *Waste Classification Guidelines* (2014d) assessment criteria, to enable disposal options to be formulated.
Leaking machinery or equipment	Stop the identified leak (if possible). Clean up the spill with absorbent material. Stockpile the impacted material in a secure location, sample and determine the appropriate disposal/treatment option.
Failure of erosion or sedimentation control measures	Stop work, repair failed control measure.
Unearthing unexpected materials, fill or waste	Stop activities, contact the site project manager. Follow the unexpected finds protocol as detailed in **Section 7.6** of this RAP. Prepare a management plan if required, to address the issue.
Identification of cultural or building heritage items	Stop work and notify site project manager. Follow the unexpected finds protocol as detailed in **Section 7.6** of this RAP. Prepare action or conservation plan as required.
Equipment failures	Ensure that spare equipment is on hand at site, or that the failed equipment can be serviced by site personnel or a local contractor.
Complaint Management	Notify Client, Project Managers and Environmental Consultant (if required) following complaint. Report complaint as per management procedures. Implement control measures to address reason of complaint (if possible). Notify complainant of results of remedial actions.

7.5 Work health and safety plan

As required by the NSW Work Health and Safety Act 2011 and associated Regulations, a Work Health and Safety (WHS) Plan should be prepared by the Principal Contractor (see **Responsibilities and Contacts, Section 7.1**), to manage the health and safety of site workers and nearby residents, and address such issues as site security, exclusion zones, excavation safety, vibration, noise, odour and dust levels. The plan should address the risks during the remediation works and cover site specific requirements associated with the contaminants present within the site soils and groundwater.

The site officer responsible for implementing health and safety procedures should induct all site personnel so that they are aware of and comply with, the requirements of this document. It is the contractor's responsibility, with assistance from client/owner(s) of the site to ensure that all other permits, approvals, consents or licences are current. A brief summary of hazards and mitigation measures relevant to the remedial works in **Table 7-5.**

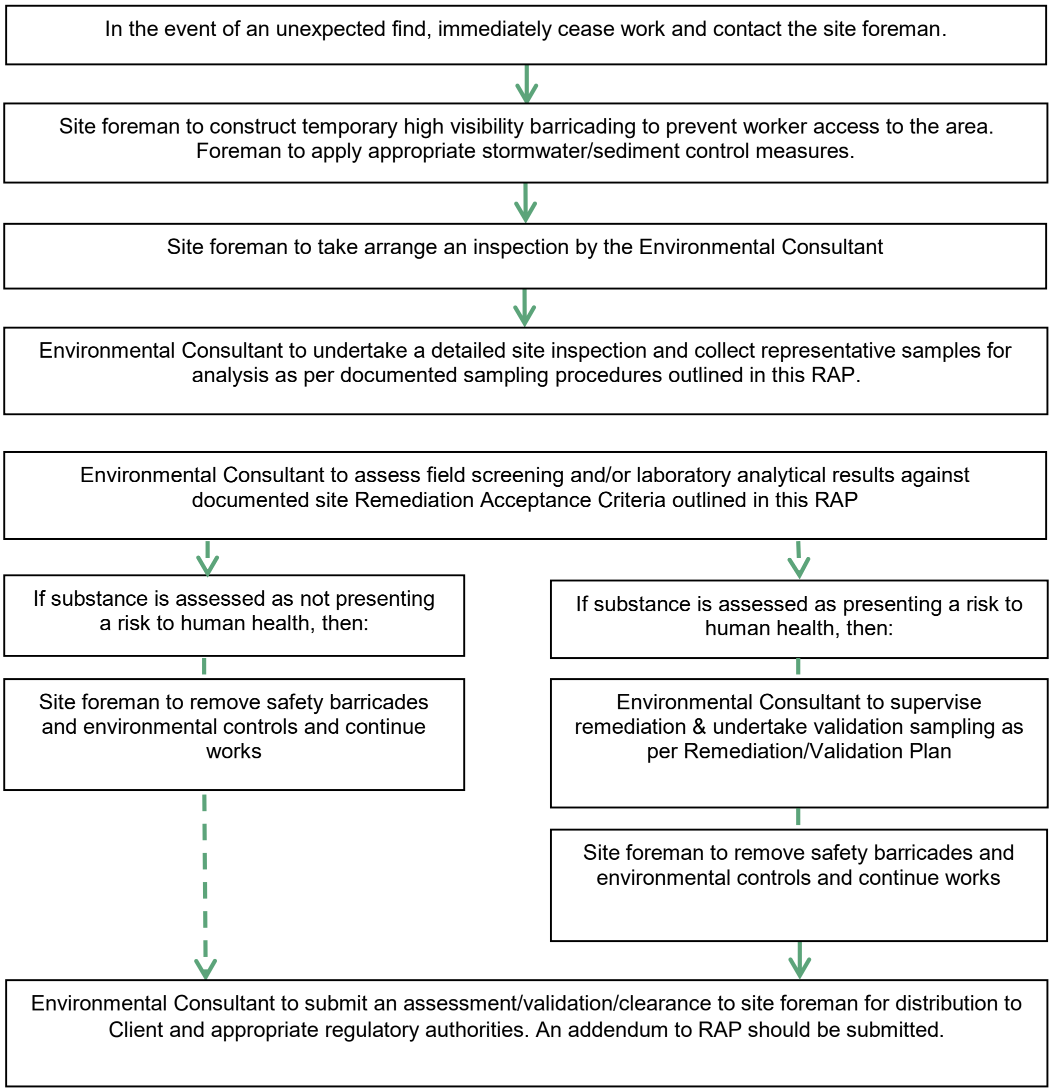
Table 7-5 Remedial hazards

Anticipated Problems	Corrective actions
Chemical Hazards	Contaminated sites have chemical compounds substances or materials that may present a risk to human health and the environment. Chemicals of concern and associated risks are detailed within the Conceptual Site Model, in **Section 3.3.** The site-specific WHS plan should set out controls to mitigate any potential risks.
Physical Hazards	The following hazards are associated with conditions that may be created during site works: ▪ Unstable excavations; ▪ Heat exposure; ▪ Buried services; ▪ Noise, vibration and dust; ▪ Fugitive emissions (strong odours, vapours); ▪ Electrical equipment; and ▪ The operation of heavy plant equipment.
Personal Protective Equipment and Monitoring	Personnel should, wherever possible, avoid direct contact with potentially contaminated material. Workers are to ensure that surface waters or groundwater is not ingested or swallowed and that direct skin contact with soil and water is avoided. Standard PPE with the addition of disposable P2 dust masks as specified for the contractor will likely be sufficient for the prescribed remedial works.

7.6 Unexpected finds protocol

Should unexpected finds be encountered, the approach in **Table 7-6** should be followed.

Table 7-6 Unexpected finds protocol



In the event of an unexpected find, immediately cease work and contact the site foreman.

Site foreman to construct temporary high visibility barricading to prevent worker access to the area. Foreman to apply appropriate stormwater/sediment control measures.

Site foreman to take arrange an inspection by the Environmental Consultant

Environmental Consultant to undertake a detailed site inspection and collect representative samples for analysis as per documented sampling procedures outlined in this RAP.

Environmental Consultant to assess field screening and/or laboratory analytical results against documented site Remediation Acceptance Criteria outlined in this RAP

If substance is assessed as not presenting a risk to human health, then:

Site foreman to remove safety barricades and environmental controls and continue works

If substance is assessed as presenting a risk to human health, then:

Environmental Consultant to supervise remediation & undertake validation sampling as per Remediation/Validation Plan

Site foreman to remove safety barricades and environmental controls and continue works

Environmental Consultant to submit an assessment/validation/clearance to site foreman for distribution to Client and appropriate regulatory authorities. An addendum to RAP should be submitted.

Contingent asbestos assessment procedure is described below:

Asbestos assessment procedure (if required):

In addition to the above, should additional asbestos impacts be identified in soil during site investigation and remediation, further assessment for asbestos should be carried out prior to disturbance of site soils. The assessment procedure is described below:

1. Follow the Unexpected Finds Protocol and notify the appointed Environmental Consultant;
2. The appointed consultant to design investigation program to delineate asbestos impacts in soil in accordance with relevant, EPA endorsed, asbestos assessment guidelines;
3. An Asbestos Management Plan to be prepared by the appointed remediation contractor for the remedial works program;
4. Areas impacted by asbestos should be segregated from the remainder of the site, and marked by prominent features that withstands weathering (e.g. star picket and danger tape);
5. Undertake separate waste classification assessments for areas impacted by asbestos and the remainder of the site;

6. Soils from asbestos-impacted areas will need to be excavated and disposed of separately from the remainder of the site. Should temporary stockpiling be required, the material handling and management requirements in **Section 7.2** should be followed;
7. Validate underlying materials after complete removal of asbestos-impacted soils on site. Validation samples should be analysed for asbestos using gravimetric method.

8. Validation sampling, analysis and quality plan

The remediation of the impacted soil areas will be deemed acceptable based on the achievement of the following validation objectives:

1. ***Remedial Excavations*** – Validation of the remedial excavations will continue to the extent of impacts, until concentrations in validation samples are within the *Soil Remediation (Validation) Criteria* (**Section 4.2**), or until the excavations reach the extent practicable;
2. ***Backfill Materials*** – Should backfilling be required, validation of imported fill materials used for backfilling will be required to verify their suitability for the proposed land use;
3. ***Groundwater*** – Concentrations in groundwater are to be validated as compliant with the adopted *Groundwater Remediation (Validation) Criteria* (**Section 4.3**), or (if exceeding) the regional background concentrations, or (if exceeding) demonstrated not constituting unacceptable human-health and ecological risks to both on and off site receptors.

8.1 Validation soil sampling methodology

Soil sampling and handling of the collected samples will be as described in **Table 8-1**.

Table 8-1 Validation sample collection and handling procedures

Action	Description
Sample collection	Soil validation samples will be collected directly from the exposed surface of excavation, or from the material brought to the surface by backhoes/excavator buckets. Sampling data should be recorded to comply with NEPM (2013) requirements.
Sampling frequency	***UPSS remedial excavations*** ▪ If UST is less than 4 m in length: One sample from beneath the centre of the UST and at least one sample from each of the four walls. ▪ If UST is between 4 – 10 m in length: One sample beneath each end of the UST footprint and two samples from each of the four walls ▪ If UST is > 10 m in length: One sample beneath each end of the UST footprint and three samples from each of the four walls. ▪ Validation of any yet-unidentified associated infrastructure to be in accordance with the Technical Note: Investigation of Service Station Sites (NSW EPA, 2014c) ***Final excavation surface*** 1 sample per 100 m^2 across the excavation base, and 1 sample per 10 linear metre along the excavation walls. ***Imported Backfill Materials*** Materials being imported to the site should be certified as VENM or suitable for the proposed land use. If certification cannot be provided, the materials should be tested at a frequency of 1 sample per 25 m^3, up to a volume of 250 m^3. A minimum of three samples is required for any volume of imported fill from the same source. For imported materials > 250 m^3 in volume, the sampling frequency may be reduced by applying statistical analysis, provided a minimum of ten samples is collected.

Action	Description
Analytical suite	***UPSS remedial excavations*** Lead, TRH, BTEX, PAH and total phenols ***Final excavation surface*** Validation samples will be field screened with a PID for soil vapour. Eight priority metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), TRH, BTEX, PAH and any additional contaminants of concern identified during site remediation. If fill materials remain on site the analytical suite will include asbestos analysed using gravimetric quantitation method in accordance with NEPM (2013) . ***Imported backfill materials*** As a minimum the analytical suite will include eight priority metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), TRHs, BTEX, PAHs, OCP, OPP, PCB and Asbestos (presence / absence screening).
Sampling, handling, transport and tracking	▪ Stainless steel sampling equipment or disposable gloves dedicated to each sampling locations will be used; ▪ All sampling equipment to be washed in a 3% solution of phosphate free detergent (Decon 90), followed by a rinse with potable water prior to each sample being collected. ▪ Direct transfer of the sample into new glass jars or plastic bags is preferred, with each jar and plastic bag individually sealed to eliminate cross contamination during transportation to the laboratory; ▪ Label sample containers individually with unique identification including Project No., Sample No., Sampling depth, date and time of sampling; ▪ Place sample containers into a chilled, enclosed and secure container for transport to the laboratory; and ▪ Provide 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 the environmental laboratory.
Sample containers & holding times	▪ Metals – 250g glass jar / refrigeration 4°C / 6 months (maximum holding period); ▪ TRH, BTEX, Phenols, PAHs, OCPs, OPPs, and PCBs – 250g glass jar / refrigeration 4°C / 14 days (maximum holding period); ▪ Asbestos – double resealable plastic (polyethylene) bags / no refrigeration / indefinite holding time.
Field QA/QC	Appropriate sampling procedures will be undertaken to prevent cross contamination, in accordance with EI's Standard Operating Procedures Manual. Field QA/QC will include one pair of intra-laboratory and inter-laboratory duplicates to be tested every 20 primary samples (5% duplicate ratio), as well as one VOC trip blank, one VOC trip spike and one equipment wash (rinsate) blank sample per sample batch. No QA/QC samples are required for asbestos sampling.
Laboratory quality assurance and quality control	All samples will be analysed by NATA-accredited laboratories. The contract laboratory will conduct in-house QA/QC procedures involving the routine analysis of: ▪ Method blanks; ▪ Spike recoveries; ▪ Laboratory duplicates; ▪ Calibration standards and blanks; ▪ QC statistical data; and Control standards and recovery plots.
Achievement of data quality objectives and indicators	Data quality indicators to be achieved are listed in **Table 8-2.** An assessment of the overall data quality should be presented in the final validation report, in accordance with the DEC (2006) *Guidelines for the NSW Site Auditor Scheme*.

Table 8-2 Data quality indicators (validation assessment)

QA/QC Measures	Data Quality Indicators
Precision – A quantitative measure of the variability (or reproducibility) of data	Data precision will be assessed by reviewing the performance of field duplicate sample sets, through calculation of relative percentage differences (RPD). Data precision will be deemed acceptable if RPDs are found to be less than 30%. RPDs that exceed this range may be considered acceptable where: ▪ Results are less than 10 times the limits of reporting (LOR); ▪ Results are less than 20 times the LOR and the RPD is less than 50%; or ▪ Heterogeneous materials or volatile compounds are encountered. In cases where RPD value is considered unacceptable, the analytical results of primary and duplicate samples will be both reviewed against the adopted assessment criteria. If the review indicates the variations in data between the primary and duplicate samples will result in a different conclusion (i.e. the higher concentration is failing the assessment criteria), the higher concentration will be used for assessment.
Accuracy – A quantitative measure of the closeness of reported data to the "true" value	Data accuracy will be assessed through the analysis of: ▪ Field trip blank samples to assess potential cross contamination; ▪ Laboratory method blanks, which are analysed for the analytes targeted in the primary samples; ▪ Laboratory matrix spike and matrix spike duplicate sample sets; ▪ Laboratory control samples; ▪ Calibration of instruments against known standards; and Variation in results reported by the primary and secondary laboratories for primary and duplicate samples.
Representativeness – The confidence (expressed qualitatively) that data are representative of each medium present onsite	To ensure the data produced by the laboratory is representative of conditions encountered in the field, the following QA/QC assessment will be carried out: ▪ Field trip spike samples to assess potential volatile loss during sample transportation. The acceptance criterion is 70% - 130% recovery for trip spike samples; ▪ Blank samples will be run in parallel with field samples by the laboratory to confirm there are no unacceptable instances of laboratory artefacts; ▪ Review of relative percentage differences (RPD) values for field and laboratory duplicates to provide an indication that the samples are generally homogeneous, with no unacceptable instances of significant sample matrix heterogeneities; ▪ The appropriateness of collection methodologies, handling, storage and preservation techniques will be assessed to ensure/confirm there was minimal opportunity for sample interference or degradation (i.e. volatile loss during transport due to incorrect preservation / transport methods); and Consistency between field vapour screening information and laboratory results.
Completeness – A measure of the amount of useable data from a data collection activity	Analytical data sets acquired during the assessment will be evaluated as complete, upon confirmation that: ▪ Standard operating procedures for sampling protocols are adhered to; ▪ Copies of all COC documentation are presented, reviewed and found to be properly completed; ▪ It can therefore be considered whether the proportion of "useable data" generated in the data collection activities is sufficient for the purposes of the land use assessment; and The actual sampling densities are generally consistent with the densities proposed in the RAP.

QA/QC Measures	Data Quality Indicators
Comparability – The confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event	Given that a reported data set can comprise several data sets from separate sampling episodes, issues of comparability between data sets are reduced through adherence to standard operation procedure and regulator-endorsed or published guidelines and standards on each data gathering activity. ▪ Sampling to be conducted by the same sampler where possible to enhance project continuity and minimise variability in sampling technique; ▪ Standard operation procedures will be adhered to; ▪ Sampling under inclement weather conditions to be avoided to minimise variability contributed by weather conditions; ▪ In addition, the data would be collected by experienced samplers and NATA-accredited laboratory methodologies would be employed in all laboratory testing programs.

8.2 Validation reporting

All fieldwork, chemical analysis, discussions, conclusions and recommendations will be documented in a validation report for the site. The validation report will be prepared in general accordance with requirements of the NSW OEH (OEH, 2011) *Guidelines for Consultants Reporting on Contaminated Sites* and NSW DEC (DEC, 2006) *Guidelines for the NSW Site Auditor Scheme,* and will confirm the site has been remediated to a suitable standard for the proposed development.

The Validation Report will be submitted for Council and Site Auditor (if required) for review at the completion of the remediation works program.

9. Conclusions

This RAP has been prepared to guide remediation works at 1-5 Chester Street, Annandale NSW, based on currently available information on site characterisation and the proposed land use (HIL-B – residential with minimal opportunities for soil access).

Site remediation works will be implemented in stages, as follows:

- Stage 1 – Site preparation
- Stage 2 – Building demolition
- Stage 3 – UPSS decommissioning, remedial excavation and validation
- Stage 4 – Groundwater investigation
- Stage 5 – Data gap closure soil investigation
- Stage 6 – Remediation of asbestos-impacted soils
- Stage 7 – Waste classification and bulk excavation
- Stage 8 – Site validation
- Stage 9 – Validation report preparation

In conclusion, and with consideration of the Statement of Limitations in **Section 10**, EI consider that the site can be made suitable for HIL-B land use through implementation of the works described in this RAP.

10. Statement of limitations

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

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

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

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

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

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

References

Aargus. (2017). *Preliminary Site Investigation, 1-5 Chester Street, Annandale NSW.* Aargus Pty Ltd, Report Ref. ES6874 Rev0, dated 8 June 2017.

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

Chapman, G. A., & Murphy, C. L. (1989). *Soil Landscapes of the Sydney 1:100,000 Sheet (9130).* Department of Conservation and Land Management, Sydney.

Contaminated Land Management Act. (1997). NSW.

DEC. (2006). *Guidelines for the NSW Site Auditor Scheme* (2nd ed.). NSW Department of Environment and Conservation.

DEC. (2007). *Guidelines for the Assessment and Management of Groundwater Contamination.* NSW Department of Environment and Conservation.

DECCW. (2009). *Guidelines for Implementing the Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation* . DECCW, 2009/653, September 2009.

DECCW. (2010a). *UPSS Technical Note - Site Validation Reporting.* NSW Department of Environment, Climate Change and Water.

EPA. (1995). *Sampling Design Guidelines.* Environment Protection Authority of New South Wales, Contaminated Site Units.

Herbert, C. (1983). *Sydney 1:100,000 Geological Sheet 9130, 1st edition.* Geological Survey of New South Wales, Sydney.

Leichhardt Municipal Council. (2013). *Leichhardt Local Environmental Plan 2013.* Leichhardt Municipal Council.

Murphy, C. L. (1997). *Acid Sulfate Soil Risk Map - Botany Bay Sheet - Edition Two.* Department of Land and Conservation, December 1997.

NEPM. (2013). *Schedule B1 Guideline on Investigation Levels for Soil and Groundwater, Schedule B2 Guideline on Site Characterisation and Schedule B4 Guideline on site-specific health risk assessments* (Amendment 2013 ed.). National Environmental Protection Council.

NHMRC. (2008). *Guidelines for Managing Risks in Recreational Water.* Australian Government, National Health and Medical Research Council.

NHMRC. (2016). *Australian Drinking Water Guidelines 6 2011 (Version 3.2 ed.).* Australian Government, National Health and Medical Research Council.

NSW EPA. (2014a). *Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2014.* NSW Environmental Protection Authority.

NSW EPA. (2014b). *Protection of the Environment Operations (Waste) Regulation 2014.* NSW Environment Protection Authority.

NSW EPA. (2014c). *Technical Note: Investigation of Service Station Sites.* NSW Environment Protection Authority.

NSW EPA. (2014d). *Waste Classification Guidelines.* NSW Environment Protection Authority, EPA 2014/0796, November 2014.

OEH. (2011). *Guidelines for Consultants Reporting on Contaminated Sites.* NSW Office of Environment and Heritage (OEH).

Protection of the Environment Operations Act . (1997). NSW.

RGM. (2017). *Plan Showing Levels & Detail Over Lot 11 in DP 499846.* RGM Property Survey, Job Reference 1-5 Chester, Drawing No. 170832-001 Rev A, dated 27 June 2017.

VIC EPA. (2000). *Groundwater Sampling Guidelines.* Environment Protection Authority, State Govenment of Victoria, Publication 669, April 2000.

WA DOH. (2009). *Guidelines for the Assessment, Remediation and Management of Asbestos-Contamianted Site in Western Asutralia.* Western Australian Department of Health, May 2009.

WorkCover. (2014). *Managing Asbestos In or On Soil.* WorkCover NSW, March 2014.

Figures

eiaustralia

Contamination | Remediation | Geotechnical

Suite 6.01, 55 Miller Street, PYRMONT 2009
Ph (02) 9516 0722 Fax (02) 9518 5088

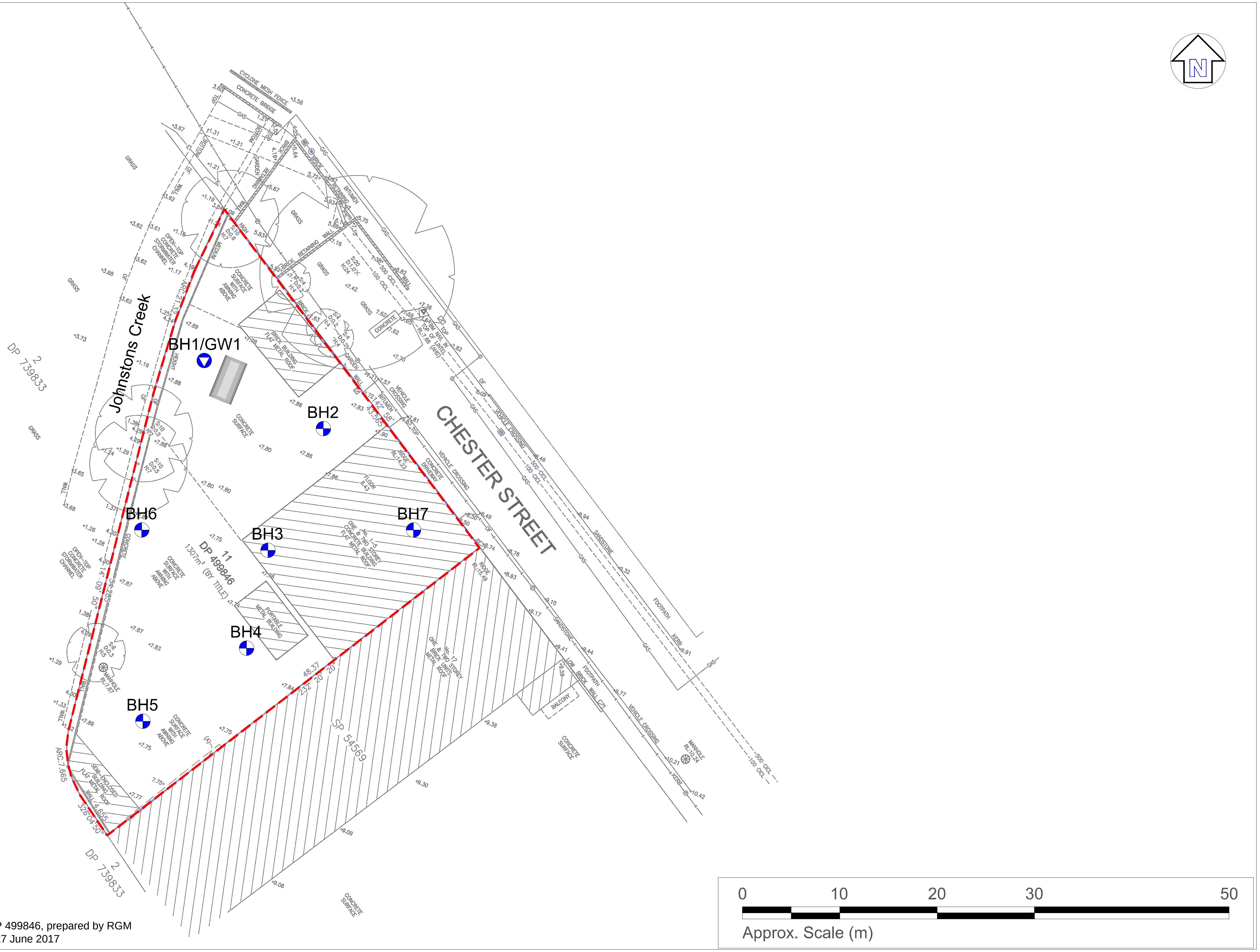
Drawn:	C.Y.
Approved:	N.F.
Date:	23-07-17
Scale:	Not To Scale

Corvas Pty Ltd
Remediation Action Plan
1-5 Chester Street, Annandale NSW

Site Locality Plan

Figure:
1

Project: E23467.E06_Rev0



Map Source: Plan showing levels & detail over Lot 11 in DP 499846, prepared by RGM Property Surveys Drawing No, 170832-001, Rev A, dated 27 June 2017

LEGEND

- -- Approximate site boundary
- ◑ Approximate previous borehole location (Aargus 2017)
- ▼ Approximate previous borehole/monitoring well location (Aargus 2017)
- ▭ Approximate UST location (Aargus 2017)

eiaustralia
Contamination | Remediation | Geotechnical

Suite 6.01, 55 Miller Street, PYRMONT 2009
Ph (02) 9516 0722 Fax (02) 9518 5088

Drawn:	C.Y.
Approved:	N.F.
Date:	27-07-17

Corvas Pty Ltd
Remediation Action Plan
1-5 Chester Street, Annandale NSW
Site Layout Plan and Previous Sampling Locations

Figure:
2

Project: E23467.E06_Rev0

Map Source: Plan showing levels & detail over Lot 11 in DP 499846, prepared by RGM Property Surveys Drawing No, 170832-001, Rev A, dated 27 June 2017

LEGEND

- – – – Approximate site boundary
- ◑ Approximate previous borehole location (Aargus 2017)
- ▼ Approximate previous borehole/monitoring well location (Aargus 2017)
- ▭ Approximate UST location (Aargus 2017)
- ▽ Proposed new groundwater monitoring well locations
- ▨ Proposed test pitting locations

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

Drawn:	C.Y.
Approved:	N.F.
Date:	27-07-17

Corvas Pty Ltd
Remediation Action Plan
1-5 Chester Street, Annandale NSW

Proposed Sampling Locations

Figure:
3

Project: E23467.E06_Rev0

Appendix A – Previous Investigation Report (Aargus, 2017)

Aargus

Environmental - Remediation - Engineering - Laboratories - Drilling

PRELIMINARY SITE INVESTIGATION

1-5 Chester Street,
Annandale NSW

Prepared for

Coach Painting Pty Ltd

7th June 2017
ES6874

HEAD OFFICE: PO Box 398 Drummoyne NSW 1470
Aargus Pty Ltd ACN 050 212 710 • Aargus Holdings Pty Ltd ACN 063 579 313
Aargus Australia Pty Ltd ACN 086 993 937 • Aargus Recruitment Pty Ltd ACN 098 905 894
Telephone: 1300 137 038 • Facsimile: 1300 136 038 • Email: admin@aargus.net • Website: www.aargus.net

Other office locations in NSW - QLD - VIC - SA and 4 overseas countries

CONTROLLED DOCUMENT
DISTRIBUTION AND REVISION REGISTER

DISTRIBUTION LIST

Copy No.	Custodian	Location
1	Nick Kariotoglou	Aargus Pty Ltd (Library)
2	Peter J Fitzhenry	Coach Painting Pty Ltd

Note: This distribution list identifies the current custodians of controlled copies of the subject document. It is expected that these custodians would be responsible for:

- the storage of the document
- ensuring prompt incorporation of amendments
- making the document available to pertinent personnel within the organization
- encouraging observance of the document by such personnel
- making the document available for audit

DOCUMENT HISTORY

Document No.	Revision No.	Issue Date	Description
ES6874	0	8/06/2017	Initial Issue

Approved for release by: Mark Kelly

Mark Kelly
Environmental Manager

Date: 7th June 2017

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

APPENDIX A:	SITE PLANS
APPENDIX B:	SITE PHOTOGRAPHS
APPENDIX C:	LAND TITLES
APPENDIX D:	NSW EPA RECORDS
APPENDIX E:	LOCAL METEOROLOGY
APPENDIX F:	REGULATORY CRITERIA
APPENDIX G:	BOREHOLE LOGS
APPENDIX H:	FIELD RECORD FORMS & CALIBRATION CERTIFICATES
APPENDIX I:	SUMMARY OF RESULTS
APPENDIX J:	LABORATORY TECHNICAL INFORMATION
APPENDIX K:	LABORATORY CERTIFICATES
APPENDIX L:	QA/QC ASSESSMENT
APPENDIX M:	IMPORTANT INFORMATION ABOUT YOUR REPORT

ABBREVIATIONS

ADWG	Australian Drinking Water Guidelines
ANZECC	Australian and New Zealand Environment and Conservation Council
AST	Aboveground Storage Tank
BGL	Below Ground Level
BTEX	Benzene, Toluene, Ethyl benzene and Xylene
COC	Contaminants of Concern
DLWC	Department of Land & Water Conservation
DNR	Department of Natural Resources
DQOs	Data Quality Objectives
POEO	Protection of the Environment Operations
DSI	Detailed Site Investigation
EPA	Environment Protection Authority
ESA	Environmental Site Assessment
HIL	Health-Based Soil Investigation Level
LGA	Local Government Area
NEHF	National Environmental Health Forum
NEPC	National Environmental Protection Council
NEPM	National Environmental Protection Measure
NHMRC	National Health and Medical Research Council
OCP	Organochlorine Pesticides
OPP	Organophosphate Pesticides
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PID	Photo Ionisation Detector
PQL	Practical Quantitation Limit
PSH	Phase Separated Hydrocarbon
PSI	Preliminary Site Investigation
QA/QC	Quality Assurance / Quality Control
RAC	Remediation Acceptance Criteria
RAP	Site Remediation Plan
RPD	Relative Percentage Difference
SAC	Site Assessment Criteria
SCID	Stored Chemical Information Database
SEPP	State Environment Planning Policy
SMP	Site Management Plan
SVC	Site Validation Criteria
TCLP	Toxicity Characteristics Leaching Procedure
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
UCL	Upper Confidence Limit
UST	Underground Storage Tank
VOC	Volatile Organic Compounds
VHC	Volatile Halogenated Compounds

EXECUTIVE SUMMARY

Aargus Pty Ltd ('Aargus') was appointed by Coach Painting Pty Ltd (the 'client') to undertake a Preliminary Site Investigation (DSI) within the property located at 1-5 Chester Street, Annandale NSW (the 'site'). The preliminary investigation was undertaken for due diligence purposes to determine the presence and extent of soil and ground water contamination within the site, in order to determine the suitability of the site for its continued use and for any future prospective development applications.

At the time of the inspection (13th May 2017), the site was predominantly being utilised for a car spray painting workshop. The site was completely sealed with concrete.

Land title information provided suggested that the site was owned by various individuals and companies from 1916 to 1977 and that the current owner acquired the site in 1977. No records were identified for the site on the EPA database. The land is not affected by one of the matters prescribed by Section 59 (2) of the *Contaminated Land Management Act 1997*.

The desktop study identified some areas of potential environmental concern, in relation to imported fill of unknown origin, pesticide use, leaks of storage tanks, motor vehicles, chemical storage in workshop, metal degradation, and potential presence of hazardous materials in current or past building structures, which may pose risks to human and environmental receptors.

The findings of the assessment indicated the following areas of environmental concern:

Soils:

- Chrysotile Asbestos (0.001%w/w FA) was detected in sample BH2 (0.2-0.3m)

Groundwater:

- Copper, Nickel and Zinc were detected in sample GW1 at concentrations above the freshwater criteria.
- F1 (C_6-C_{10}) was detected in GW1 at concentrations of 3,380mg/L, which was above LOR but below assessment criteria.

- F2 (C_{10}-C_{15}) was detected in GW1 at concentrations of 310mg/L, which was above LOR but below assessment criteria.

The following data gaps were identified with respect to the pollution linkages:

- The lateral and/or vertical extent of BH2 is currently unknown and an appropriate remediation strategy should be devised as part of the remediation works to be carried out in the future for any proposed development.
- The contamination status below the USTs and associated infrastructure.

Based on the results of this investigation it is considered that the risks to human health and the environment associated with soil contamination at the site are low to moderate within the context of the current commercial land use.

However if the site is proposed to be re-developed in the future, the following requirements need to be considered in relation to making the site suitable for its intended land use:

- Re-assessment of investigative results under the proposed future land use 'HIL' guidelines.
- An appropriate remedial / management strategy is developed, culminating in preparation of a Remedial Action Plan (RAP) in accordance with EPA guidelines, in regards to the abovementioned soil exceedance locations BH2 as well as the USTs, and associated infrastructure.
- Another round of groundwater testing following remediation.
- Any soils requiring removal from the site, as part of future site works, should be classified in accordance with the "Waste Classification Guidelines, Part 1: Classifying Waste" NSW EPA (2014).

1 INTRODUCTION

1.1 Background

Aargus Pty Ltd ('Aargus') was appointed by Coach Painting Pty Ltd (the 'client') to undertake a Preliminary Site Investigation (DSI) within the property located at 1-5 Chester Street, Annandale NSW (the 'site'). The location of the property is presented in Figure 1 of Appendix A.

The preliminary investigation was undertaken for due diligence purposes to determine the presence and extent of soil and ground water contamination within the site, in order to determine the suitability of the site for its continued use and for any future prospective development applications.

1.2 Objective

The primary objectives of this DSI are as follows:

- Identify potential areas where contamination may have occurred from current and historical activities;
- Identify potential contaminants associated with potentially contaminating activities;
- Assess the potential for soils and groundwater to have been impacted by current and historical activities; and
- Assess the suitability of the site for redevelopment into a mixed use development based on its current condition and the findings of this investigation.

1.3 Scope of Works

The scope of works for this DSI includes:

- Review of the physical site setting and site conditions based on a site inspection, including research of the location of sewers, drains, holding tanks and pits, spills, patches of discoloured vegetation, etc. (where applicable);
- Research and review of the information available, including previous environmental investigations, current and historical titles information, review of aerial photographs, groundwater bore searches, EPA notices, anecdotal evidence, site survey and site records on waste management practices;
- Development of a refined Conceptual Site Model (CSM) to demonstrate the interactions between potential sources of contamination, exposure pathways and human/ecological receptors identified;
- A targeted soil boring/sampling investigative study – formulating and conducting a sampling plan and borehole investigation;
- A targeted groundwater monitoring well installation/sampling investigative study – formulating and conducting a sampling plan and groundwater investigation;
- Laboratory analysis and results from sample analysis – findings and comparison to regulatory guidelines;
- Field and laboratory Quality Assurance/Quality Control (QA/QC); and
- Recommendations for additional investigations should any data gaps be identified or possible strategies for the management of the site, where relevant.

This report was prepared with reference to the NSW Environment Protection Authority (EPA) "*Guidelines for Consultants Reporting on Contaminated Sites*" (2011).

2 SITE IDENTIFICATION AND DESCRIPTION

2.1 Site Identification

Site identification information and land use is summarised in the table below.

Table 1: Site Identification

Lot and DP Number (Address)	Lots 11 in DP499846 (1-5 Chester Street, Annandale NSW)
Coordinates *	NW: Latitude: -33.88477, Longitude: 151.173911 NE: Latitude: -33.884687, Longitude: 151.174059 SW: Latitude: -33.885173, Longitude: 151.173919 SE: Latitude: -33.884979, Longitude: 151.174225
Approx. Total Site Area	1,359m^2
Local Government Area	Inner West City Council
Parish	Petersham
County	Cumberland
Current Land Zoning**	IN2 – Light Industrial
Site End Users	Workers and Visitors

Notes: * refer to http://maps.six.nsw.gov.au/
** refer to Zoning Map published in http://www.legislation.nsw.gov.au/maps/d14d3295-d134-4310-84e7-a117f35297c2/4800_COM_LZN_009_005_20161220.pdf

The site boundary and Lot and DP numbers are presented in Figure 2 of Appendix A.

2.2 Site Inspection

A site visit was carried out on Wednesday 13th May 2017 by an Aargus field engineer to inspect the site for any potential sources of contamination and document any observations made regarding the current site conditions.

At the time of the site inspection, the following observations were made:

- The site was approximately triangular in shape.
- The site was used as a car spray painting workshop.

- The site was occupied by a warehouse constructed of brick with metal roof and sealed concrete floor in the south eastern section of the site, a workshop area with metal awning in the south west and western section of the site and a small brick building used as office with a shed next to it in the north section of the site.
- The main access to the site was along eastern boundary from Chester Street.
- Site was completely sealed with concrete.
- Cracks and oil staining observed within the entire site.
- Cars were parked under the awning and in the north portion of the site.
- The site boundaries were defined by Johnston Creek along western and northern boundary, a commercial building along southern boundary and Chester Street along the eastern boundary.
- Vegetation (grass) was observed in the western and northern boundaries of the site. No stress to vegetation was observed.
- No surface standing water was noticed at the site.

The site features are presented in Figure 3. Site photographs are included in Appendix C.

2.3 Topography and Surface Water Drainage

The following observations were made during the site inspection carried out on the 13th May 2017:

- The site is generally flat with a slight slope to the north at the northeast corner towards Johnsons Creek
- Stormwater runoff from the site is expected to flow in a north direction along Chester Road.

2.4 Surrounding Land Uses

The surrounding land uses identified are described in the table below:

Table 2: Surrounding Land Uses

Orientation	Description
North	Douglas Grant Park and Johnstons Creek
East	Chester Street then commercial building(Kennards Self Storage Camperdown, The Informed Tourist)
South	Commercial building
West	Johnstons Creek then medium residential

3 SITE HISTORY

3.1 Land Titles

A review of historical documents held at the NSW Department of Lands offices was undertaken to identify the current and previous land owners, and potential land uses. The results of the title search are summarised in the following table.

Table 3: Land Title Information

Year	Lot 11 in DP499846 (1-5 Chester Street, Annandale NSW)
1988-Current	Peter John Fitzhenry
	Prior: Vol. 13815,Fol. 125
1979-1988	Peter John Fitzhenry
	Prior: Vol. 12207,Fol. 69
1977-1979	Peter John Fitzhenry
1973-1977	Peter John Fitzhenry/ Clifton George Vincent
1973-1973	Wadame Magda
	Prior: Vol. 4954,Fol. 225
1970-1973	Wadame Magda
1968-1970	Roberta Jefferon
1943-1968	Electric Control Ltd/ Engineering Limited
1938-1943	Grace Bros Pty Ltd
	Prior: Vol. 1318, Fol. 25
1923-1938	Philip Ignatino Delponte
1920-1923	Grace Bros Pty Ltd
1916-1920	William Edwin

In summary, the land title information provided indicated that the company owned by different companies between 1920 to 1968 with the exception of 1923 to 1938. The site was owned by private individuals at least from 1916 to the current date. In 1977 the site transferred to the current site owner Peter John Fitzhenry.

3.2 EPA Records

3.2.1 CLM Act 1997

The NSW EPA publishes records of contaminated sites under Section 58 of the Contaminated Land Management (CLM) Act 1997. The notices relate to investigation and/or remediation of site contamination considered to pose a significant risk of harm under the definition in the CLM Act. However, it should be noted that the EPA record of Notices for Contaminated Land does not provide a record of all contaminated land in NSW.

A search of the EPA database revealed that the subject site is not on the list of NSW contaminated sites notified to EPA.

There is one (1) site listed in the suburb of Camperdown that being O'Dea Reserve. The O'Dea Reserve is located 850m to the south from the site and it includes one (1) former notice. The one (1) former notices pertaining to the site is related to the voluntary remediation proposal.

Copies of the EPA records are included in Appendix D.

3.2.2 POEO Register

A search of the POEO Register revealed that the site was not listed. A copy of the POEO register search is included in Appendix D.

3.3 Industrial Processes and Products Manufactured

A review of industrial processes and/or products manufactured at the site was conducted, and based on the site inspection and historical study, product manufacturing on site is unlikely to have occurred.

3.4 Former Chemical Storage and Transfer Areas

There is one UST kept on site. The non-destructive investigation indicates there was one separate area with a possible UST present. A small amount of chemicals were kept within the workshop and spray painting booths. It is unlikely that there were any bulk chemical storage and transfer areas and/or products manufactured at the site.

3.5 Product Spill & Loss History

It was indicated by the site owner, that to their knowledge no serious land or water contamination had occurred.

3.6 Discharges to Land, Water and Air

No discharge to the land, water and air were observed.

3.7 Complaint History

As indicated by the site owner, there was no complaints lodged against the site.

3.8 Historical Use of Adjacent Land

It was indicated by the client that to their knowledge, the adjacent lands to the site have been used primarily for residential / commercial developments.

3.9 Discussion and Summary of Site History

Based on available information, the site historical usage is summarised as follows:

- Land title information provided suggested that the site was owned by various individuals and companies from 1916 to 1977 and that the current owner acquired the site in 1977.
- No records were identified for the site on the EPA database.
- The land is not affected by one of the matters prescribed by Section 59 (2) of the *Contaminated Land Management Act 1997*.

4 ENVIRONMENTAL SETTING

4.1 Sensitive Environmental Receptors

The nearest environmental receptors in the site vicinity include:

- The Johnstons Creek is located approx. 6m to the west.
- The Douglas Grant Park is located approx. 20m to the north.
- Annandale Public School is located approx. 316m to the west.
- Camperdown Park is located approx. 348m to the south.

4.2 Geology

The Geological Map of Sydney (Geological Series Sheet 9130, Scale 1:100,000, 1983), published by the Department of Mineral Resources indicates the residual soils within the site to be underlain by Wianamatta Group Ashfield Shale consisting of black to dark grey shale and laminite.

4.3 Acid Sulfate Soils

To determine whether there is a potential for acid sulphate soils to be present at the site, reference was made to the NSW Department of Land & Water Conservation (DLWC) *Acid Sulphate Soil Risk Maps* (Edition Two, December 1997, Scale 1:250,000), specifically Map No. 93 – "Botany Bay". A review of the map indicated that the subject site is located in the Disturbed Terrain area that may include filled areas, and often occur during reclamation of low lying swamps for urban developments.

Other disturbed terrain includes areas which have been mined or dredged, or have undergone heavy ground disturbance through general urban development or construction of dams or levees.

A search of the NSW Government Planning & Environment shows that the site is located within Class 3 of Acid Sulphate Soil Risk area (https://www.planningportal.nsw.gov.au/find-a-property/property/1918569_1-5_Chester_Street_11_Annandale_DP499846/1-5_chester_street,_annandale,_2038).

4.4 Hydrogeology

Based on available information, our desktop study indicates that groundwater from site is likely to be flowing towards the Johnstone Creek, approximately 60m west.

A search of the Department of Natural Resources (DNR) borehole database information revealed no groundwater bores within a 500m radius of the site.

4.5 Summary of Local Meteorology

The monthly rainfall of the local area can be represented by the data collected by Bureau of Meteorology (BOM) from the rainfall gauge located in Sydney Olympic Park, which is located approximately 40km west of the site. Records indicate that the mean annual rainfall for the since 1995 is 911.8 mm.

Reference can be made to Appendix G – Local Meteorology.

5 AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

Based on the site inspection, site history, previous reports and review of available information from the desktop study, the potential Areas of Environmental Concern (AEC) and their associated Contaminants of Concern (CoC) for the site were identified. These are summarised in the following table.

Table 4: Summary of Potential Areas and Contaminants of Concern

Potential AEC	Potentially contaminating activity	Potential CoCs	Potentially Impacted Medium	Likelihood of Site Impact	Justification
Entire site	Importation of fill material from unknown origin	Metals, TPH, BTEX, PAH, OCP, PCB, Asbestos	Soil	Low	Based on the site observations and site topography, the presence of imported fill material is likely to be minimal.
	Potential for pesticides to have been sprayed or injected on or underneath concrete slabs	OCP	Soil	Low	The site is not known for having been used for agricultural purposes from the 1950s when OCPs were first introduced into Australia. If use of OCPs has occurred, the impact is likely to have been localised and limited to the topsoil layer.
UST, Chemical storage in workshops	Potential for leaks from storage tanks	Metals, TPH, BTEX, PAH	Soil and groundwater	Low to moderate	Tank integrity test indicates the tank were not leaking. The workshop area was sealed with concrete.
Car Parking Areas	Potential for leaks from parked vehicles	Metals, TPH, BTEX, PAH	Soil	Low	The concrete surfaces were in good conditions; however, minor oil staining was noted across the site.
Metals Features	Degradation of metal features	Metals	Soil	Low	If this has occurred, it would likely be restricted to the surface soils.
Building Structures	Potential Asbestos/Fibro Features	Asbestos	Soil	Low	If present, these will be removed by licensed contractors.

6 DATA QUALITY OBJECTIVES

6.1 Step 1 – State the Problem

6.1.1 Problem Statement

The investigation is for due diligent purposes to determine the presence and extent of any possible contaminants onsite. This site investigation report is be prepared by a consultant to assess whether the site is suitable for the continued use for commercial land use.

However, the desktop study identified some areas of potential environmental concern, in relation to imported fill of unknown origin, pesticide use, leaks of storage tanks, motor vehicles, chemical storage in workshop, metal degradation, and potential presence of hazardous materials in current or past building structures, which may pose risks to human and environmental receptors.

6.1.2 Objectives

The objectives of the PSI are:

- To assess the potential for the soils and groundwater to have been impacted by current and historically contaminating activities; and
- To assess the suitability of the site for future development.

6.1.3 Project Team

The nominated core project team and their responsibilities are listed in the table below.

Table 5: Project Team and Responsibilities

Project Team Member	Responsibilities
Mark Kelly – Environmental Manager	Project Director & Technical Review
Con Kariotoglou – Senior Project Manager	Project Manager & Report Author
Ningye Zhang – Environmental Engineer	Field Representative

6.2 Step 2 - Identify the Decisions of the Study

The decisions required to address the contamination problem are as follows:

- Is soil and groundwater contamination present within the areas of potential environmental concern identified?
- Is soil and groundwater contamination likely to present an unacceptable risk of harm to humans or the environment?
- Is the site currently suitable for the proposed land use being residential with minimal access to soil and groundwater?
- Is there a potential for onsite/offsite migration issues?
- If not, does the site require further investigation and/or remediation works?

6.3 Step 3 - Identify Information Inputs

The following information is required for input into the decisions identified in Step 2:

- Identification of potential areas and contaminants of concern as detailed in Section 5 of this report;
- Selection of soil and groundwater assessment criteria from appropriate guidelines as detailed in Section 8 of this report;
- Collection of soil and groundwater samples from site;
- Headspace analysis for screening of VOCs present within soils using a PID; and
- Comparison and interpretation of results again the adopted soil and groundwater assessment criteria.

6.4 Step 4 – Define the Study Boundaries

The spatial and temporal aspects of the investigation area that the data must represent to support the decisions identified in Step 2 are as follows:

- The lateral extent of the study boundary is defined by the site boundaries as shown in the Site Location Plans (refer to Figure 1).
- The vertical extent of the study boundary is defined by the depth of the natural soil and groundwater in borehole BH1/GW1 to a depth of approximately 7.98 metres below the ground surface.

6.5 Step 5 – Develop the Analytical Approach

The acceptable limits for laboratory QA/QC parameters are shown in the table below and are based upon the laboratory reported acceptable limits and those stated within the NEPM 2013 Guidelines.

Table 6: Acceptable Limits for QC Samples

Type of QC Sample	Control Limit
FIELD	
Rinsate Blanks	Analytes <LOR
Intra-Laboratory Duplicates	RPD's <50%
Inter-Laboratory Duplicates	RPD's <50%
Trip Blanks	Volatiles <LOR
Trip Spike Recovery	>70%
LABORATORY	
Method Blanks	< Laboratory LOR
Matrix Spike	Recovery targets: • Metals: 70% to 130% • Organics: 60% to 140%
Laboratory Duplicate	RPD's <30%
Laboratory Control Samples	Recovery targets: 60% to 140%
Surrogate Spike	Recovery targets: 60% to 140%

The following conditions should be adopted:

- If the control limits are exceeded, then an assessment of the significance of the results should be carried out;
- If the results of the DQI assessment indicate that the data set is reliable, then the data set will be deemed to be acceptable for the purposes of the investigation; and
- If the measured concentrations of soil and groundwater samples analysed meet their respective validation criteria, then no additional assessment is required is required.

6.6 Step 6 - Specify Limits on Decision Errors

There are two types of decision errors:

- **Sampling errors**, which occur when the samples collected are not representative of the conditions within the investigation area; and
- **Measurement errors**, which occur during sample collection, handling, preparation, analysis and data reduction.

These errors may lead to following (null hypothesis):

- Deciding that the site is not suitable for the proposed development when it actually is (Type I error);
- Deciding that the site is suitable for the proposed development when it is actually not (Type II error);
- Deciding that the risks to human health from soil vapour concentrations are high and require further management or remediation, when the risks are actually low (Type I error); and
- Deciding that the risks to human health from soil vapour concentrations are low and requires no further management, when the risks are actually high (Type II error).

A 5% significance level has been selected for Type I errors on the basis that 95% of the data set will satisfy the DQIs. Therefore, the acceptable limit of the decision errors is based on a 5% probability of the hypothesis being incorrect.

An assessment will be made as to the likelihood of a decision error being made based on:

- The acceptable limits for inter/intra laboratory duplicate sample comparisons as specified in Step 5 of the DQOs; and
- The acceptable limits for laboratory QA/QC parameters are based upon the laboratory reported acceptable limits and those stated within the NEPM Guidelines.

If the concentration of a particular contaminant of concern exceeds its assessment criteria, then a further assessment is required to address the significance of the result. Statistical analysis based on 95% UCL may be used to assess the significance of the data provided the following conditions are met:

- the arithmetic mean of the data set must be less than its respective threshold level; that is, it is acceptable for individual results to exceed its respective threshold level, but the cumulative mean of the data set of soil and groundwater sample results must not exceed the threshold level;
- the standard deviation of the data set is less than 50% of the relevant threshold level; and
- no individual sample result should be greater than 250% of the relevant threshold level.

Ecological data is not included in this assessment process as ecological results cannot be statistically interpreted.

6.7 Step 7 - Optimise the Design for Obtaining Data

The optimum design for obtaining data in order to achieve the Data Quality Objectives is as follows:

- Only NATA-accredited environmental testing laboratories will be commissioned to analyse soil samples and will implement a quality control plan conforming to the NEPM (Assessment of Site Contamination) Measure Schedule B(3) Guidelines for Analysis of Potentially Contaminated Soils;
- An assessment of the Data Quality Indicators to determine if the field procedures and laboratory analytical results are reliable;
- The investigation will be carried out by an experienced and qualified Environmental Scientist, who is trained in sampling at contaminated sites in accordance with Aargus protocols based on best practice industry standards;
- Collection of QA/QC samples at frequencies prescribed in the NEPM Guidelines; and
- In accordance with the NSW EPA "Sampling Design Guidelines" (September 1995) a minimum of seven (7) sampling points for a site area of 1,631m^2 will be adopted to provide general site coverage.

7 DATA QUALITY INDICATORS

7.1 General

The five Data Quality Indicators (DQIs) comprising completeness; comparability; representativeness; precision and accuracy provide an assessment of the reliability of field procedures and laboratory analytical results in accordance with the 'Guidelines for the NSW Site Auditor Scheme (2nd Edition), 2006. These are addressed in the following sub-sections.

7.2 Completeness

Data Completeness is a measure of the amount of useable data (expressed as %) from a data collection activity. The completeness is equal to the percentage of valid quality assurance and quality control results.

The assessment should address the following:

Table 7: Data Completeness

Field	Laboratory
• All critical locations are sampled; • All samples collected from critical grids and depths; • Consistency in the use of standard operating procedures, equipment, sampler; • Completion and correctness of field documentation.	• All critical samples and analytes are analysed in accordance with the DQOs; • Appropriateness of laboratory methods and PQLs.

The minimum target frequency for each type of QA/QC sample should be carried out in accordance with the following tables:

Table 8: QA/QC Requirements

Field QA/QC Sample	Frequency
Intra-Laboratory Duplicate	1 in 20 samples
Inter-Laboratory Duplicate	1 in 20 samples
Field Blanks	1 per day (rinsate)
Trip Blank	1 per sample batch
Trip Spike	1 per sample batch

Where any of the above objectives are not achieved for particular samples, steps will be taken to rectify the non-conformance, if possible. Alternatively, data qualifiers detailing the nature of the quality problem will be documented in the report and attached to relevant data in the result summary tables.

The target for overall completeness for each data set is a minimum of 95%. A data completeness of less than 95% may be accepted where it can be justified that the non-conformance does not have a significant effect on the outcome of the results.

7.3 Comparability

Data Comparability is the confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event.

The qualitative assessment should address the following:

Table 9: Data Comparability

Field	Laboratory
• Consistency in the use of standard operating procedures, equipment, sampler • Consistency in the method of sample collection for each media • Quantification of influence by climatic conditions	• Consistency of analytical methods and limits of reporting (LOR) for each analyte • Whether laboratory limits of reporting are set at < 20% of the adopted site criteria value for each analyte • Consistent use of one primary and one secondary laboratory

7.4 Representativeness

Data Representativeness is the confidence (expressed qualitatively) that data are representative of each media present on the site.

The qualitative assessment should address the following:

Table 10: Data Representativeness

Field	Laboratory
• Samples are collected in accordance with the proposal • Receipt of samples within holding times • Receipt of intact samples • Receipt of adequately preserved samples	• All samples are extracted and analysed within their respective holding times

7.5 Precision

Data Precision is a quantitative measure of the variability (or reproducibility) of data.

Intra-laboratory or Inter-laboratory Duplicate Samples (B) results are compared with Primary Sample (A) results using Relative Percentage Differences (RPDs) according to the following formula:

$$\%RPD = \left|\frac{\mathrm{A} - \mathrm{B}}{\mathrm{A} + \mathrm{B}}\right| \times 200$$

Duplicate sampling rates for this assessment (**for each separate sample batch**) are to be tested for all the same analytes as the primary sample:

Table 11: Data Precision

Type of QC Sample	Control Limit
Field Intra-Laboratory Duplicate (Blind)	RPD < +/- 50%
Field Inter-Laboratory Duplicate (Split)	RPD < +/- 50%

Where the laboratory has reported results for a particular analyte below the limit of reporting for either the primary sample or a duplicate sample, the RPD is reported as 'Not Calculable' or NC. A discussion should be made as to which sample should be adopted and compared against the relevant assessment criteria. However, no discussion is required where both the primary sample and the duplicate sample for a particular analyte are below the limit of reporting.

7.6 Accuracy

Data Accuracy is a quantitative measure of the closeness of reported data to the true value. Laboratory measured recovery of analytes in lab control samples with known concentrations. Laboratory QA/QC testing is to include:

Table 12: Data Accuracy

Laboratory QA/QC Sample	Frequency
Method Blank	1 per 20 samples
Matrix Spike	1 per 20 samples
Laboratory Duplicate	Laboratory defined
Laboratory Control	Laboratory defined
Surrogate Spike	All organic samples

8 SITE INVESTIGATION AND SCREENING LEVELS

8.1 General

The selection of appropriate human health, ecological and groundwater site assessment criteria were based on the following guiding documents:

- "Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000" (ANZECC);
- "Australian Water Quality Guidelines 2000" (AWQG);
- "Australian Drinking Water Guidelines 2011" (ADWG);
- "Guidelines for Managing Risk to Recreational Waters 2008 (GMRRW); and
- "National Environmental Protection (Assessment of Site Contamination) Amendment Measure 2013 (No.1)", NEPC (2013).

Full details of the site investigation and screening levels for each potential contaminant of concern in soils and groundwater identified in Section 5 are presented in Appendix H.

8.2 Soils Investigation and Screening Levels

8.2.1 Health Investigation Levels (HILs)

The NEPM presents Tier 1 Health Investigation Levels (HILs) for a broad range of chemicals such as metals, inorganics, PAHs, phenols, pesticides and other organics. The HILs are applicable to generic land uses such as residential, commercial/industrial or public open space and all soil types, generally within the first 3 metres of soil below ground level. The HILs have been applied to assess human health risks via all relevant pathways of exposure.

Based on the proposed development, soil investigation results within the site will be assessed against the **HIL 'D'** – *Commercial/industrial, includes premises such as shops, offices, factories and industrial sites*

8.2.2 Health Screening Levels (HSLs)

The NEPM presents Tier 1 Health Screening Levels (HSLs) for the following petroleum compounds and fractions:

- Benzene, Toluene, Ethylbenzene and Xylenes (BTEX);
- Naphthalene; and
- TPH C6-C10 and TPH >C10-C16 fractions

The HSLs are applicable to generic land uses such as residential, commercial/industrial or recreational/public open space and different soil types between the ground surface and soils >4 metres below ground level. The HILs have been applied to assess human health risks via the inhalation and direct contact pathways of exposure.

Point 1 of Table 1A (4), which indicates that HSL D can be used in lieu of HSL B for buildings that comprise car parks or commercial properties on the ground floor.

8.2.3 Ecological Screening Levels (ESLs)

Table 1B (6) of the NEPM presents Ecological Screening Levels (ESLs) for TPH C6-C40 fractions, BTEX and benzo(a)pyrene.

The ESLs are applicable to generic land uses such as areas of ecological significance, urban residential areas and public open space, and commercial/industrial land uses. The ESLs have been applied to assess risks to terrestrial ecosystems, generally, within the top 2 metres of coarse or fine soil at the final surface/ground level.

8.2.4 Petroleum Hydrocarbon Management Limits

Table 1B (7) of the NEPM presents petroleum hydrocarbon management limits for application to TPH fractions C_6-C_{10}, >C_{10}-C_{16}, >C_{16}-C_{34} and >C_{34}-C_{40}. The management limits are applicable for coarse or fine soils in residential, parkland, public open space or commercial/industrial land uses following consideration of relevant ESLs and HSLs.

8.2.5 Asbestos

Health screening for asbestos in soil, which are based on scenario-specific likely exposure levels, are adopted from the WA DoH guidelines and are referred in Table 7 in Schedule B1.

Table 13 Health screening levels for asbestos contamination in soil

	Health Screening Level (w/w)			
Form of asbestos	**Residential A[1]**	**Residential B[2]**	**Recreational C[3]**	**Commercial/ Industrial D[4]**
Bonded ACM	0.01%	0.04%	0.02%	0.05%
FA and AF[5] (friable asbestos)	0.001%			
All forms of asbestos	No visible asbestos for surface soil			

1. Residential A with garden/accessible soil also includes children's day care centres, preschools and primary schools.
2. Residential B with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments.
3. Recreational C includes public open space such as parks, playgrounds, playing fields (e.g. ovals), secondary schools and unpaved footpaths.
4. Commercial/industrial D includes premises such as shops, offices, factories and industrial sites.
5. The screening level of 0.001% w/w asbestos in soil for FA and AF (i.e. non-bonded/friable asbestos) only applies where the FA and AF are able to be quantified by gravimetric procedures (refer Section 4.10). This screening level is not applicable to free fibres.

8.3 Groundwater Investigation and Screening Levels

8.3.1 Potential Beneficial Uses

Groundwater investigation and screening levels were established by identifying the potential beneficial uses of groundwater down-gradient from the site based on the Six Environmental Values presented in the table below.

Table 14: Potential Beneficial Uses of Groundwater

Environmental Value	Applicability
Freshwater aquatic ecosystem	✓
Marine aquatic ecosystem	✗
Agricultural use - irrigation	✗
Agricultural use – stock watering	✗
Recreational use	✓
Raw drinking water	✗

The applicable Environmental Values were selected on the basis of the following down-gradient receptors as identified in Section 4.1 of this report:

- The fresh water aquatic ecosystem, recreational users and aesthetics at Johnstone Creek located approximately 60m west of the site:

No abstraction wells for agricultural use were identified within 500m of the site.

For each relevant Environmental Value identified above, the groundwater investigation and screening levels adopted are discussed in the following sub-sections. Full details of the investigation and screening levels for potential contaminants of concern in groundwater are presented in Appendix H.

If the screening or investigation levels are exceeded, then further consideration will be given to processes such natural attenuation, advection, adsorption and contaminant flux to assess potential risks to down-gradient aquatic ecosystems or drinking water sources.

8.3.2 Protection of Aquatic Ecosystems

Table 1C of the NEPM presents Groundwater Investigation Levels (GILs) for the protection of fresh water and marine water in slightly to moderately disturbed ecosystems. However, where the closest sensitive receptor is high value or highly disturbed, Section 3.1 of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000) provides a range of water quality guidelines values based upon three levels of ecosystem conditions as shown in the table below.

Table 15: Aquatic Ecosystem Values

Ecosystem Value	Protection Level	Brief Definition	Applicability
High value ecosystems (HVE)	99%	Effectively unmodified, with ecological integrity regarded as intact.	×
Slightly to moderately disturbed ecosystems (SMDE)	95%	Small impacts to aquatic biological diversity within moderately cleared catchments with reasonably intact riparian vegetation.	✓
Highly disturbed ecosystems (HDE)	90%	Measurably degraded ecosystems typically associated with shipping ports or urban catchments.	×

Based on observations made during the site walkover, the aquatic ecosystem value of the Johnstone Creek area was considered to be slightly to moderately disturbed and that the NEPM GILs are applicable.

However, where contaminants are potentially bio-accumulative, trigger values for the protection of 99% of species were used. Low reliability trigger values presented in Table 3.4.1 of the ANZECC 2000 guidelines were also adopted in the absence of high or moderate reliability trigger values.

8.3.3 Recreational Water Use and Aesthetics

The GMRRW guidelines (as referenced in NEPM) recommend adopting a multiplication factor of 10 to 20 to the ADWG for the assessment of recreational water quality. This is based on the rationale that the ADWG guideline values are based on a daily consumption of 2L, which is considered to be very conservative for application to recreational water exposure. On this basis, a multiplication factor of '10' (i.e. recreational consumption of 200mL per day) will be applied to the ADWG health guidelines to establish screening criteria.

8.4 Export of Waste

To assess the waste classification of materials to be disposed of off-site, the NSW EPA refers to the NSW EPA (2014) "*Waste Classification Guidelines. Part 1: Classifying Waste*".

9 SOIL INVESTIGATION

9.1 General Methodology

The soil investigation was carried out on the 13th May 2017 and was designed to meet the Data Quality Objectives. The fieldwork procedures adopted were carried out in general accordance with the Aargus fieldwork protocols, which are based on industry standard practice as prescribed in the NEPM.

Each borehole was drilled by a drilling rig using solid flight augers. The boreholes were backfilled with clean spoil or clean sand/gravel.

A description of sub-surface conditions observed during drilling are presented in borehole logs included in Appendix G.

9.2 Sampling Design Rationale

Seven boreholes (BH1 to BH7) were drilled by adopting a targeted sampling pattern across the site to provide general site coverage with consideration given to accessibility, site features and the proposed development zones.

It is considered that the number of sampling points adopted meets the minimum requirements of the NSW EPA "Sampling Design Guidelines" (1995) for a site area of 1,631m^2 and to detect a hotspot diameter of 19.9m. The borehole locations are shown in Figure 4 of Appendix A.

9.3 Sampling Density and Sampling Depth

Boreholes were advanced through fill material and terminated at least 0.5m into natural soils to allow for the collection of at least one soil sample from fill material and one from natural soils.

9.4 Sampling Methodology

Soil sampling was carried out in general accordance with Aargus Fieldwork Protocols. In summary:

- Soil samples were collected using a solid flight auger from each soil type or change in lithology.
- Samples were transferred into clean laboratory supplied containers using a hand trowel.
- In general, each soil sample was divided into two sub-samples. One of the sub-samples was placed into a laboratory-supplied container and a second sub-sample was placed in a separate zip-lock bag for field headspace screening using a PID.

Sampling of asbestos was undertaken as follows:

- One wetted 500ml sample from each sampling location was submitted for laboratory analysis for AF.

9.5 Field Tests

A calibrated Photo-ionisation Detector (PID) meter was used to obtain the following field measurements:

- Background concentrations of ionisable volatile organic compounds (VOCs) in the ambient air taken approximately 5 to 10 metres upwind of the general work area; and
- Headspace analysis of bagged soil samples collected to detect the presence of ionisable VOCs.

The PID readings were observed before and after each measurement of a sample to ensure that the PID was operating correctly. The procedures followed in performing field headspace on soil samples can be found in the Aargus Field Protocols.

Readings of PID maximums, fluctuations and general comments of observation were recorded in Aargus field record forms included in Appendix H. The PID calibration certificate can be found in Appendix H.

9.6 Soil Laboratory Analysis

Soil samples were submitted to their respective laboratories as specified in Section 11.2. The schedules of analysis for each sampling batch are presented in Appendix I.

10 GROUNDWATER INVESTIGATION

10.1 General Methodology

The groundwater sampling was carried out on the 18th May 2017. Groundwater gauging, purging and sampling methodology adopted was carried out in accordance with Aargus fieldwork protocols.

Groundwater-related field record forms included in Appendix J.

10.2 Sampling Design Rationale

One (1) of the boreholes drilled was converted into a groundwater monitoring well on the 13th May 2017 and were designated as GW1 (BH1). The location of the monitoring wells are shown on Figure 4 of Appendix A and were selected on the basis of accessibility and to provide an assessment of groundwater conditions beneath the site.

A list of the groundwater monitoring wells and their function in the monitoring network are presented in the table below.

Table 16: Groundwater Network

Well ID	**Site**	**Status**	**Function**
GW1	Annandale	Installed on the 13th May 2017	Considered down-gradient well based on terrain map, check the extent of the on-site migration and general monitoring

10.3 Well Installation

Groundwater monitoring well was constructed on 13th May 2017 by adopting the following methodology:

- 50mm diameter, Class 18uPVC threaded and flush joined casing and 0.45 machine-slotted screens were used;

- The screen extended 1m above and 2m below the standing water table measured after drilling;
- Coarse, washed sand and gravel was placed in the annulus surrounding the piping to a height of 0.2m above the screen;
- Bentonite pellets were placed in the annulus above the sand to form an impermeable plug of a thickness of 1.0m and near the top of the well to prevent surface runoff from entering directly into the well;
- A PVC cap was placed on the casing; and
- 140mm diameter stainless steel flushed covers were used for groundwater well GW1, finishes and concreted onto the ground surface.

A summary of the groundwater monitoring well construction details installed are listed in the table below and are also presented in full detail within their respective borehole logs included in Appendix H.

Table 17: Summary of Well Construction Details

Well ID	Total Depth (m BGL)	Screening Zone (m BGL)	Lithological Description
GW1	7.98	4.68-7.98	Natural

The wells were developed by completely removing existing water column in the well after the construction.

10.4 Groundwater Gauging

Prior to purging and sampling of groundwater at each monitoring well, groundwater levels were measured and the presence of phase-separated hydrocarbons (PSH) was checked using an oil-water interface probe.

Measurements of groundwater well depths were also obtained to assess whether siltation of the well had occurred following well development. Where a significant difference was noted, the well was redeveloped. In this investigation, no significant difference was observed in the measurement of groundwater well depths.

Groundwater levels were measured within a single time interval at all locations prior to the commencement of purging and sampling.

10.5 Groundwater Purging and Sampling

Prior monitoring, wells were purged and sampled using low flow techniques with a micropurge pump and maintaining a flow rate of between 100ml/min and 500 ml/min to reduce potential loss of VOCs.

Purging of groundwater was carried out until three consecutive readings from a calibrated Water Quality Meter were measured within the stabilisation criteria specified for each physico-chemical parameters listed in the table below.

Table 18: Groundwater Quality Stabilisation Criteria

Parameter	**Measurement Unit**	**Stabilisation Variance**
Temperature	°C	± 0.2
pH	pH units	± 0.1
Oxidation Reduction Potential (ORP)	mV	± 10 mV
Dissolved Oxygen (DO)	mg/L	± 0.2 or 10%
Electrical Conductivity	mS/cm	± 5%

Groundwater samples were collected only after stabilised groundwater quality readings were achieved to ensure representative sampling and then transferred into laboratory-supplied sample containers appropriate for laboratory analyses. A copy of the calibration certificate can be found in Appendix J.

10.6 Laboratory Analyses

Groundwater samples were submitted to their respective laboratories as specified in Section 11.2. The schedules of analysis for each sampling batch are presented in Appendix I.

11 QUALITY ASSURANCE / QUALITY CONTROL

11.1 Field QA/QC

11.1.1 General

The frequency required for each field quality assurance / quality control (QA/QC) sample is presented in the table below.

Table 19: QA/QC Sampling Frequency

	Intra-Lab Duplicates	Inter-Lab Duplicates	Rinsates	Trip Blanks	Trip Spikes
Sampling Frequency	1 in 20 primary samples	1 in 20 primary samples	1 / Day	1 / Day	1 / Day

11.1.2 Field Duplicates

Duplicates of primary samples were collected to enable the assessment of variability in analyte concentrations between samples collected from the same sampling point. The tables below list the duplicate soil, groundwater and soil vapour samples collected with their corresponding primary samples.

Table 20: Soil Field Duplicate Samples

Primary Sample ID	Sample Depth (m bgl)	Blind Duplicate ID	Split Duplicate ID	Date Sampled
BH1	0.2 – 0.4	D1	SS1	13.05.2017

11.1.3 Rinsates

Rinsate samples recovered for each day in which sampling took place to identify possible cross contamination between the sampling locations are listed in the table below.

Table 21: Rinsate Samples

Sample ID	Equipment Type	Sample Media	Date Collected
R1	Hand Trowel	Soil	13.05.2017

11.1.4 Trip Blanks / Spikes

Trip spike and trip blank samples were collected to assess the effect of sample handling on volatile concentrations in the samples collected and are listed in the table below.

Table 22: Trip Blank/Trip Spikes

Sample ID	QC Sample Type	Media	Date Collected
TB1	Trip Blank	Soil	13.05.2017
TS1	Trip Spike	Soil	13.05.2017

11.1.5 Sample Handling, Storage and Transport

The following sampling handling, storage and transport procedures were adopted to ensure sample integrity:

- Samples were collected in laboratory supplied containers. A list of sample preservation methods and the types of sample containers used are attached in Appendix J.
- Soil and groundwater sample containers were placed immediately into a chilled cooler box and dispatched to their respective analytical laboratories on the same day. If this was not possible, samples were temporarily held overnight in the Aargus office refrigerator at a temperature of no greater than 4 °C and dispatched the following day.
- A Chain of Custody form (COC) was completed for all samples collected and included with the samples for transport to their respective laboratories for chemical analysis. Copies of COCs are included in Appendix K.
- All glass bottles were individually bubble wrapped for protection and insulated containers/coolers were used for sample shipment.
- Disposable nitrile gloves were used for OH&S purposes and were changed between every sample location.

11.1.6 Decontamination Procedures

The decontamination of non-dedicated sampling equipment was achieved by washing with phosphate-free detergent and tap water, followed by a final rinse with distilled water. Decontamination was conducted after the collection of samples at each sample location. A clean pair of disposable gloves was used when handling each sample.

The augers were decontaminated between sampling locations by physically removing soil material between boreholes, washing the augers with Decon 90 and rinsing them with water.

We highlight that separate bailer chord and disposable bailers were used for each monitoring well during development, and separate disposable tubing used when sampling. These equipment items were not subject to decontamination procedures.

11.1.7 Calibration of Equipment

The 10.6eV lamp of the PID was calibrated with isobutylene gas at 100ppm prior to commencement of fieldwork and prior to commencement of each day's fieldwork. The battery in the PID unit was recharged after every day's use in the field.

Copies of calibration records for each relevant item of equipment used can be found in Appendix H.

11.2 Laboratory QA/QC

11.2.1 Laboratories Used

The following NATA-accredited laboratories were commissioned to carry out laboratory analysis of soil and groundwater samples collected:

- Primary Laboratory for soil and groundwater samples – ALS Environmental (Sydney)
- Secondary Laboratory for soil samples – ALS Environmental (Melbourne)
- ASET was selected to conduct asbestos analysis on all primary soil samples

These laboratories also operate Quality Systems that are designed to comply with ISO/IEC 17025. All primary samples, blind duplicates, rinsate samples, trip blank/spikes were dispatched to the primary laboratory. All split samples were dispatched to the secondary laboratory. Laboratory Certificates of Analysis are included in Appendix K.

11.2.2 Holding Times

The holding times for chemicals analysed are presented in Appendix M and were based on USEPA methods, Standard Methods for the Examination of Water and Wastewater (APHA).

11.2.3 Test Methods and Practical Quantitation Limits

The test methods adopted by ALS Environmental – Sydney & Melbourne are listed in Appendix P and Practical Quantitation Limits (PQLs) adopted are specified within the Laboratory Certificates of Analysis included in Appendix M.

The methods used by the laboratories generally comply with those listed in the NEPM and the Australian and New Zealand Environment and Conservation Council (ANZECC)-1996 "*Guidelines for the Laboratory Analysis of Contaminated Soils*". Alternate methods used by the laboratories (i.e. not identified in the NEPM and ANZECC guidelines) have been validated by the laboratories, as recommended in the NEPM and ANZECC guidelines, and endorsed by NATA.

11.3 QA/QC Data Evaluation

A full evaluation of the Data Quality Indicators (DQIs) for both fieldwork and laboratory procedures is presented in Appendix Q. These were assessed with reference to Appendix V of the NEPM and Guidelines for the NSW Site Auditor Scheme (2nd ed.), 2006. In summary, the findings of the QA/QC evaluation indicated the following:

- Data Completeness – The data set is considered to be adequately complete.
- Data Comparability – The data set is considered to be adequately comparable.
- Data Representativeness – The data set is considered to be adequately representative.
- Data Precision – The data set is considered to be adequately precise. However, the following minor non-conformances were identified:
    - The calculated RPDs for Copper, Nickel and B(a)P based on sample results SS1 exceeded the control limits. However, this was likely due to variations in the groundwater quality during sampling and the use of preservatives ion the sampling bottles. Given that the majority of RPDs were within the criteria, the data set was considered to be adequately precise and was not considered to affect the outcome of the assessment.
- Data Accuracy – The data set is considered to be adequately accurate.

The sampling methods (including sample preservation, transport and decontamination procedures) and laboratory methods followed during this investigation works were consistent with Aargus protocols and were found to meet the DQOs for this project.

It is therefore considered that the data is sufficiently reliable and that the results can be used for the purpose of this project.

12 FIELD OBSERVATIONS

12.1 Geology

Based on surface and sub-surface conditions observed during the intrusive investigation, the surface and sub-surface profile across the site is summarised in the table below.

Table 23: Summary of Geological Observations

Geological Unit	Lithological Description
Fill / Topsoil	Clayey Sand, Silty Sand and Gravelly Sand
Natural Soils (Residual)	Silty CLAY and Sandy CLAY
Bedrock	Sandstone

The following additional observations were made:

- Some Hydrocarbon staining was observed on concrete surfaces across the site.
- No Hydrocarbon odours were noted within any of the borehole locations.
- No fibre-containing fragments or sheeting were observed in any of the borehole samples.

We recommend that this section be read in conjunction with Figure 4 (Sample Location Plan) in Appendix A, the Daily Work Sheets in Appendix H and the borehole logs in Appendix G.

12.2 Field Headspace Results

Ionisable VOC detections in PID readings taken from soil samples subjected to field headspace analysis are listed in the following table.

Table 24: Summary of PID Results

Sample ID	Depth Range (m bgl)	PID Readings	Stratum
BH1	0.2-0.4	0.6 ppm	Fill
BH2	0.2-0.3	0.2 ppm	Fill
BH3	0.2-0.3	0.1 ppm	Fill
BH4	0.2-0.3	0.5 ppm	Fill
BH5	0.2-0.3	0.6 ppm	Fill
BH6	0.2-0.3	0.2 ppm	Fill
BH7	0.2-0.3	0.4 ppm	Fill

The PID field record forms can be found in Appendix H.

12.3 Groundwater Observations during Drilling

Groundwater observations made during drilling are summarised in the table below.

Table 25: Groundwater Observations during Drilling

Borehole ID	Initial Depth (m BGL)	Flow Type	Standing Water Level (m BGL)	PSH (mm)	Lithology (Initial Depth)
GW1/BH1	7.98	Seepage	4.68	None	Natural – Weathered Shale

These results indicated the following:

- No PSH were observed in the groundwater monitoring wells during drilling.

12.4 Groundwater Monitoring Results

12.4.1 Groundwater Measurements

Groundwater levels measured and observations made during the monitoring event carried out on the 18th May 2017 are summarised in the table below.

Table 26: Groundwater Elevations and Observations

Well ID	Well Depth (m BGL)	Groundwater Depth Measured (m BGL)	Groundwater Depth Measured (m RL AHD)	PSH Depth (m BGL) / Thickness (mm)
GW1	7.98	4.68	-	None

Note: No information regarding R.L.s were available from the client

Based on the general topography of the site vicinity the general groundwater flow from site is inferred to be in a westerly direction towards Johnstone Creek as shown in Figure 4 in Appendix A.

12.4.2 Physio-Chemical Parameters

The stabilised measurements taken for each groundwater physico-chemical parameter are summarised in the table below. Copies of detailed field measurement records for each monitoring well location are presented in Appendix H.

Table 27: Physico-Chemical Parameters

Well ID	Temperature (°C)	pH	EC (mS/cm)	Redox (mV)	DO (ppm)
GW1	18.6	6.50	7.99	282.3	2.94

The results of the field parameters measured are summarised as follows:

- pH readings ranged from 6.45to 6.50 indicating the groundwater is slightly alkaline;
- EC readings ranged from 7.83 mS/cm to 7.99 mS/cm, indicating that the groundwater on site is slightly brackish. This is considered due to salinity presented within the clay-shale strata and alkaline groundwater.
- Redox potential readings ranged from 282.3 mV to 321.1 mV, indicating an environment between the suboxic (ferric iron reduction) and aerobic zones; and
- DO readings ranged from 2.94 mg/L to 6.66 mg/L, indicating low levels to support fish & insects.

13 LABORATORY RESULTS

13.1 General

A comparison of soil and groundwater laboratory results against their respective assessment criteria (as specified in Section 8) are presented in the summary tables in Appendix I. Certificates of laboratory analysis are attached in Appendix K. A discussion of the results is presented in the following sub-sections.

13.2 Soil Results

13.2.1 Heavy Metals

13.2.1.1 Health Investigation Levels (HILs)

As indicated in Table A1, the concentrations of the discrete heavy metals were below the Health Investigation Level (HIL) for a commercial land use, that being the HIL 'D'.

13.2.2 TRH, BTEX, NAPHTHALENE &/OR BENZO(a)PYRENE

13.2.2.1 Health Screening Levels (HSLs)

As indicated in Table B1, the F1 (C_6-C_{10}), F2 (>C_{10}-C_{16}), benzene, toluene, ethyl benzene, xylenes and naphthalene concentrations were below the HSL 'D' for a sand soil profile with a source depth of "0m to <1m".

13.2.2.2 Ecological Screening Levels (ESLs)

As indicated in Table B3, the F1 (C_6-C_{10}), F2 (>C_{10}-C_{16}), F3 (C_{16}-C_{34}), F4 (C_{34}-C_{40}), benzene, toluene, ethyl benzene, xylenes and benzo(a)pyrene concentrations were below the ESL for a coarse grained soil texture in an "commercial and industrial" environment.

13.2.2.3 Management Limits

As indicated in Table B5, the F1 (C_6-C_{10}), F2 (>C_{10}-C_{16}), F3 (C_{16}-C_{34}) and F4 (C_{34}-C_{40}), concentrations were below the Management Limits for a coarse grained soil texture in an "commercial and industrial" environment.

13.2.3 PAH, OCP & PCB

13.2.3.1 Health Investigation Levels (HILs)

As indicated in Table C, the concentrations of the benzo(a)pyrene (as TEQ), Total PAH, OCP & PCB were below the Health Investigation Level (HIL) for commercial and industrial, that being the HIL 'D'.

13.2.3.2 Ecological Investigation Levels (EILs)

As indicated in Table C, the concentrations of naphthalene and DDT/DDE/DDD were below the Ecological Investigation Level (EIL) for commercial and industrial.

13.2.3.3 Ecological Screening Levels (ESLs)

As indicated in Table C, the benzo(a)pyrene concentrations were below the ESL for a coarse grained soil texture in an "commercial and industrial" environment.

13.2.4 Asbestos

As indicated in Table D, no asbestos was detected in any of the samples analysed, and no ACM was observed during the sampling, with the exception of:

- Sample BH2 (0.2-0.3m) 0.001%w.w FA

13.3 Groundwater Results

13.3.1 Heavy Metals

As indicated in Table A in Appendix I, the heavy metal concentrations were below the assessment criteria with exception of the following:

- Copper was detected in sample GW1 at a concentration of 836 μg/L, which was above the freshwater criteria of 1.4 μg/L.
- Nickel was detected in sample GW1 at a concentration of 18 μg/L, which was above the freshwater criteria of 11 μg/L.
- Zinc was detected in sample GW1 at a concentration of 577 μg/L, which was above the freshwater criteria of 8 μg/L.

13.3.2 TRH, BTEX & PAH

13.3.2.1 Fresh Water

As indicated in Table B, the BTEX concentrations were either less than the laboratory limit of reporting (LOR) and below the fresh water or water for recreational purpose assessment criteria.

13.3.2.2 Health Screening Levels (HSLs)

As indicated in Table C, the F1 (C_6-C_{10}), F2 (>C_{10}-C_{16}), benzene, toluene, ethyl benzene, xylenes and naphthalene concentrations were below the HSL 'A' & HSL 'B' for a clay soil profile with a source depth of "2m to <4m" and"4m to <8m", with the exception of:

- F1 (C_6-C_{10}) was detected in GW1 at concentrations of 3,380mg/L, which was above LOR but below assessment criteria.
- F2 (C_{10}-C_{15}) was detected in GW1 at concentrations of 310mg/L, which was above LOR but below assessment criteria.

13.3.3 PAH

As indicated in Table D, the PAH concentrations were below the assessment criteria.

14 DISCUSSION OF RESULTS

A summary of the soil results for this assessment are provided below:

14.1 Soil

- All of heavy metals concentrations from the primary soil samples analysed met their respective assessment criteria under the HIL 'D' land use scenario.
- All of the TRH, BTEX and naphthalene concentrations from primary soil samples analysed met their respective HSLs, ESLs and/or Management Limits.
- The PAHs (including benzo(a)pyrene (TEQ)), OCP & PCB concentrations from primary samples analysed met their HILs 'D', & ESLs criteria.
- Chrysotile Asbestos (0.001%w/w FA) was detected in sample BH2 (0.2-0.3m)

14.2 Groundwater

- All of heavy metals concentrations from the primary soil samples analysed met their respective assessment criteria under the HIL 'B' land use scenario, with the exception of the following:
  - Copper, Nickel and Zinc were detected in sample GW1 at concentrations above the freshwater criteria.
- All of the TRH, BTEX and PAH concentrations from primary groundwater samples analysed met their respective criteria, with the exception of the following:
  - F1 (C_6-C_{10}) was detected in GW1 at concentrations of 3,380mg/L, which was above LOR but below assessment criteria.
  - F2 (C_{10}-C_{15}) was detected in GW1 at concentrations of 310mg/L, which was above LOR but below assessment criteria.

Reference should be made to Figure 4 in Appendix A for a copy of the soil and groundwater exceedance location plan.

15 SITE MODEL

15.1 Conceptual Site Model

The refined Conceptual Site Model (CSM) presented in the table below provides a representation of the potential risks associated with the linkages between the following elements:

- Potential contamination sources and their associated contaminants of concern identified in Section 5. Only potential areas of concern with a significance rating of low to high were included;
- Potential human receptors that may be impacted by site contamination are current and future end-users, construction workers and the general public within the immediate vicinity;
- Potential environmental receptors identified in Section 4;
- Potential exposure pathways; and
- Whether each source-pathway-receptor pollution linkage are complete, limited or not present, based on current and future site conditions.

Table 28: Conceptual Site Model

Potential Sources	**Potential Receptor**	**Potential Exposure Pathways**	**Complete Linkages**	**Risk**	**Justification**
Chrysotile Asbestos in BH2 (0.2-0.3) UST and associated infrastructure Nickel Copper & Zinc in GW1 F1, F2 detections in GW1	Site users or the general public	Dermal contact, inhalation or ingestion of exposed impacted soils	Limited (Current)	Low	Impacted soils are below the existing concrete slabs.
			No (Future)	Negligible	If present, contaminated soils are likely to be remediated.
		Inhalation or ingestion of exposed impacted soils	Limited	Low	Impacted soils are below the existing concrete slabs.
			No (Future)	Negligible	If present, contaminated soils are likely to be remediated.
	The aquatic ecosystems at Brickmakers Creek	Migration of impacted groundwater and surface water run-off	Yes (Current)	Low	No obvious sources of contamination were observed on site that could migrate off site with surface water run-off.
			No (Future)	Negligible	If present, contaminated groundwater is likely to be remediated and any remaining residual contamination would likely be at negligible concentrations.
	Underlying Aquifer	Leaching and migration of contaminants through groundwater infiltration	Limited (Current)	Low	Groundwater infiltration is likely to be higher within sandy or weathered bedrock zones. However, this would be limited within higher strength bedrock at further depths where groundwater would be present within water bearing zones such as fractures and joints.
			No (Future)	Negligible	If present, contaminated soils are likely to be remediated and removed with the remaining soils from the basement excavation level for off-site disposal.
Asbestos in buildings	Site users or the general public	Inhalation or ingestion of airborne fibres	Limited (Current)	Low	Asbestos may exist in the main building, considering its age.
			No (Future)	Negligible	Contaminated soils are likely to be remediated and removed for off-site disposal.

16 CONCLUSION AND RECOMMENDATIONS

The findings of the assessment indicated the following areas of environmental concern:

SOILS:

- Chrysotile Asbestos (0.001%w/w FA) was detected in sample BH2 (0.2-0.3m)

GROUNDWATER:

- Copper, Nickel and Zinc were detected in sample GW1 at concentrations above the freshwater criteria.
- F1 (C_6-C_{10}) was detected in GW1 at concentrations of 3,380mg/L, which was above LOR but below assessment criteria.
- F2 (C_{10}-C_{15}) was detected in GW1 at concentrations of 310mg/L, which was above LOR but below assessment criteria.

The following data gaps were identified with respect to the pollution linkages:

- The lateral and/or vertical extent of BH2 is currently unknown and an appropriate remediation strategy should be devised as part of the remediation works to be carried out in the future for any proposed development.
- The contamination status below the USTs and associated infrastructure.

Based on the results of this investigation it is considered that the risks to human health and the environment associated with soil contamination at the site are low to moderate within the context of the current commercial land use.

However if the site is proposed to be re-developed in the future, the following requirements need to be considered in relation to making the site suitable for its intended land use:

- Re-assessment of investigative results under the proposed future land use 'HIL' guidelines.
- An appropriate remedial / management strategy is developed, culminating in preparation of a Remedial Action Plan (RAP) in accordance with EPA guidelines, in regards to the abovementioned soil exceedance locations BH2 as well as the USTs, and associated infrastructure.
- Another round of groundwater testing following remediation.
- Any soils requiring removal from the site, as part of future site works, should be classified in accordance with the "Waste Classification Guidelines, Part 1: Classifying Waste" NSW EPA (2014).

Thank you for the opportunity to undertake this work. We would be pleased to provide further information on any aspects of this report.

For and on behalf of
Aargus Pty Ltd

Written By:	**Reviewed By:**
	Mark Kelly
Con Kariotoglou	**Mark Kelly**
Project Manager / WHS Consultant	Environmental Manager

LIMITATIONS

The Aargus assessment is based on the result of limited site investigations and sample testing. Neither Aargus, nor any other reputable consultant, can provide unqualified warranties nor does Aargus assume any liability for site conditions not observed or accessible during the time of the investigations.

Despite all reasonable care and diligence, the materials encountered and concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. There is always some disparity in subsurface conditions across a site that cannot be fully defined by investigation. Hence it is unlikely that measurements and values obtained from sampling and testing during environmental works carried out at a site will characterise the extremes of conditions that exist within the site. In addition, site characteristics may change at any time in response to variations in natural conditions, chemical reactions, truck movement or contractor movement of soils and other events, e.g. groundwater movement and or spillages of contaminating substances. These changes may occur subsequent to Aargus investigations and assessment.

This report and associated documentation and the information herein have been prepared solely for the use of the client at the time or writing the report and is valid (for the purposes of management or transport of material) for a period of one month only from the date of issue. Any other reliance assumed by third parties on this report shall be at such parties' own risk. Any ensuing liability resulting from use of the report by third parties cannot be transferred to Aargus.

Whilst this report provides a review of site conditions encountered at sampling locations within the investigation, it should be noted that if materials are proposed to moved from site - Part 5.6, Section 143 of the Protection of the Environment Operations (POEO) Act 1997 states that is an offence for waste to be transported to a place that cannot lawfully be used as a facility to accept that waste. It is the duty of the owner and transporter of the waste to ensure that all material removed from a site must be accompanied by an appropriate waste classification report and materials are disposed of appropriately. An environmental or validation report does not constitute a waste classification report and results are treated differently. Aargus accepts no liability for the unlawful disposal of waste materials from any site. Aargus does not accept any responsibility for the material tracking, loading, management, transport or disposal of waste from the site. If material is to be removed from a site, before disposal of any material to a licensed landfill is undertaken, the site owner must ensure an appropriate waste classification exists for all materials on the site planning to be removed, the waste producer will need to obtain prior consent from the licensed landfill/recycler. The receiving site should check to ensure that the material received matches the description provided in the report.

Opinions are judgements, which are based on our understanding and interpretation of current regulatory standards, and should not be construed as legal opinions.

Appendix O – Important information about your environmental site report should also be read in conjunction with this report.

REFERENCES

This report was prepared with reference to the following guiding documents:

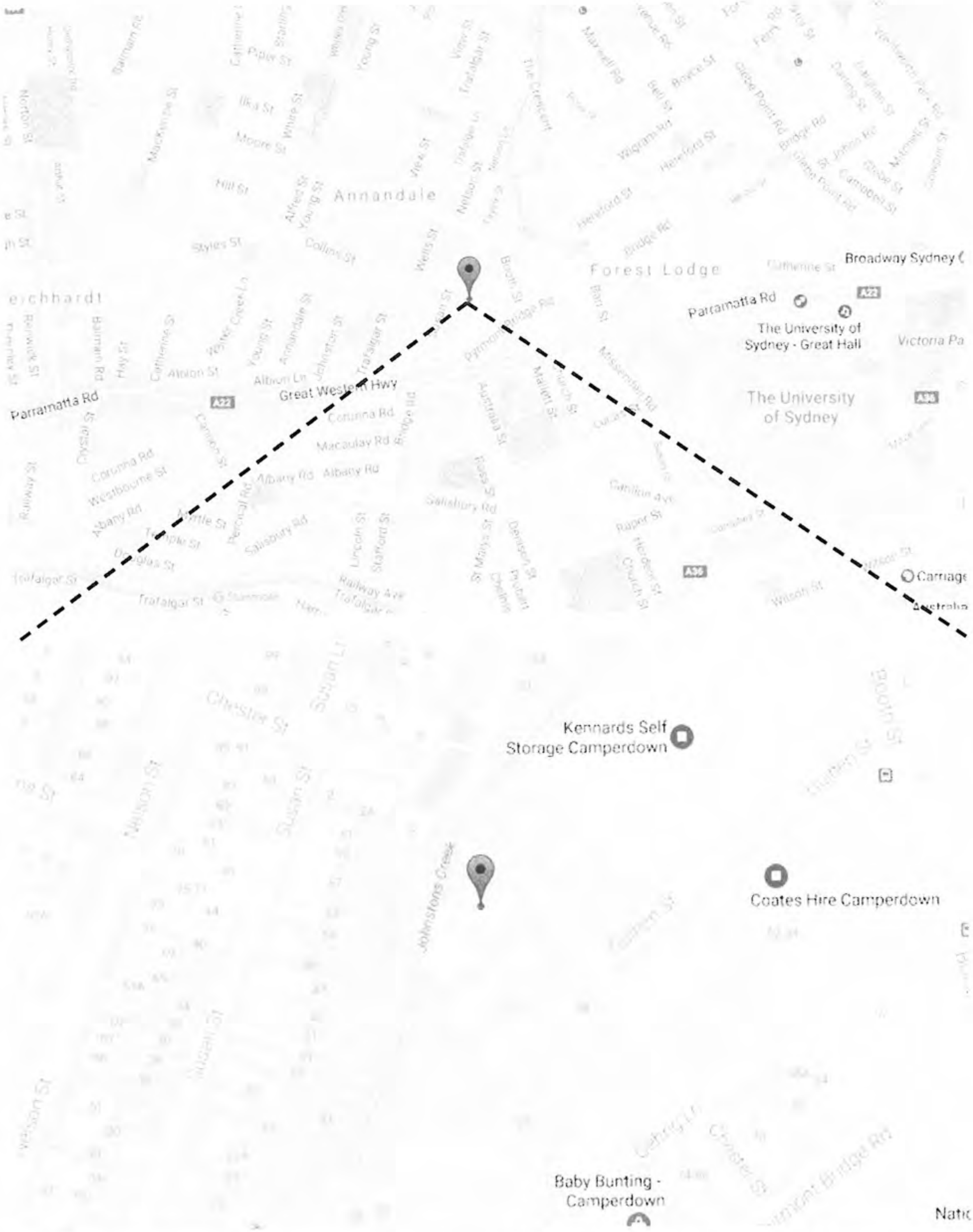
- ANZECC/NHMRC (1992) – "Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites". Australian and New Zealand Environment and Conservation Council and the National Health and Medical Research Council, Canberra.
- Department of Urban Affairs and Planning – EPA (1998) "Managing Land Contamination – Planning Guidelines – SEPP 55 – Remediation of Land".
- National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No.1).
- NSW DEC "Guidelines for the NSW Site Auditor Scheme" (2006, 2nd edition). NSW Environment Protection Authority, Sydney.
- NSW EPA (2014) – "Waste Classification Guidelines, Part 1: Classifying Waste";
- NSW EPA "Guidelines for Consultants Reporting on Contaminated Sites" (2011). NSW Environment Protection Authority, Sydney.
- NSW EPA "Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997" (2009). NSW Environment Protection Authority, Sydney;
- NSW EPA "Sampling Design Guidelines" (1995). NSW Environment Protection Authority, Sydney.

APPENDIX A

SITE PLANS

Aargus

SITE LOCALITY MAP



PROJECT DETAILS

Project Title	Preliminary Site Investigation
Project No.	ES6874
Client	Coach Painting Pty Ltd
Site Address	1-5 Chester Street, Annandale NSW

Aargus

DRAWING DETAILS

Figure No.	1	**Rev No.**	0
Scale	As above	**Size**	A4
Drawn by	SP	**Date**	01.06.2017
Approved by	MK	**Date**	01.06.2017

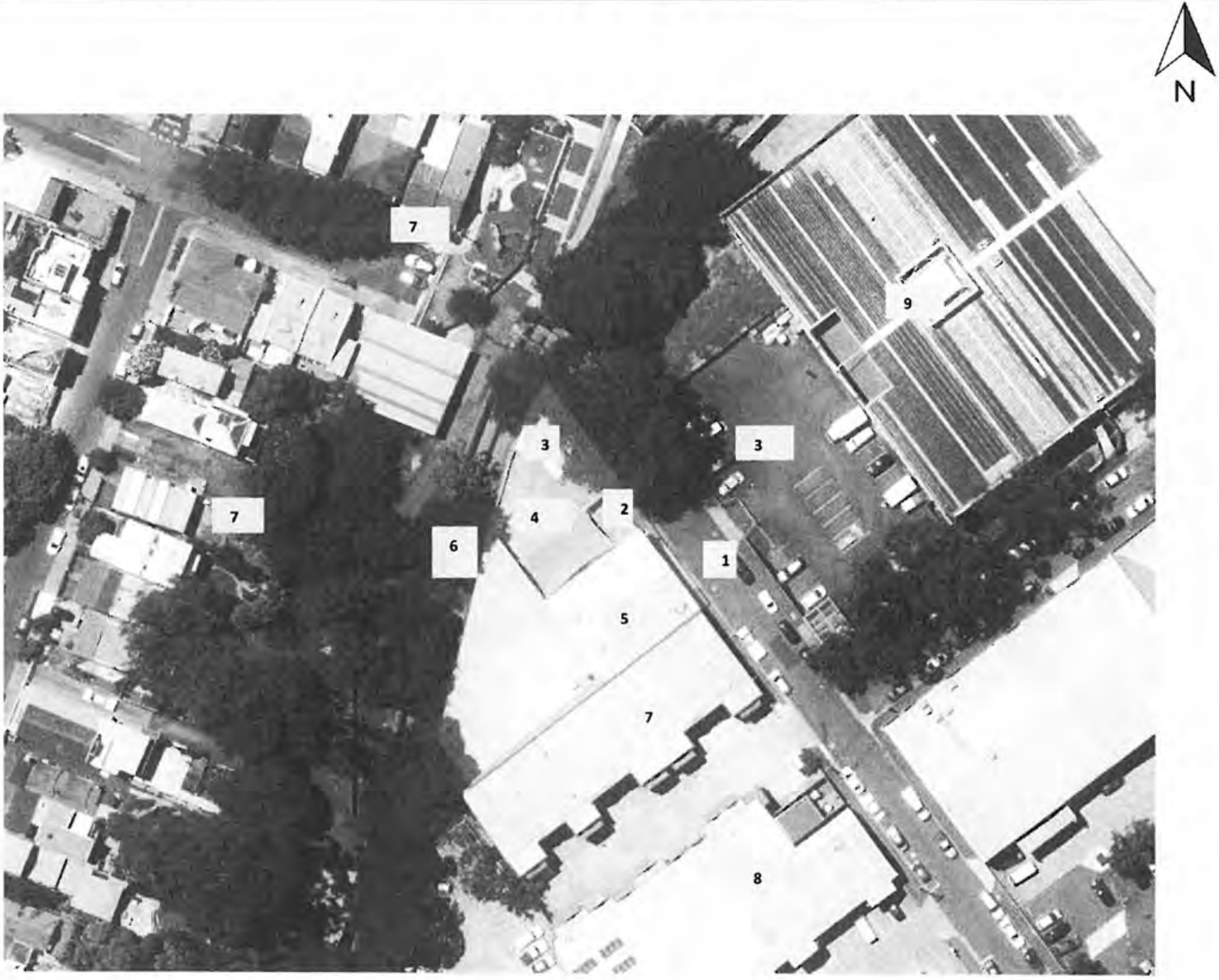
LOT & DEPOSITED PLAN

PROJECT DETAILS	
Project Title	Preliminary Site Investigation
Project No.	ES6874
Client	Coach Painting Pty Ltd
Site Address	1-5 Chester Street, Annandale NSW

Aargus

DRAWING DETAILS			
Figure No.	2	**Rev No.**	0
Scale	As above	**Size**	A4
Drawn by	SP	**Date**	01.06.2017
Approved by	MK	**Date**	01.06.2017

SITE FEATURES



SITE FEATURES - LEGEND

1. Chester Street
2. Driveway sealed with asphalt
3. Car wash bay
4. Open car park
5. Spray Booth inside
6. Johnstons Creek
7. Neighbouring Low to medium Residential properties
8. Neighbouring Commercial warehouses and offices
9. Neighbouring Kennards Self Storage

PROJECT DETAILS	
Project Title	Preliminary Site Investigation
Project No.	ES6874
Client	Coach Painting Pty Ltd
Site Address	1-5 Chester Street, Annandale NSW

Aargus

DRAWING DETAILS			
Figure No.	3	**Rev No.**	0
Scale	As above	**Size**	A4
Drawn by	LC	**Date**	05.06.2017
Approved by	MK	**Date**	05.06.2017

SAMPLING LOCATIONS

Source: http://maps.six.nsw.gov.au/

LEGEND	
□	Site Boundary
●	Borehole Sampling Locations
●	Groundwater Sampling Locations
⬚	USTs

PROJECT DETAILS	
Project Title	Preliminary Site Investigation
Project No.	ES6874
Client	Coach Painting Pty Ltd
Site Address	1-5 Chester Street, Annandale NSW

Aargus

DRAWING DETAILS			
Figure No.	4	**Rev No.**	0
Scale	As above	**Size**	A4
Drawn by	LC	**Date**	05.06.2017
Approved by	MK	**Date**	05.06.2017

APPENDIX B

SITE PHOTOGRAPHS

Aargus

Photograph N° 7

View of 1-5 Chester St, Annandale.
Showing **Borehole Location BH3**
Looking southwest. Inspected on 13.05.2017

Photograph N° 8

View of 1-5 Chester St, Annandale.
Showing **Borehole Location BH4**
Looking southwest. Inspected on 13.05.2017

Photograph N° 9

View of 1-5 Chester St, Annandale.
Showing **Borehole Location BH5**
Looking south. Inspected on 13.05.2017

Photograph N° 10

View of 1-5 Chester St, Annandale.
Showing **Borehole Location BH6**
Looking west. Inspected on 13.05.2017

Photograph N° 11

View of 1-5 Chester St, Annandale.
Showing **Borehole Location BH7**
Looking east. Inspected on 13.05.2017

Photograph N° 12

View of 1-5 Chester St, Annandale.
Showing **UST location.**
Looking south. Inspected on 13.05.2017

APPENDIX C

LAND TITLES

Aargus

13815125

NEW SOUTH WALES

[redacted]FICATE OF TITLE

[redacted]AL PROPERTY ACT, 1900

Vol. 13815 Fol. 125

Appln. No.3149

Prior Title Vol.12207 Fol.69

EDITION ISSUED

5 3 1979

(Page 1) Vol. 13815 Fol. 125

I certify that the person described in the First Schedule is the registered proprietor of the undermentioned estate in the land within described subject nevertheless to such exceptions encumbrances and interests as are shown in the Second Schedule.

CANCELLED

Registrar General

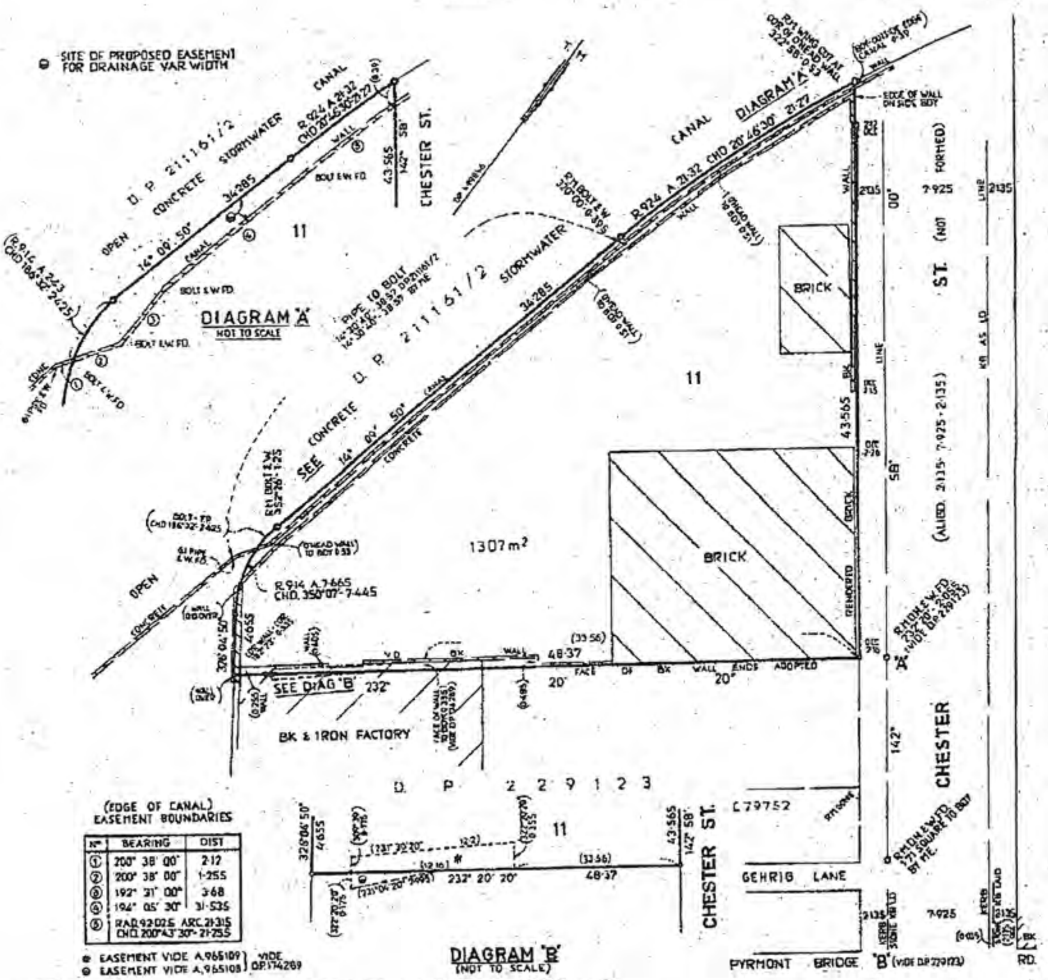
SEE AUTO FOLIO

PERSONS ARE CAUTIONED AGAINST ALTERING OR ADDING TO THIS CERTIFICATE OR ANY NOTIFICATION HEREON

WARNING: THIS DOCUMENT MUST NOT BE REMOVED FROM THE REGISTRAR GENERAL'S OFFICE.

PLAN SHOWING LOCATION OF LAND

LENGTHS ARE IN METRES



(EDGE OF CANAL)
EASEMENT BOUNDARIES

Nº	BEARING	DIST
①	200° 38' 00"	2·12
②	200° 38' 00"	1·255
③	192° 31' 00"	3·68
④	194° 05' 30"	31·535
⑤	RAD.92·025 ARC.21·315 CHD.200°43'30"-21·255	

- ● EASEMENT VIDE A.965109 } VIDE DP.174269
- ◎ EASEMENT VIDE A.965108 }

R53868 S

ESTATE AND LAND REFERRED TO

Estate in Fee Simple in Lot 11 in Deposited Plan 499846 at Camperdown in the Municipality of Leichhardt Parish of Petersham and County of Cumberland being part of 97.13 hectares granted to William Bligh on 10-8-1806.

FIRST SCHEDULE

PETER JOHN FITZHENRY of Camperdown, Company Director.

GRY

SECOND SCHEDULE

1. Reservations and conditions, if any, contained in the Crown Grant above referred to.
2. EA A965109 Easement appurtenant to the land above described affecting the land shown so burdened in the plan hereon.
3. EA A965109 Easement affecting the part of the land above described shown so burdened in the plan hereon.
4. ~~Q112175 Mortgage to The Commercial Bank of Australia Limited.~~ V912295
5. ~~Q634859 Mortgage to A.G.C. (Advances) Limited.~~ Discharged S63712

NOTE: ENTRIES RULED THROUGH AND AUTHENTICATED BY THE SEAL OF THE REGISTRAR GENERAL ARE CANCELLED

Vol. 13815 Fol. 125

C.T. 27-8-80.
S637:2 D/m
Q112175 Mtge.
4-7-83
T652375 M
— 6 Pm/k
V16339 T/A
V16340 N/D
V912295 D/M.
6 D/M

FIRST SCHEDULE (continued)

REGISTERED PROPRIETOR	INSTRUMENT		REGISTERED	Signature of Registrar General
	NATURE	NUMBER		

CANCELLED

SEE AUTO FOLIO

SECOND SCHEDULE (continued)

INSTRUMENT		PARTICULARS	REGISTERED	Signature of Registrar General	CANCELLATION	
NATURE	NUMBER					
~~T652375~~		~~Mortgage to Doris Ellen Lambert, Neville Reginald Wills, David Bernard Whitehouse, Susan Ellen Rocchi, Greig Melville Baldwin, Phylis Doreen Baldwin and Wolfgang Gerhard Liers - for tenancy see dealing. Registered 25-8-1983~~			Discharged	V912296
~~T652376~~		~~Postponement of Mortgage. Priority T652375, Q112175. Registered 25-8-1983~~				
~~Q112175~~		~~Mortgage. Mortgagee now Westpac Banking Corporation. See T652376 and T282693. Registered 26-8-1983.~~			Cancelled	V912295
~~T652376~~		~~Postponement of Mortgage. Priority now T652375, Q112175. Registered 26-8-1983.~~			Cancelled	V912296
~~T652375~~		~~Mortgage. Mortgagees: Davydde Geoffrey Owens, Neville Reginald Wills, David Bernard Whitehouse, Susan Ellen Rocchi, Greig Melville Baldwin, Phylis Doreen Baldwin, Wolfgang Gerhard Liers - for tenancy see dealing, by Transmission V16339 and Notice of Death V16340. Registered 15-3-1984~~			Cancelled	V912296

REG. GEN.

REG GEN 26-8-1983

(Page 2 of 2 pages)

NOTE: ENTRIES RULED THROUGH AND AUTHENTICATED BY THE SEAL OF THE REGISTRAR GENERAL ARE CANCELLED

12207069

C[redacted]CATE OF TITLE

NEW SOUTH WALES

[redacted]ROPERTY ACT, 1900

Appln. No.3149

Prior Title Vol.4954 Fol.225

Vol. 12207 Fol. 69

Edition issued 5-9-1973.

N338644

CANCELLED

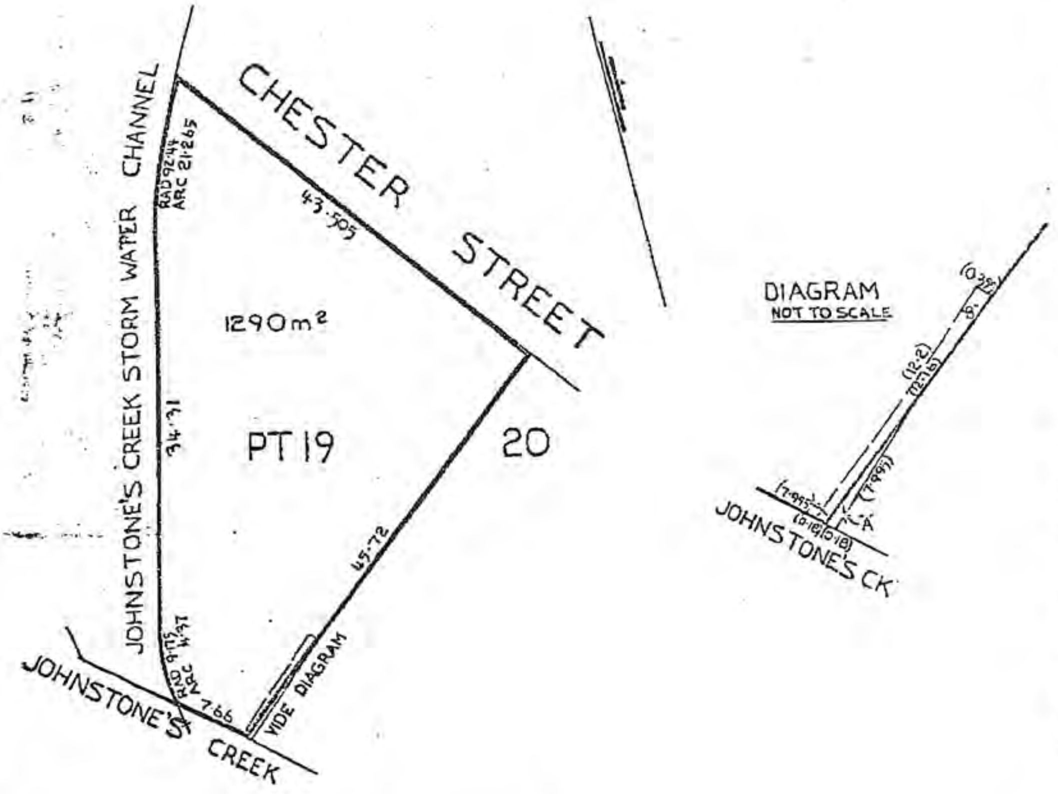
(Page 1) Vol. 12207 Fol. 69

I certify that the person described in the First Schedule is the registered proprietor of the undermentioned estate in the land within described subject nevertheless to such exceptions encumbrances and interests as are shown in the Second Schedule.

Registrar General.

PLAN SHOWING LOCATION OF LAND

LENGTHS ARE IN METRES



N338644

REDUCTION RATIO 1:500

ESTATE AND LAND REFERRED TO

Estate in Fee Simple in the part of Lot 19 in Deposited Plan 231 in the Municipality of Leichhardt Parish of Petersham County of Cumberland being also part of 97.13 hectares granted to William Bligh on 10-8-1806.

FIRST SCHEDULE

~~MADAME MAGDA KORNER of Woollahra, Beautician.~~

SECOND SCHEDULE

1. Reservations and conditions, if any, contained in the Crown Grant above referred to.
2. Easement created by Transfer No.A965108 appurtenant to the land above described affecting the piece of land designated A in the plan hereon.
3. Easement created by Transfer No.A965109 affecting the part of the land above described shown designated B in the plan hereon.

Registrar General.

PERSONS ARE CAUTIONED AGAINST ALTERING OR ADDING TO THIS CERTIFICATE OR ANY NOTIFICATION HEREON

WARNING THIS DOCUMENT MUST NOT BE REMOVED FROM THE LAND TITLES OFFICE

NOTE: ENTRIES RULED THROUGH AND AUTHENTICATED BY THE SEAL OF THE REGISTRAR GENERAL ARE CANCELLED

Vol. 12207 Fol 69

V. C. N. BLIGHT, GOVERNMENT PRINTER

FIRST SCHEDULE (continued)

REGISTERED PROPRIETOR	INSTRUMENT NATURE	INSTRUMENT NUMBER	INSTRUMENT DATE	ENTERED	Signature of Registrar General
~~Peter John Fitzhenry of Camperdown, Company Director and Clifton George Vincent of Point Piper, Company Director as tenants in common~~	~~Transfer~~	~~N338645~~	~~21-6-1973~~	~~27-9-1973~~	
Peter John Fitzhenry of Camperdown, Company Director	Transfer	Q112174	—	14-3-1977	

This Deed is cancelled and Certificate of Title issued.
Vol. 13815 Fol 125 dated 5/3/1979
Vide: R53868
Registrar General

N338645 Te.
/46 mtge.
Q112173 D/m
— 74T
R — 75m
CT 20/3/78.
Q631859 M/R
78M 251
AMENDMENT SURVEY
CT 24/7/78
CT 19/12/78
R53868 Sec 11 App

SECOND SCHEDULE (continued)

INSTRUMENT NATURE	INSTRUMENT NUMBER	INSTRUMENT DATE	PARTICULARS	ENTERED	Signature of Registrar General	CANCELLATION		
~~Mortgage~~	~~N338646~~	~~21-6-1973~~	~~to The Commercial Bank of Australia Limited.~~	~~27-9-1973~~		Discharged	Q112173	
Mortgage	Q112175	—	to The Commercial Bank of Australia Limited	14-3-1977				
Mortgage	Q631859	—	to A.G.C. (Advances) Limited.	6-4-1978				

(Page 2 of 2 pages)

RG 2/60A

NOTE: ENTRIES RULED THROUGH AND AUTHENTICATED BY THE SEAL OF THE REGISTRAR GENERAL ARE CANCELLED

Land & Property Information

TITLE SEARCH

Computer Folio Certificate issued under
Section 96D of the Real Property Act 1900

No. 91

Search certified to:
17/5/2017 10:09 AM

COMPUTER FOLIO REFERENCE	
11/499846	
EDITION No. & DATE OF CURRENT CERTIFICATE OF TITLE	
2	12/1/2004

Page 1

LAND

LOT 11 IN DEPOSITED PLAN 499846
AT CAMPERDOWN
LOCAL GOVERNMENT AREA INNER WEST
PARISH OF PETERSHAM COUNTY OF CUMBERLAND
TITLE DIAGRAM DP499846

FIRST SCHEDULE

PETER JOHN FITZHENRY

SECOND SCHEDULE (3 NOTIFICATIONS)
----

1 RESERVATIONS AND CONDITIONS IN THE CROWN GRANT(S)
2 A965109 EASEMENT APPURTENANT TO THE LAND ABOVE DESCRIBED AFFECTING THE LAND SHOWN SO BURDENED IN DP174289
3 A965109 EASEMENT AFFECTING THE PART OF THE LAND ABOVE DESCRIBED SHOWN SO BURDENED IN DP174289

NOTATIONS

UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

The Registrar General certifies that at the date and time specified above the person(s) described in the First Schedule was the registered proprietor of an estate in fee simple (or other such estate or interest set out in the Schedule) in the land described, subject to any exceptions, encumbrances, interests and entries which appear in the Second Schedule.

* ANY ENTRIES PRECEDED BY AN ASTERISK DO NOT APPEAR ON THE CURRENT EDITION OF THE CERTIFICATE OF TITLE
WARNING: THE INFORMATION APPEARING UNDER NOTATIONS HAS NOT BEEN FORMALLY RECORDED IN THE REGISTER.

Registrar General

NSW GOVERNMENT Land & Property Information

HISTORICAL TITLE SEARCH

Certificate issued under Section 96G
of the Real Property Act 1900

No. 92

Search certified to: 17/5/2017 10:09AM

Computer Folio Reference: 11/499846

First Title(s): SEE PRIOR TITLE(S)
Prior Title(s): VOL 13815 FOL 125

Recorded	Number	Type of Instrument	C.T. Issue
21/8/1988		TITLE AUTOMATION PROJECT	LOT RECORDED FOLIO NOT CREATED
6/12/1988		CONVERTED TO COMPUTER FOLIO	FOLIO CREATED CT NOT ISSUED
29/5/1997	3103533	MORTGAGE	EDITION 1
12/1/2004	AA315578	DISCHARGE OF MORTGAGE	EDITION 2
21/3/2004	AA501351	DEPARTMENTAL DEALING	
15/5/2014	AI580195	DEPARTMENTAL DEALING	

*** END OF SEARCH ***

The Registrar General certifies that at the date and time specified above the information set out in this search constitutes the historical record of all dealings recorded in or action taken in respect of the mentioned title which is required to be kept by the Registrar General under section 32(7) of the Real Property Act 1900.

Registrar General

APPENDIX D

NSW EPA RECORDS

NSW EPA

Healthy Environment, Healthy Community, Healthy Business

Home Contaminated land Record of notices

Search results

Your search for:Suburb: CAMPERDOWN

Matched 1 notice relating to 1 site.

Search Again

Refine Search

Suburb	Address	Site Name	Notices related to this site
CAMPERDOWN	Salisbury LANE	O'Dea Reserve	1 former

Page 1 of 1

1 June 2017

NSW EPA

Healthy Environment, Healthy Community, Healthy Business

Home Contaminated land Record of notices

Site and notice details

Your search for: Suburb: CAMPERDOWN 1 notice on 1 site were matched.

Return to list of search results

Search Again Refine Search

Area No: 3342

The information below was correct at the time the notices were issued.

Site: O'Dea Reserve
Address: Salisbury LANE, CAMPERDOWN
LGA: Marrickville Council

Owner: Marrickville Council
Lot 1-4 DP 600644

Notices relating to this site (0 current and 1 former)

(Map) where available, maps show the part of the site affected by the notice

* notice matched search criteria

Notice recipient	Notice type & number	Status	Date
Marrickville Council	Agreed Voluntary Remediation Proposal * 26029	Former	Issued 20 Dec 2002 Completed 07 Oct 2005

1 June 2017

NSW EPA

Healthy Environment, Healthy Community, Healthy Business

Home > Environment protection licences > POEO Public Register >
Search for licences, applications and notices

Search results

Your search for: **General Search** with the following criteria

Suburb - CAMPERDOWN

returned 4 results

Export to excel 1 of 1 Pages Search Again

Number	Name	Location	Type	Status	Issued date
289	SYDNEY SOUTH WEST AREA HEALTH SERVICE	MISSENDEN ROAD, CAMPERDOWN, NSW 2050	POEO licence	No longer in force	14 Aug 2000
1044227	SYDNEY SOUTH WEST AREA HEALTH SERVICE	MISSENDEN ROAD, CAMPERDOWN, NSW 2050	s.58 Licence Variation	Issued	08 Feb 2005
6068	THE PRETERM FOUNDATION	300 BRIDGE ROAD, CAMPERDOWN, NSW 2050	POEO licence	Surrendered	09 May 2000
1018967	THE PRETERM FOUNDATION	300 BRIDGE ROAD, CAMPERDOWN, NSW 2050	s.58 Licence Variation	Issued	22 Oct 2002

01 June 2017

Connect

Feedb

Web s
[illegible]

APPENDIX E

LOCAL METEOROLOGY

Australian Government
Bureau of Meteorology

Climate statistics for Australian locations

Monthly climate statistics

All years of record

Site information

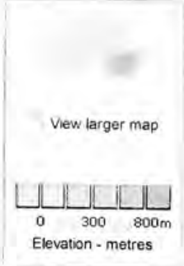
Site name: SYDNEY OLYMPIC PARK (SYDNEY OLYMPIC PK (
Site number: 066195
Latitude: 33.85 °S **Longitude:** 151.06 °E
Elevation: 28 m
Commenced: 1995 **Status:** Open
Latest available data: 30 Aug 2011

Additional information

Additional site information

Nearest alternative sites

1. 066046 PARRAMATTA (7.1km)
2. 066194 CANTERBURY RACECOURSE AWS (7.4km)
3. 066124 PARRAMATTA NORTH (MASONS DRIVE) (7.9km)



View: ● Main statistics ○ All available | **Period:** 30 year period not available | **Text size:** ● Normal ○ Large

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Temperature															
Mean maximum temperature (°C)	28.4	28.1	26.6	23.9	20.8	18.3	17.6	19.5	22.5	24.3	25.3	27.4	23.6	16	1996 2011
Mean minimum temperature (°C)	19.3	19.4	17.8	14.3	11.2	8.9	7.8	8.7	11.6	13.7	15.8	17.9	13.9	16	1996 2011
Rainfall															
Mean rainfall (mm)	84.4	109.8	66.0	89.2	88.2	75.8	63.5	56.7	52.7	64.9	76.2	58.0	911.8	14	1995 2011
Decile 5 (median) rainfall (mm)	65.2	109.4	52.4	65.6	54.8	59.1	53.9	30.4	48.0	47.0	68.4	54.4	899.5	16	1995 2011
Mean number of days of rain ≥ 1 mm	7.6	7.7	7.6	6.9	7.7	6.9	6.3	4.4	5.5	7.1	7.8	6.8	82.3	15	1995 2011
Other daily elements															
Mean daily sunshine (hours)															
Mean number of clear days															
Mean number of cloudy days															
9 am conditions															
Mean 9am temperature (°C)	22.3	21.9	20.3	18.0	14.6	12.0	11.2	12.9	16.4	18.7	19.6	21.5	17.4	15	1996 2010
Mean 9am relative humidity (%)	67	72	72	68	70	71	68	61	57	56	64	64	66	15	1996 2010
Mean 9am wind speed (km/h)	9.6	9.3	8.4	9.5	10.5	10.9	11.0	11.6	11.8	11.1	11.4	10.0	10.4	14	1996 2010
3 pm conditions															
Mean 3pm temperature (°C)	26.3	26.1	24.9	22.4	19.5	17.3	16.6	18.1	20.6	22.1	23.2	25.3	21.9	15	1996 2010
Mean 3pm relative humidity (%)	53	55	53	51	51	52	48	41	43	45	51	50	49	15	1996 2010
Mean 3pm wind speed (km/h)	19.0	17.3	16.0	14.2	12.6	12.5	13.5	15.8	17.6	18.6	19.3	19.4	16.3	14	1996 2010

red = highest value blue = lowest value

Product IDCJCM0028 Prepared at Thu 01 Jun 2017 02:24:43 AM EST

Monthly statistics are only included if there are more than 10 years of data. The number of years (provided in the 2nd last column of the table) may differ between elements if the observing program at the site changed. More detailed data for individual sites can be obtained by contacting the Bureau.

Related Links

This page URL: http://www.bom.gov.au/climate/averages/tables/cw_066195.shtml
About climate averages: http://www.bom.gov.au/climate/cdo/about/about-stats.shtml
Bureau of Meteorology website: http://www.bom.gov.au

Page created: Thu 01 Jun 2017 02:24:43 AM EST

This page was created at on

APPENDIX F

Table 1A(1) Health investigation levels for soil contaminants

Chemical	Health-based investigation levels (mg/kg)			
	Residential[1] A	Residential[1] B	Recreational[1] C	Commercial/ industrial[1] D
Metals and Inorganics				
Arsenic[2]	100	500	300	3 000
Beryllium	60	90	90	500
Boron	4500	40 000	20 000	300 000
Cadmium	20	150	90	900
Chromium (VI)	100	500	300	3600
Cobalt	100	600	300	4000
Copper	6000	30 000	17 000	240 000
Lead[3]	300	1200	600	1 500
Manganese	3800	14 000	19 000	60 000
Mercury (inorganic)[5]	40	120	80	730
Methyl mercury[4]	10	30	13	180
Nickel	400	1200	1200	6 000
Selenium	200	1400	700	10 000
Zinc	7400	60 000	30 000	400 000
Cyanide (free)	250	300	240	1 500
Polycyclic Aromatic Hydrocarbons (PAHs)				
Carcinogenic PAHs (as BaP TEQ)[6]	3	4	3	40
Total PAHs[7]	300	400	300	4000
Phenols				
Phenol	3000	45 000	40 000	240 000
Pentachlorophenol	100	130	120	660
Cresols	400	4 700	4 000	25 000
Organochlorine Pesticides				
DDT+DDE+DDD	240	600	400	3600
Aldrin and dieldrin	6	10	10	45
Chlordane	50	90	70	530
Endosulfan	270	400	340	2000
Endrin	10	20	20	100
Heptachlor	6	10	10	50
HCB	10	15	10	80
Methoxychlor	300	500	400	2500
Mirex	10	20	20	100
Toxaphene	20	30	30	160
Herbicides				
2,4,5-T	600	900	800	5000

Chemical	Health-based investigation levels (mg/kg)			
	Residential[1] A	Residential[1] B	Recreational[1] C	Commercial/ industrial[1] D
2,4-D	900	1600	1300	9000
MCPA	600	900	800	5000
MCPB	600	900	800	5000
Mecoprop	600	900	800	5000
Picloram	4500	6600	5700	35000
Other Pesticides				
Atrazine	320	470	400	2500
Chlorpyrifos	160	340	250	2000
Bifenthrin	600	840	730	4500
Other Organics				
PCBs[8]	1	1	1	7
PBDE Flame Retardants (Br1–Br9)	1	2	2	10

Notes:

(1) Generic land uses are described in detail in Schedule B7 Section 3

HIL A – Residential with garden/accessible soil (home grown produce <10% fruit and vegetable intake (no poultry), also includes childcare centres, preschools and primary schools.

HIL B – Residential with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments.

HIL C – Public open space such as parks, playgrounds, playing fields (e.g. ovals), secondary schools and footpaths. This does not include undeveloped public open space where the potential for exposure is lower and where a site-specific assessment may be more appropriate.

HIL D – Commercial/industrial, includes premises such as shops, offices, factories and industrial sites.

(2) Arsenic: HIL assumes 70% oral bioavailability. Site-specific bioavailability may be important and should be considered where appropriate (refer Schedule B7).

(3) Lead: HIL is based on blood lead models (IEUBK for HILs A, B and C and adult lead model for HIL D where 50% oral bioavailability has been considered. Site-specific bioavailability may be important and should be considered where appropriate.

(4) Methyl mercury: assessment of methyl mercury should only occur where there is evidence of its potential source. It may be associated with inorganic mercury and anaerobic microorganism activity in aquatic environments. In addition the reliability and quality of sampling/analysis should be considered.

(5) Elemental mercury: HIL does not address elemental mercury. A site-specific assessment should be considered if elemental mercury is present, or suspected to be present.

(6) Carcinogenic PAHs: HIL is based on the 8 carcinogenic PAHs and their TEFs (potency relative to B(a)P) adopted by CCME 2008 (refer Schedule B7). The B(a)P TEQ is calculated by multiplying the concentration of each carcinogenic PAH in the sample by its B(a)P TEF, given below, and summing these products.

PAH species	TEF	PAH species	TEF
Benzo(a)anthracene	0.1	Benzo(g,h,i)perylene	0.01
Benzo(a)pyrene	1	Chrysene	0.01

Benzo(b+j)fluoranthene	0.1	Dibenz(a,h)anthracene	1
Benzo(k)fluoranthene	0.1	Indeno(1,2,3-c,d)pyrene	0.1

Where the B(a)P occurs in bitumen fragments it is relatively immobile and does not represent a significant health risk.

(7) Total PAHs: HIL is based on the sum of the 16 PAHs most commonly reported for contaminated sites (WHO 1998). The application of the total PAH HIL should consider the presence of carcinogenic PAHs and naphthalene (the most volatile PAH). Carcinogenic PAHs reported in the total PAHs should meet the B(a)P TEQ HIL. Naphthalene reported in the total PAHs should meet the relevant HSL.

(8) PCBs: HIL relates to non-dioxin-like PCBs only. Where a PCB source is known, or suspected, to be present at a site, a site-specific assessment of exposure to all PCBs (including dioxin-like PCBs) should be undertaken.

Table 1A(2) Interim soil vapour health investigation levels for volatile organic chlorinated compounds

Chemical	Interim soil vapour HIL (mg/m³)			
	Residential[1] A	Residential[1] B	Recreational[1] C	Commercial / Industrial[1] D
TCE	0.02	0.02	0.4	0.08
1,1,1-TCA	60	60	1200	230
PCE	2	2	40	8
cis-1,2-dichloroethene	0.08	0.08	2	0.3
Vinyl chloride	0.03	0.03	0.5	0.1

Notes:

1. Land use settings are equivalent to those described in Table 1A(1) Footnote 1 and Schedule B7, though secondary school buildings should be assessed using residential 'A/B' for vapour intrusion purposes.
2. Interim HILs for VOCCs are conservative soil vapour concentrations that can be adopted for the purpose of screening sites where further investigation is required on a site-specific basis. They are based on the potential for vapour intrusion using an indoor air-to-soil vapour attenuation factor of 0.1 and an outdoor air-to-soil vapour attenuation factor of 0.05.
3. Application of the interim HILs is based on a measurement of shallow (to 1 m depth) soil vapour (or deeper where the values are to be applied to a future building with a basement) or sub-slab soil vapour.
4. The applicability of the interim HILs needs to be further considered when used for other building types such as homes with a crawl-space and no slab, which may require site-specific assessment.
5. Use of the interim HILs requires comparison with data that has been collected using appropriate methods and meets appropriate data quality requirements.
6. Oral and dermal exposure should be considered on a site-specific basis where direct contact exposure is likely to occur.

Table 1A(3) Soil HSLs for vapour intrusion (mg/kg)

	HSL A & HSL B Low – high density residential				HSL C recreational / open space				HSL D Commercial / Industrial				
CHEMICAL	**0 m to <1 m**	**1 m to <2 m**	**2 m to <4m**	**4 m+**	**0 m to <1 m**	**1 m to <2 m**	**2 m to <4 m**	**4 m+**	**0 m to <1 m**	**1 m to <2 m**	**2 m to <4 m**	**4 m+**	**Soil saturation concentration (Csat)**
SAND													
Toluene	160	220	310	540	NL	NL	NL	NL	NL	NL	NL	NL	560
Ethylbenzene	55	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	64
Xylenes	40	60	95	170	NL	NL	NL	NL	230	NL	NL	NL	300
Naphthalene	3	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	9
Benzene	0.5	0.5	0.5	0.5	NL	NL	NL	NL	3	3	3	3	360
F1(9)	45	70	110	200	NL	NL	NL	NL	260	370	630	NL	950
F2(10)	110	240	440	NL	NL	NL	NL	NL	NL	NL	NL	NL	560
SILT													
Toluene	390	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	640

	HSL A & HSL B Low - high density residential				HSL C recreational / open space				HSL D Commercial / Industrial				
Ethylbenzene	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	69
Xylenes	95	210	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	330
Naphthalene	4	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	10
Benzene	0.6	0.7	1	2	NL	NL	NL	NL	4	4	6	10	440
F1(9)	40	65	100	190	NL	NL	NL	NL	250	360	590	NL	910
F2(10)	230	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	570
CLAY													
Toluene	480	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	630
Ethylbenzene	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	68
Xylenes	110	310	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	330
Naphthalene	5	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	10
Benzene	0.7	1	2	3	NL	NL	NL	NL	4	6	9	20	430
F1(9)	50	90	150	290	NL	NL	NL	NL	310	480	NL	NL	850
F2(10)	280	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	560

Notes:

(1) Land use settings are equivalent to those described in Table 1A(1) Footnote 1 and Schedule B7. HSLs for vapour intrusion for high density residential assume residential occupation of the ground floor. If communal car parks or commercial properties occupy the ground floor, HSL D should be used.

(2) The key limitations of the HSLs should be referred to prior to application and are presented in Friebel and Nadebaum (2011b and 2011d).

(3) Detailed assumptions in the derivation of the HSLs and information on how to apply the HSLs are presented in Friebel and Nadebaum (2011a and 2011b).

(4) Soil HSLs for vapour inhalation incorporate an adjustment factor of 10 applied to the vapour phase partitioning to reflect the differences observed between theoretical estimates of soil vapour partitioning and field measurements. Refer Friebel & Nadebaum (2011a) for further information.

(5) 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'.

(6) The HSLs for TPH C_6-C_{10} in sandy soil are based on a finite source that depletes in less than seven years, and therefore consideration has been given to use of sub-chronic toxicity values. The >C_8-C_{10} aliphatic toxicity has been adjusted to represent sub-chronic exposure, resulting in higher HSLs than if based on chronic toxicity. For further information refer to Section 8.2 and Appendix J in Friebel and Nadebaum (2011a).

(7) The figures in the above table may be multiplied by a factor to account for biodegradation of vapour. A factor of 10 may apply for source depths from 2 m to <4 m or a factor of 100 for source depths of 4 m and deeper. To apply the attenuation factor for vapour degradation, a number of conditions must be satisfied. Firstly the maximum length of the shorter side of the concrete slab and surrounding pavement cannot exceed 15 m, as this would prevent oxygen penetrating to the centre of the slab. Secondly, measurement of oxygen in the subsurface is required to determine the potential for biodegradation. Oxygen must be confirmed to be present at >5% to use these factors.

(8) For soil texture classification undertaken in accord with AS 1726, the classifications of sand, silt and clay may be applied as coarse, fine with liquid limit <50% and fine with liquid limit>50% respectively, as the underlying properties to develop the HSLs may reasonably be selected to be similar. Where there is uncertainty, either a conservative approach may be adopted or laboratory analysis should be carried out.

(9) To obtain F1 subtract the sum of BTEX concentrations from the C_6-C_{10} fraction.

(10) To obtain F2 subtract naphthalene from the >C_{10}-C_{16} fraction.

Table 1A(4) Groundwater HSLs for vapour intrusion (mg/L)

CHEMICAL	HSL A & HSL B Low – high density residential			HSL C recreational / open space			HSL D Commercial / industrial			Solubility limit
	2 m to <4 m	4 m to <8 m	8 m+	2 m to <4 m	4 m to <8 m	8 m+	2 m to <4 m	4 m to <8 m	8 m+	
SAND										
Toluene	NL	NL	NL	NL	NL	NL	NL	NL	NL	61
Ethylbenzene	NL	NL	NL	NL	NL	NL	NL	NL	NL	3.9
Xylenes	NL	NL	NL	NL	NL	NL	NL	NL	NL	21
Naphthalene	NL	NL	NL	NL	NL	NL	NL	NL	NL	0.17
Benzene	0.8	0.8	0.9	NL	NL	NL	5	5	5	59
F1(7)	1	1	1	NL	NL	NL	6	6	7	9.0
F2(8)	1	1	1	NL	NL	NL	NL	NL	NL	3.0
SILT										
Toluene	NL	NL	NL	NL	NL	NL	NL	NL	NL	61
Ethylbenzene	NL	NL	NL	NL	NL	NL	NL	NL	NL	3.9
Xylenes	NL	NL	NL	NL	NL	NL	NL	NL	NL	21

	HSL A & HSL B Low – high density residential			HSL C recreational / open space			HSL D Commercial / industrial			
Naphthalene	NL	NL	NL	NL	NL	NL	NL	NL	NL	0.17
Benzene	4	5	5	NL	NL	NL	30	30	30	59
F1(7)	6	6	6	NL	NL	NL	NL	NL	NL	9.0
F2(8)	NL	NL	NL	NL	NL	NL	NL	NL	NL	3.0
CLAY										
Toluene	NL	NL	NL	NL	NL	NL	NL	NL	NL	61
Ethylbenzene	NL	NL	NL	NL	NL	NL	NL	NL	NL	3.9
Xylenes	NL	NL	NL	NL	NL	NL	NL	NL	NL	21
Naphthalene	NL	NL	NL	NL	NL	NL	NL	NL	NL	0.17
Benzene	5	5	5	NL	NL	NL	30	30	35	59
F1(7)	NL	NL	NL	NL	NL	NL	NL	NL	NL	9.0
F2(8)	NL	NL	NL	NL	NL	NL	NL	NL	NL	3.0

Notes:

(1) Land use settings are equivalent to those described in Table 1A(1) Footnote 1 and Schedule B7. HSLs for vapour intrusion for high density residential assume residential occupation of the ground floor. If communal car parks or commercial properties occupy the ground floor, HSL D should be used.

(2) The key limitations of the HSLs are presented in Friebel and Nadebaum (2011d) and should be referred to prior to application.

(3) Detailed assumptions in the derivation of the HSLs and information on the application of the HSLs are presented in Friebel and Nadebaum (2011a and 2011b).

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

(5) The figures in the above table may be multiplied by a factor to account for biodegradation of vapour. A factor of 10 may apply for source depths from 2 m to <4 m or a factor of 100 for source depths of 4 m and deeper. To apply the attenuation factor for vapour degradation, a number of conditions must be satisfied. Firstly, the maximum length of the shorter side of the concrete slab and surrounding pavement cannot exceed 15 m, as this would prevent oxygen penetrating to the centre of the slab. Secondly, measurement of oxygen in the subsurface is required to determine the potential for biodegradation. Oxygen must be confirmed to be present at >5% to use these factors.

(6) For soil texture classification undertaken in accord with AS 1726, the classifications of sand, silt and clay may be applied as coarse, fine with liquid limit <50% and fine with liquid limit >50% respectively, as the underlying properties to develop the HSLs may reasonably be selected to be similar. Where there is uncertainty, either a conservative approach may be adopted or laboratory analysis should be carried out.

(7) To obtain F1 subtract the sum of BTEX concentrations from the C_6-C_{10} fraction.

(8) To obtain F2 subtract naphthalene from the >C_{10}-C_{16} fraction.

Table 1A(5) Soil vapour HSLs for vapour intrusion (mg/m³)

	HSL A & HSL B Low – high density residential					HSL C recreational / open space					HSL D Commercial / Industrial				
CHEMICAL	0 m to <1 m	1 m to <2 m	2 m to <4 m	4 m to <8 m	8 m+	0 m to <1 m	1 m to <2 m	2 m to <4 m	4 m to <8 m	8 m+	0 m to <1 m	1 m to <2 m	2 m to <4 m	4 m to <8 m	8 m+
SAND															
Toluene	1300	3800	7300	15 000	29 000	NL	NL	NL	NL	NL	4800	16 000	39 000	84 000	NL
Ethylbenzene	330	1100	2200	4300	8700	NL	NL	NL	NL	NL	1300	4600	11 000	25 000	53 000
Xylenes	220	750	1500	3000	6100	NL	NL	NL	NL	NL	840	3,200	8000	18 000	37 000
Naphthalene	0.8	3	6	10	25	410	NL	NL	NL	NL	3	15	35	75	150
Benzene	1	3	6	10	20	360	2400	4700	9500	19 000	4	10	30	65	130
F1(8)	180	640	1,300	2600	5300	86 000	NL	NL	NL	NL	680	2800	7000	15 000	32 000
F2(9)	130	560	1200	2400	4800	NL	NL	NL	NL	NL	500	2400	NL	NL	NL
SILT															
Toluene	1400	14 000	32 000	69 000	140 000	NL	NL	NL	NL	NL	5700	63 000	NL	NL	NL
Ethylbenzene	380	4200	9700	21 000	43 000	NL	NL	NL	NL	NL	1500	19 000	54 000	NL	NL
Xylenes	260	2900	6800	15 000	30 000	NL	NL	NL	NL	NL	1000	13 000	38 000	NL	NL
Naphthalene	0.9	10	25	60	120	NL	NL	NL	NL	NL	4	50	150	350	750
Benzene	1	10	25	55	110	1800	12 000	24 000	48 000	97 000	4	50	140	320	670

	HSL A & HSL B Low – high density residential					HSL C recreational / open space					HSL D Commercial / Industrial				
F1(8)	210	2600	6000	13 000	26 000	NL	NL	NL	NL	NL	850	11 000	33 000	77 000	160 000
F2(9)	160	2300	5400	NL	NL	NL	NL	NL	NL	NL	670	NL	NL	NL	NL
CLAY															
Toluene	1600	23 000	53 000	110 000	NL	NL	NL	NL	NL	NL	6500	100 000	NL	NL	NL
Ethylbenzene	420	6800	16 000	35 000	NL	NL	NL	NL	NL	NL	1800	31 000	NL	NL	NL
Xylenes	280	4800	11 000	24 000	50 000	NL	NL	NL	NL	NL	1200	21 000	NL	NL	NL
Naphthalene	1	20	45	95	200	NL	NL	NL	NL	NL	4	85	240	560	1200
Benzene	1	15	40	90	180	3000	20 000	40 000	81 000	160 000	5	80	230	530	1100
F1(8)	230	4200	9900	21 000	44 000	NL	NL	NL	NL	NL	1000	19 000	55 000	130 000	270 000
F2(9)	180	3,800	NL	NL	NL	NL	NL	NL	NL	NL	800	NL	NL	NL	NL

1. Land use settings are equivalent to those described in Table 1A(1) Footnote 1 and Schedule B7. HSLs for vapour intrusion for high density residential assume residential occupation of the ground floor. If communal car parks or commercial properties occupy the ground floor, HSL D should be used.
2. The key limitations of the HSLs should be referred to prior to application and are presented in Friebel and Nadebaum (2011b and 2011d).
3. Detailed assumptions in the derivation of the HSLs and information on how to apply the HSLs are presented in Friebel and Nadebaum (2011a and 2011b).
4. The maximum possible soil vapour concentrations have been calculated based on vapour pressures of the pure chemicals. Where soil vapour HSLs exceed these values a soil-specific 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'.
5. Soil vapour HSLs should be compared with measurements taken as laterally close as possible to the soil or groundwater sources of vapour (i.e. within or above vapour sources). Consideration is required of where the sample is taken, the current condition of the site and the likely future condition of the site. Shallow gas measurements in open space (less than 1 m below ground surface) may be subject to influences of weather conditions and moisture.
6. The figures in the above table may be multiplied by a factor to account for biodegradation of vapour. A factor of 10 may apply for source depths from 2 m to <4 m or a factor of 100 for source depths of 4 m and deeper. To apply the attenuation factor for vapour degradation, a number of conditions must be satisfied. Firstly, the maximum length of the shorter side of the concrete slab and surrounding pavement cannot exceed 15 m, as this would prevent oxygen penetrating to the centre of the slab. Secondly, measurement of oxygen in the subsurface is required to determine the potential for biodegradation. Oxygen must be confirmed to be present at >5% to use these factors.

7. For soil texture classification undertaken in accord with AS 1726, the classifications of sand, silt and clay may be applied as coarse, fine with liquid limit <50% and fine with liquid limit >50% respectively as the underlying properties to develop the HSLs may reasonably be selected to be similar. Where there is uncertainty, either a conservative approach may be adopted or laboratory analysis should be carried out.
8. To obtain F1 subtract the sum of BTEX concentrations from the C_6-C_{10} fraction.
9. To obtain F2 subtract naphthalene from the >C_{10}-C_{16} fraction.

Table 1B(5) Generic EILs for aged As, fresh DDT and fresh naphthalene in soils irrespective of their physicochemical properties

	Ecological Investigation Levels (mg total contaminant/kg)		
CHEMICAL	**Areas of ecological significance**	**Urban residential and public open space[1]**	**Commercial and industrial**
Arsenic[2]	40	100	160
DDT[3]	3	180	640
Naphthalene[3]	10	170	370

Notes:

1. Urban residential/public open space is broadly equivalent to the HIL-A, HIL-B and HIL-C land use scenarios in Table 1A(1) Footnote 1 and as described in Schedule B7.
2. Aged values are applicable to arsenic contamination present in soil for at least two years. For fresh contamination refer to Schedule B5c.
3. Insufficient data was available to calculate aged values for DDT and naphthalene, consequently the values for fresh contamination should be used.
4. Insufficient data was available to calculate ACLs for As, DDT and naphthalene. The EIL should be taken directly from Table 1B(5).

Table 1B(6) ESLs for TPH fractions F1 – F4, BTEX and benzo(a)pyrene in soil

CHEMICAL	Soil texture	ESLs (mg/kg dry soil)		
		Areas of ecological significance	Urban residential and public open space	Commercial and industrial
F1 C_6-C_{10}	*Coarse/ Fine*	125*	180*	215*
F2 $>C_{10}$-C_{16}		25*	120*	170*
F3 $>C_{16}$-C_{34}	*Coarse*	-	300	1700
	Fine	-	1300	2500
F4 $>C_{34}$-C_{40}	*Coarse*	-	2800	3300
	Fine	-	5600	6600
Benzene	*Coarse*	8	50	75
	Fine	10	65	95
Toluene	*Coarse*	10	85	135
	Fine	65	105	135
Ethylbenzene	*Coarse*	1.5	70	165
	Fine	40	125	185
Xylenes	*Coarse*	10	105	180
	Fine	1.6	45	95
Benzo(a)pyrene	*Coarse*	0.7	0.7	1.4
	Fine	0.7	0.7	1.4

Notes:

(1) ESLs are of low reliability except where indicated by * which indicates that the ESL is of moderate reliability.
(2) '-' indicates that insufficient data was available to derive a value.
(3) To obtain F1, subtract the sum of BTEX concentrations from C_6-C_{10} fraction.

Table 1 B(7) Management Limits for TPH fractions F1–F4 in soil

TPH fraction	Soil texture	Management Limits[1] (mg/kg dry soil)	
		Residential, parkland and public open space	Commercial and industrial
F1[2] C_6- C_{10}	*Coarse*	700	700
	Fine	800	800
F2[2] >C_{10}-C_{16}	*Coarse*	1000	1000
	Fine	1000	1000
F3 >C_{16}-C_{34}	*Coarse*	2500	3500
	Fine	3500	5000
F4 >C_{34}-C_{40}	*Coarse*	10 000	10 000
	Fine	10 000	10 000

[1] Management limits are applied after consideration of relevant ESLs and HSLs

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

Table 4

SOIL HEALTH SCREENING LEVELS FOR DIRECT CONTACT (mg/kg)[a,b]

Chemical	HSL-A Residential (Low Density)	HSL-B Residential (High **Density**)	HSL-C Recreational Open Space	HSL-D Commercial / Industrial
Toluene	14,000	21,00	18,000	99,000
Ethylbenzene	4,500	5,900	5,300	27,000
Xylenes	12,000	17,000	15,000	81,000
Naphthalene	1,400	2,200	1,900	11,000
Benzene	100	140	120	430
C6-C10	4,400	5,600	5,100	26,000
>C10-C16	3,300	4,200	3,800	20,000
>C16-C34	4,500	5,800	5,300	27,000
>C34-C40	6,300	8,100	7,400	38,000

Note:

(a) Derived assumptions used in the derivation of the HSLs and information on how to apply the HSLs are presented in:

- Frebel E & Nadebaum P 2011. Health screening levels for petroleum hydrocarbons in soil and groundwater Part 1: Technical development document, CRC CARE Technical Report no. 10, CRC for Contamination Assessment and Remediation of the Environment, Adelaide, Australia
- Frebel E & Nadebaum P 2011. Health screening levels for petroleum hydrocarbons in soil and groundwater Part 2: Application document, CRC CARE Technical Report no. 10, CRC for Contamination Assessment and Remediation of the Environment, Adelaide, Australia

(b) The key limitations in the development of the HSLs should be referred to prior to application. These are presented in the text of the summary document and the HSL application checklist in Appendix A of the Application Document (Frebel & Nadebaum 2011 – Part 2)

Table 7: Health screening levels for asbestos contamination in soil

Form of Asbestos	Health Screening Level (w/w)			
	Residential A[1]	Residential B[2]	**Recreational C[3]**	Commercial/ Industrial D[4]
Bonded ACM	0.01%	0.04%	**0.02%**	0.05%
FA & AF (friable asbestos & fines)	**0.001%**			
All forms of asbestos	**No visible asbestos for surface soil**			

Notes:

1. Residential A with garden/accessible soil also includes children's day care centres, preschools and primary schools.
2. Residential B with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments.
3. Residential C includes public open space such as parks, playgrounds, playing fields (e.g. Ovals), secondary schools and unpaved footpaths.
4. Commercial/Industrial D includes premises such as shops, offices, factories and industrial sites.

Table 1C Groundwater Investigation Levels (GILs)

Substance		Groundwater Investigation Levels		
		Fresh Waters[A]	Marine Waters[A]	Drinking Water[B]
		(µg/L)	(µg/L)	(mg/L)
Metals and Metalloids				
Aluminium, Al pH>6.5		55	-	-
Antimony		-	-	0.003
Arsenic		24 as As(III) 13 as As(V)	-	0.01
Barium		-	-	2
Beryllium		-	-	0.06
Boron		370[C]	-	4
Cadmium	H	0.2	0.7[D]	0.002
Chromium, Cr (III)	H	-	27	-
Chromium, Cr (VI)		1[C]	4.4	0.05
Cobalt		-	1	-
Copper	H	1.4	1.3	2
Iron, (Total)		-	-	-
Lead	H	3.4	4.4	0.01
Manganese		1900[C]	-	0.5
Mercury (Total)		0.06[D]	0.1[D]	0.001
Molybdenum		-	-	0.05
Nickel	H	11	7	0.02
Selenium (Total)		5[D]	-	0.01
Silver		0.05	1.4	0.1
Tributyl tin (as Sn)		-	0.006[C]	-
Tributyl tin oxide		-	-	0.001
Uranium		-	-	0.017
Vanadium		-	100	-
Zinc	H	8[C]	15[C]	-
Non-metallic Inorganics				
Ammonia[E] (as NH_3-N at pH 8)		900[C]	910	-
Bromate		-	-	0.02
Chloride		-	-	-
Cyanide (as un-ionised Cn)		7	4	0.08
Fluoride		-	-	1.5

Substance	**Groundwater Investigation Levels**		
	Fresh Waters[A]	**Marine Waters**[A]	**Drinking Water**[B]
	(µg/L)	**(µg/L)**	**(mg/L)**
Hydrogen sulphide (un-ionised H_2S measured as S)	1	-	-
Iodide	-	-	0.5
Nitrate (as NO_3)	refer to guideline	refer to guideline	50
Nitrite (as NO_2)	refer to guideline	refer to guideline	3
Nitrogen	refer to guideline	refer to guideline	-
Phosphorus	refer to guideline	refer to guideline	-
Sulphate (as SO_4)	-	-	500
Organic alchohols/other organics			
Ethanol	1400	-	-
Ethylenediamine tetra-acetic acid (EDTA)	-	-	0.25
Formaldehyde	-	-	0.5
Nitrilotriacetic acid	-	-	0.2
Anilines			
Aniline	8	-	-
2,4-Dichloroaniline	7	-	-
3,4-Dichloroaniline	3	150	-
Chlorinated Alkanes			
Dichloromethane	-	-	0.004
Trihalomethanes (total)	-	-	0.25
Tetrachloromethane (carbon tetrachloride)	-	-	0.003
1,2-Dichloroethane	-	-	0.003
1,1,2-Trichloroethane	6500	1900	-
Hexachloroethane	290[D]	-	-
Chlorinated Alkenes			
Chloroethene (vinyl chloride)	-	-	0.0003
1,1-Dichloroethene	-	-	0.03
1,2-Dichoroethene	-	-	0.06
Tetrachloroethene (PCE) (Perchloroethene)	-	-	0.05

Substance	Groundwater Investigation Levels		
	Fresh Waters^{A}	Marine Waters^{A}	Drinking Water^{B}
	(µg/L)	(µg/L)	(mg/L)
Chlorinated Benzenes			
Chlorobenzene	-	-	0.3
1,2- Dichlorobenzene	160	-	1.5
1,3- Dichlorobenzene	260	-	-
1,4- Dichlorobenzene	60	-	0.04
1,2,3- Trichlorobenzene	3^{D}	-	0.03 for individual or total trichlorobenzenes
1,2,4- Trichlorobenzene	85^{D}	20^{D}	
1,3,5-Trichlorobenzene	-	-	
Polychlorinated Biphenyls (PCBs)			
Aroclor 1242	0.3^{D}	-	-
Aroclor 1254	0.01^{D}	-	-
Other Chlorinated Compounds			
Epichlorohydrin	-	-	0.1
Hexachlorobutadiene	-	-	0.0007
Monochloramine	-	-	3
Monocyclic Aromatic Hydrocarbons			
Benzene	950	500^{C}	0.001
Toluene	-	-	0.8
Ethylbenzene	-	-	0.3
Xylenes	350 (as o-xylene) 200 (as p-xylene)	-	0.6
Styrene (Vinyl benzene)	-	-	0.03
Polycyclic Aromatic Hydrocarbons (PAHs)			
Naphthalene	16	50^{C}	-
Benzo[a]pyrene	-	-	0.00001
Phenols			
Phenol	320	400	-
2-Chlorophenol	340^{C}	-	0.3
4-Chlorophenol	220	-	-
2,4-Dichlorophenol	120	-	0.2
2,4,6-Trichlorophenol	3^{D}	-	0.02
2,3,4,6-Tetrachlorophenol	10^{D}	-	-
Pentachlorophenol	3.6^{D}	11^{D}	0.01

Substance	Groundwater Investigation Levels		
	Fresh Waters[A]	Marine Waters[A]	Drinking Water[B]
	(µg/L)	(µg/L)	(mg/L)
2,4-Dinitrophenol	45	-	-
Phthalates			
Dimethylphthalate	3700	-	-
Diethylphthalate	1000	-	-
Dibutylphthalate	10[D]	-	-
Di(2-ethylhexyl) phthalate	-	-	0.01
Pesticides			
Acephate	-	-	0.008
Aldicarb	-	-	0.004
Aldrin plus Dieldrin	-	-	0.0003
Ametryn	-	-	0.07
Amitraz	-	-	0.009
Amitrole	-	-	0.0009
Asulam	-	-	0.07
Atrazine	13	-	0.02
Azinphos-methyl	-	-	0.03
Benomyl	-	-	0.09
Bentazone	-	-	0.4
Bioresmethrin	-	-	0.1
Bromacil	-	-	0.4
Bromoxynil	-	-	0.01
Captan	-	-	0.4
Carbaryl	-	-	0.03
Carbendazim (Thiophanate-methyl)	-	-	0.09
Carbofuran	0.06	-	0.01
Carboxin	-	-	0.3
Carfentrazone-ethyl	-	-	0.1
Chlorantraniliprole	-	-	6
Chlordane	0.03[D]	-	0.002
Chlorfenvinphos	-	-	0.002
Chlorothalonil	-	-	0.05
Chlorpyrifos	0.01[D]	0.009[D]	0.01
Chlorsulfuron	-	-	0.2
Clopyralid	-	-	2

Substance	Groundwater Investigation Levels		
	Fresh Waters[A]	Marine Waters[A]	Drinking Water[B]
	(µg/L)	(µg/L)	(mg/L)
Cyfluthrin, Beta-cyfluthrin	-	-	0.05
Cypermethrin isomers	-	-	0.2
Cyprodinil	-	-	0.09
1,3-Dichloropropene	-	-	0.1
2,2-DPA	-	-	0.5
2,4-D [2,4-dichlorophenoxy acetic acid]	280	-	0.03
DDT	0.006[D]	-	0.009
Deltramethrin	-	-	0.04
Diazinon	0.01	-	0.004
Dicamba	-	-	0.1
Dichloroprop	-	-	0.1
Dichlorvos	-	-	0.005
Dicofol	-	-	0.004
Diclofop-methyl	-	-	0.005
Dieldrin plus Aldrin	-	-	0.0003
Diflubenzuron	-	-	0.07
Dimethoate	0.15	-	0.007
Diquat	1.4	-	0.007
Disulfoton	-	-	0.004
Diuron	-	-	0.02
Endosulfan	0.03[D]	0.005[D]	0.02
Endothal	-	-	0.1
Endrin	0.01[D]	0.004[D]	-
EPTC	-	-	0.3
Esfenvalerate	-	-	0.03
Ethion	-	-	0.004
Ethoprophos	-	-	0.001
Etridiazole	-	-	0.1
Fenamiphos	-	-	0.0005
Fenarimol	-	-	0.04
Fenitrothion	0.2	-	0.007
Fenthion	-	-	0.007
Fenvalerate	-	-	0.06
Fipronil	-	-	0.0007

Substance	**Groundwater Investigation Levels**		
	Fresh Waters^{A}	**Marine Waters^{A}**	**Drinking Water^{B}**
	(µg/L)	**(µg/L)**	**(mg/L)**
Flamprop-methyl	-	-	0.004
Fluometuron	-	-	0.07
Fluproponate	-	-	0.009
Glyphosate	370	-	1
Haloxyfop	-	-	0.001
Heptachlor	0.01^{D}	-	-
Heptachlor epoxide	-	-	0.0003
Hexazinone	-	-	0.4
Imazapyr	-	-	9
Iprodione	-	-	0.1
Lindane (γ-HCH)	0.2	-	0.01
Malathion	0.05	-	0.07
Mancozeb (as ETU, ethylene thiourea)	-	-	0.009
MCPA	-	-	0.04
Metaldehyde	-	-	0.02
Metham (as methylisothiocyanate, MITC)	-	-	0.001
Methidathion	-	-	0.006
Methiocarb	-	-	0.007
Methomyl	3.5		0.02
Methyl bromide	-	-	0.001
Metiram (as ETU, ethylene thiourea)	-	-	0.009
Metolachlor/s–Metolachlor	-	-	0.30
Metribuzin	-	-	0.07
Metsulfuron-methyl	-	-	0.04
Mevinphos	-	-	0.006
Molinate	3.4	-	0.004
Napropamide	-	-	0.4
Nicarbazin	-	-	1
Norflurazon	-	-	0.05
Omethoate	-	-	0.001
Oryzalin	-	-	0.4
Oxamyl	-	-	0.007

Substance	Groundwater Investigation Levels		
	Fresh Waters^A	Marine Waters^A	Drinking Water^B
	(µg/L)	(µg/L)	(mg/L)
Paraquat	-	-	0.02
Parathion	0.004^C	-	0.02
Parathion methyl	-	-	0.0007
Pebulate	-	-	0.03
Pendimethalin	-	-	0.4
Pentachlorophenol	-	-	0.01
Permethrin	-	-	0.2
Picloram	-	-	0.30
Piperonyl butoxide	-	-	0.6
Pirimicarb	-	-	0.007
Pirimiphos methyl	-	-	0.09
Polihexanide	-	-	0.7
Profenofos	-	-	0.0003
Propachlor	-	-	0.07
Propanil	-	-	0.7
Propargite	-	-	0.007
Proparzine	-	-	0.05
Propiconazole	-	-	0.1
Propyzamide	-	-	0.07
Pyrasulfatole	-	-	0.04
Pyrazophos	-	-	0.02
Pyroxsulam	-	-	4
Quintozene	-	-	0.03
Simazine	3.2	-	0.02
Spirotetramat	-	-	0.2
Sulprofos	-	-	0.01
2,4,5-T	36	-	0.1
Tebuthiuron	2.2	-	-
Temephos	-	0.05^D	0.4
Terbacil	-	-	0.2
Terbufos	-	-	0.0009
Terbuthylazine	-	-	0.01
Terbutryn	-	-	0.4
Thiobencarb	2.8	-	0.04
Thiometon	-	-	0.004

Substance	Groundwater Investigation Levels		
	Fresh Waters[A]	Marine Waters[A]	Drinking Water[B]
	(µg/L)	(µg/L)	(mg/L)
Thiram	0.01	-	0.007
Toltrazuril	-	-	0.004
Toxafene	0.1 [D]	-	-
Triadimefon	-	-	0.09
Trichlorfon	-	-	0.007
Triclopyr	-	-	0.02
Trifluralin	2.6[D]	-	0.09
Vernolate	-	-	0.04
Surfactants			
Linear alkylbenzene sulfonates (LAS)	280	-	-
Alcohol ethoxylated sulfate (AES)	650	-	-
Alcohol ethoxylated surfactants (AE)	140	-	-

A Investigation levels apply to typical slightly-moderately disturbed systems. See ANZECC & ARMCANZ (2000) for guidance on applying these levels to different ecosystem conditions.

B Investigation levels are taken from the health values of the Australian Drinking Water Guidelines (NHMRC 2011).

C Figure may not protect key species from chronic toxicity, refer to ANZECC & ARMCANZ (2000) for further guidance.

D Chemical for which possible bioaccumulation and secondary poisoning effects should be considered, refer to ANZECC & ARMCANZ (2000) for further guidance.

E For changes in GIL with pH refer to ANZECC & ARMCANZ (2000) for further guidance.

H Values have been calculated using a hardness of 30 mg/L $CaCO_3$ refer to ANZECC & ARMCANZ (2000) for further guidance on recalculating for site-specific hardness.

APPENDIX G

BOREHOLE LOGS

Aargus

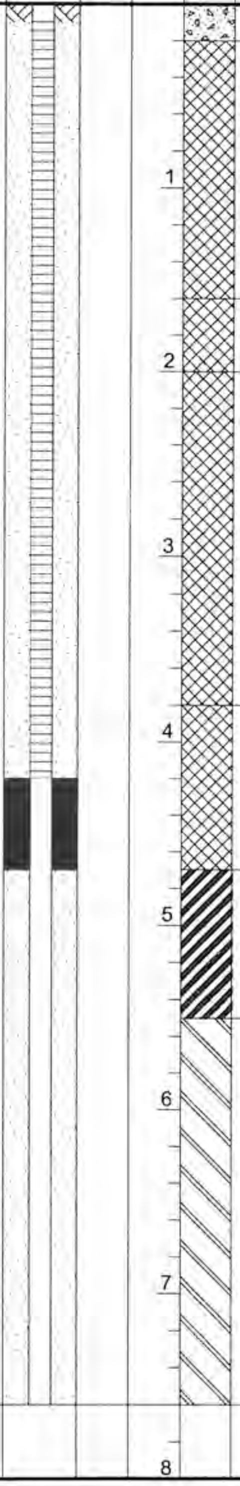
Aargus Pty Ltd
446 Parramatta Road
Petersham NSW 2049
Telephone: 1300 137 038

BOREHOLE NUMBER BH1

PAGE 1 OF 1

CLIENT Peter J Fitzhenry
PROJECT NAME Detailed Site Investigation
PROJECT NUMBER ES6874
PROJECT LOCATION 1-5 Chester Street, Camperdown NSW

DATE STARTED 13/5/17
COMPLETED 13/5/17
R.L. SURFACE
DATUM
DRILLING CONTRACTOR IVAN DRILLING Pty Ltd
SLOPE -90°
BEARING ---
EQUIPMENT Truck Mounted Drill Rig
HOLE LOCATION
HOLE SIZE 100mm
LOGGED BY LC
CHECKED BY MK
NOTES



Method	Water	RL (m)	Depth (m)	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
DT					Concrete.		No fibro-cement fragements observed, No hydrocarbons odour noted, No staining, PID=0
ADT			1		Clayed Sand, medium to coarse grained, dark grey, with grave, grass, silt.	D1/SS1	
			2		Silty Sand, fine grained, yellow.		
			3		Gravelly Sand, fine grained, grey/dark grey, with gravel and metals.		
			4		Silty Clay, low plasticity, reddish brown, with gravel and sand.		
			5	CH	Silty CLAY, high plasticity, red/orange.		
			6 7	CI	Sand CLAY, medium plasticity, red/orange.		
			8		Borehole BH1 terminated at 7.6m		

Aargus Pty Ltd
446 Parramatta Road
Petersham NSW 2049
Telephone: 1300 137 038

BOREHOLE NUMBER BH2

PAGE 1 OF 1

CLIENT Peter J Fitzhenry
PROJECT NAME Detailed Site Investigation
PROJECT NUMBER ES6874
PROJECT LOCATION 1-5 Chester Street, Camperdown NSW

DATE STARTED 13/5/17
COMPLETED 13/5/17
R.L. SURFACE
DATUM
DRILLING CONTRACTOR IVAN DRILLING Pty Ltd
SLOPE -90°
BEARING ---
EQUIPMENT Truck Mounted Drill Rig
HOLE LOCATION
HOLE SIZE 100mm
LOGGED BY LC
CHECKED BY MK
NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
DT						Concrete.		No fibro-cement fragements observed, No hydrocarbons odour noted, No staining, PID=0
ADT			0.5			Clayed Sand, medium to coarse grained, dark grey, with grave, grass, silt.		
			1.0			Borehole BH2 terminated at 0.5m		

Aargus Pty Ltd
446 Parramatta Road
Petersham NSW 2049
Telephone: 1300 137 038

BOREHOLE NUMBER BH3

PAGE 1 OF 1

CLIENT Peter J Fitzhenry
PROJECT NAME Detailed Site Investigation
PROJECT NUMBER ES6874
PROJECT LOCATION 1-5 Chester Street, Camperdown NSW

DATE STARTED 13/5/17 **COMPLETED** 13/5/17
R.L. SURFACE
DATUM
DRILLING CONTRACTOR IVAN DRILLING Pty Ltd
SLOPE -90°
BEARING ---
EQUIPMENT Truck Mounted Drill Rig
HOLE LOCATION
HOLE SIZE 100mm
LOGGED BY LC
CHECKED BY MK
NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
DT				▩		Concrete.		No fibro-cement fragements observed. No hydrocarbons odour noted. No staining. PID=0
ADT			0.5	▨		Clayed Sand, medium to coarse grained, dark grey, with grave, grass, silt.	▮	
			1.0			Borehole BH3 terminated at 0.5m		

Aargus
Aargus Pty Ltd
446 Parramatta Road
Petersham NSW 2049
Telephone: 1300 137 038

BOREHOLE NUMBER BH4

PAGE 1 OF 1

CLIENT Peter J Fitzhenry

PROJECT NAME Detailed Site Investigation

PROJECT NUMBER ES6874

PROJECT LOCATION 1-5 Chester Street, Camperdown NSW

DATE STARTED 13/5/17 **COMPLETED** 13/5/17

R.L. SURFACE

DATUM

DRILLING CONTRACTOR IVAN DRILLING Pty Ltd

SLOPE -90°

BEARING ---

EQUIPMENT Truck Mounted Drill Rig

HOLE LOCATION

HOLE SIZE 100mm

LOGGED BY LC

CHECKED BY MK

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
DT				▒		Concrete.		No fibro-cement fragements observed, No hydrocarbons odour noted, No staining, PID=0
ADT				▩		Clayed Sand, medium to coarse grained, dark grey, with grave, grass, silt.		
			0.5			Borehole BH4 terminated at 0.5m		
			1.0					

Aargus

Aargus Pty Ltd
446 Parramatta Road
Petersham NSW 2049
Telephone: 1300 137 038

BOREHOLE NUMBER BH5

PAGE 1 OF 1

CLIENT Peter J Fitzhenry

PROJECT NAME Detailed Site Investigation

PROJECT NUMBER ES6874

PROJECT LOCATION 1-5 Chester Street, Camperdown NSW

DATE STARTED 13/5/17 **COMPLETED** 13/5/17

R.L. SURFACE

DATUM

DRILLING CONTRACTOR IVAN DRILLING Pty Ltd

SLOPE -90°

BEARING ---

EQUIPMENT Truck Mounted Drill Rig

HOLE LOCATION

HOLE SIZE 100mm

LOGGED BY LC

CHECKED BY MK

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
DT				▒		Concrete.		No fibro-cement fragements observed, No hydrocarbons odour noted, No staining, PID=0
ADT			0.5	▩		Clayed Sand, medium to coarse grained, dark grey, with grave, grass, silt.	▮	
			1.0			Borehole BH5 terminated at 0.5m		

Aargus
Aargus Pty Ltd
446 Parramatta Road
Petersham NSW 2049
Telephone: 1300 137 038

BOREHOLE NUMBER BH6

PAGE 1 OF 1

CLIENT Peter J Fitzhenry
PROJECT NAME Detailed Site Investigation
PROJECT NUMBER ES6874
PROJECT LOCATION 1-5 Chester Street, Camperdown NSW

DATE STARTED 13/5/17 **COMPLETED** 13/5/17
R.L. SURFACE
DATUM
DRILLING CONTRACTOR IVAN DRILLING Pty Ltd
SLOPE -90°
BEARING ---
EQUIPMENT Truck Mounted Drill Rig
HOLE LOCATION
HOLE SIZE 100mm
LOGGED BY LC
CHECKED BY MK
NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
DT				░		Concrete.		No fibro-cement fragements observed, No hydrocarbons odour noted, No staining, PID=0
ADT			0.5	▨		Clayed Sand, medium to coarse grained, dark grey, with grave, grass, silt.	▮	
			1.0			Borehole BH6 terminated at 0.5m		

Aargus
Aargus Pty Ltd
446 Parramatta Road
Petersham NSW 2049
Telephone: 1300 137 038

BOREHOLE NUMBER BH7

PAGE 1 OF 1

CLIENT Peter J Fitzhenry
PROJECT NAME Detailed Site Investigation
PROJECT NUMBER ES6874
PROJECT LOCATION 1-5 Chester Street, Camperdown NSW

DATE STARTED 13/5/17 **COMPLETED** 13/5/17
R.L. SURFACE
DATUM
DRILLING CONTRACTOR IVAN DRILLING Pty Ltd
SLOPE -90°
BEARING —
EQUIPMENT Truck Mounted Drill Rig
HOLE LOCATION
HOLE SIZE 100mm
LOGGED BY LC
CHECKED BY MK
NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
DT				⁘		Concrete.		No fibro-cement fragements observed. No hydrocarbons odour noted. No staining, PID=0
ADT			0.5	▨		Clayed Sand, medium to coarse grained, dark grey, with grave, grass, silt.	▮	
			1.0			Borehole BH7 terminated at 0.5m		

APPENDIX H

FIELD RECORD FORMS & CALIBRATION CERTIFICATES

Aargus

Aargus

GROUNDWATER MONITORING RECORD FORM

PROJECT INFORMATION

Client:	Peter	**Monitoring Well ID:**	GW1
Site Address:	1-5 chester St, Annandale	**Logged By:**	SP
Project:	D53	**Date:**	18.5.17

MONITORING WELL DETAILS

Depth (m) as constructed:	8.00 m	**Depth (m) as measured:**	7.98 m
Finish:	Gatic cover	**Co-ordinates:**	
Condition:	good	**Surveyed Levels:**	

METHODOLOGY AND EQUIPMENT

Water Measurement Device:		**Reference Point:**	Top of well
Water Quality Meter:		**Reference Point to Ground Surface (mm):**	0.0
GW Extraction Method:			

GROUNDWATER GAUGING (PRE-PURGE)

SWL (m bgl):	4.60 m
Depth to Product (m bgl):	
Product Thickness (mm):	
Time:	

GROUNDWATER GAUGING (POST-PURGE)

SWL (m bgl):	4.68 m
Depth to Product (m bgl):	
Product Thickness (mm):	
Time:	

PURGING AND PHYSICO-CHEMICAL PARAMETERS

Time (Started)	Time (Finished)	Volume Purged	Pump Rate (mL/min)	Temperature (°C)	DO (mg/L)	pH (pH units)	EC (µS/cm)	Redox Potential (mV)
9:30 am	9:33 Am			18.4	6.66	6.45	792	321.1
9:33	9:35			18.4	5.70	6.48	783	318.9
9:36	9:39			18.4	3.93	6.48	786	306.2
9:40	9:45			18.5	3.70	6.49	792	301.2
9:45	9:48			18.5	3.26	6.50	796	292.2
9:48	10:02			18.5	2.75	6.50	798	283.5
10:05	10:10			18.6	2.24	6.50	799	282.3
			Stabilisation Criteria	± 0.2 °C	± 0.2 mg/L	± 0.1 pH units	± 5%	± 10 mV

OBSERVATIONS

Odour:	No	**Sheen:**	no
Colour / Turbidity:	medium	**Recent Rain (Days):**	—

SAMPLING

Samples Taken:	Primary	Blind		Split		Rinsate	TS/TB
Containers:							
Field Filtered:							
Preservation:							

Record Checked by:		Document Version:	0
Date:		Updated:	7/2/13

Site Assessment
Daily Worksheet Record

Aargus

Project Name: DSI	Project No:
Client Name:	Fieldwork Date: 18.5.17
Site Address: 1-5 chester St, Annandale	
Site Contact:	Phone:
Aargus Field Staff: SP	Phone:
Site Safety Induction Required? Yes [✓ No] (circle)	Date of Induction:

Meteorological Data:				Station:	
Weather	Rainfall (mm)	Wind Direction	Wind Speed	Temp °C	Humidity
sunny	—	—	—	—	—

Site Observations:		Whole Site / Part Site (circle)
Stormwater Controls	Traffic Controls	Silt Fencing
—	—	—
Plant & Equipment Onsite	Exclusion Zones	PPE Required
Odours Present	Odour Suppression	Staining Present
USTs / ASTs present	Hotspots present	Stockpiles present

Site Observations	Location & Comments
	• SWL before sampling = 4.60 m
	• turbidity = medium
	light brown / no odors /
	foam

Project	BSI + Sample	Job No	56874
Location	Annandale.	Sampling By	NZ
Refer to Drawing No			

TABLE 1

Page 1 of 1

TP/BH/ Sample	Depth (m)	Sample Depth (m)	Date	Time	Material Description	Remarks*
0-0.2					C.	
0.2-1.6	0.2-0.4 1.1-1.2	(D1/SS)			F1	No smell
1.6-2.0	1.8-1.9				F2	No smell
2.0-3.8	2.5-2.6				F3	No smell
3.8-4.7	3.9-4.0				F4	
4.7-5.5	4.8-4.9				N1	moist.
5.5-7.6	/				N2.	becoming wet @ 5.8m BGL
7.6	Bedrock. TC refusal. screen 4.7-7.6m.					
BH2 - BH7			F1 recovered in all locations sampled 0.2-0.3 concrete 0-0.2			

Project:

Job No:

Location:

Sampled By:

Refer to Drawing No:

Date:

MATERIAL DESCRIPTION

Page 1 of 1

F1	Clayey Sand, dark grey, med - coarse gr, with lots of gravels, glass, silt.
F2	silty Sand, fine gr, yellow
F3	Gravelly Sand, fine gr, grey/dark grey, with gravels, metals etc.
F4	Silty Clay, low -pl, reddish brown, with gravels & sand
N1	Silty CLAY, high pl. red/orange
N2	sand CLAY, med. pl. red/orange

[redacted]

1-5 Chester st
Camperdown
Peter
0419 398000.

Aargus

Aargus Pty Ltd

PID Certification Report

Mini Rae 2000

This PID has been performance checked/calibrated as follows:

☑ Calibrate 0.0ppm Reading 0.0 ppm
☑ Calibrate 99.3 ppm isobutylene Reading 99.0 ppm
☑ Charged
☑ Filter check
☑ Lamp check

Date: 12-5-17
Checked by: Con Karcofuglu
Signature:

Please check that the following items are contained within the PID Equipment Register

☑ PID carry case
☐ ~~Model 580 EZ~~ PID meter
☑ Charger
☐ Adapter for charger
☐ Calibration tube
☐ Sample Probe
☑ Water Filter Trap
☑ Computer cable connector
☐ Floppy disk software

Serial Number: 87148

APPENDIX I

SUMMARY OF RESULTS

TABLE D
PAH, PHENOLS, PCB AND CYANIDE
TEST RESULTS (GROUNDWATER SAMPLES)

Analyte	PAH (µg/L)	
Sample Location	NAPHTHALENE	BENZO(a)PYRENE
GW1	0.09	<0.021
Practical Quantitation Limits (PQL)	0.02	0.005
ANZECC & ARMCANZ a Guidelines for Fresh and Marine Water Quality (2000)		
Aquatic Ecosystems (Trigger Values)		
Fresh	16	NV
Marine	50	NV
Water for recreational purposes		0.01
Livestock Drinking water		0.01
Australian Drinking Water Guidelines (2011)		
Drinking water	NV	0.01

Notes
a: Investigation levels apply to typical slightly-moderated
b: PCB - Arochlor 1242
c: PCB - Arochlor 1254
NV: No Value derived

TABLE B1
TOTAL RECOVERABLE HYDROCARBONS (TRH), BTEX AND NAPHTHALENE TEST RESULTS FOR HSLs IN SAND

	Analyte	TRH (mg/kg)		BTEX (mg/kg)				
		F1[a]	F2[b]	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES	NAPHTHALENE
Sample Location	Depth (m)							
BH1	0.2-0.4	<10	<50	<0.2	<0.5	<0.5	<0.5	<1
BH2	0.2-0.3	<10	<50	<0.2	1.7	<0.5	<0.5	<1
BH3	0.2-0.3	<10	<50	<0.2	<0.5	<0.5	<0.5	<1
BH4	0.2-0.3	<10	<50	<0.2	<0.5	<0.5	<0.5	<1
BH5	0.2-0.3	<10	<50	<0.2	<0.5	<0.5	<0.5	<1
BH6	0.2-0.3	<10	<50	<0.2	<0.5	<0.5	<0.5	<1
BH7	0.2-0.3	<10	<50	<0.2	0.6	<0.5	<0.5	<1
D1		<10	<50	<0.2	<0.5	<0.5	<0.5	<1
SS1		<10	<50	<0.2	1.1	<0.5	<0.5	<1
Practical Quantitation Limits (PQL)		10	50	0.2	0.5	0.5	0.5	1
NATIONAL ENVIRONMENT PROTECTION MEASURE (2013)								
Health Screening Levels (HSL) - Table 1A (3)								
HSL A & HSL B: Low-high density residential								
Source depth - 0m to <1m		45	110	0.5	160	55	40	3
Source depth - 1m to <2m		70	240	0.5	220	NL	60	NL
Source depth - 2m to <4m		110	440	0.5	310	NL	95	NL
Source depth - 4m +		200	NL	0.5	540	NL	170	NL
HSL C: recreational / open space								
Source depth - 0m to <1m		NL	NL	NL	NL	NL	NL	NL
Source depth - 1m to <2m		NL	NL	NL	NL	NL	NL	NL
Source depth - 2m to <4m		NL	NL	NL	NL	NL	NL	NL
Source depth - 4m +		NL	NL	NL	NL	NL	NL	NL

APPENDIX J

(ALS) Environmental

Recommended Holding Times and Preservations for Soil and Air

APPLICABLE LOCATIONS

The bottles, preservation and holding times following are for the ALS Environmental operations excluding the ALS Water Resources Group (WRG). The ALS operations covered by this document include;

Adelaide
Unit 2, 1 Burma Road
Pooraka, Adelaide, SA 5095
P +6- 8-8162-5130
ALSEnviro.Adelaide@alsglobal.com

Brisbane
2 Byth Street (Corner Byth and Shand St)
Stafford QLD 4053
P +61-7-3243-7222
ALSEnviro.Brisbane@alsglobal.com

Darwin
4/16 Charlton Court
Woolner, NT 0820
P +61-488-073-271
ALSEnviro.Darwin@alsglobal.com

Gladstone
46 Callemondah Drive
Clinton Gladstone, QLD 4680
P +61-7-4971-5600
ALSEnviro.Gladstone@alsglobal.com

Mackay
78 Harbour Road
Mackay, QLD 4740
P +61-7-4944-0177
ALSEnviro.Mackay@alsglobal.com

Melbourne
2-4 Westall Road
Springvale VIC 3171
P +61-3-8549-9600
ALSEnviro.Melbourne@alsglobal.com

Mudgee
29 Sydney Road
Mudgee NSW 2850
P +61-2-6372-6735
ALSEnviro.Mudgee@alsglobal.com

Newcastle
5 Rosegum Road
Warabrook NSW 2304
P +61-2-4968-9433
ALSEnviro.Newcastle@alsglobal.com

Nowra
4/13 Geary Place
North Nowra NSW 2541
P +61-2-4423-2063
ALSEnviro.Nowra@alsglobal.com

Perth
10 Hod Way
Malaga WA 6090
P +61-8-9209-7655
ALSEnviro.Perth@alsglobal.com

Roma
Lot 4, 73 Beaumont Drive
Roma QLD 4455
P +61-7-4622-8978
ALSEnviro.Roma@alsglobal.com

Sydney
277-289 Woodpark Road
Smithfield NSW 2164
P +61-2-8784-8555
ALSEnviro.Sydney@alsglobal.com

Townsville
14-15 Desma Court
Bohle, QLD 4818
P +61-7-4796-0600
ALSEnviro.Townsville@alsglobal.com

Wollongong
99 Kenny Street
Wollongong NSW 2500
P +61-2-4225-3125
ALSEnviro.Wollongong@alsglobal.com

SOIL AND SEDIMENT SAMPLE CHILLING AND SUBMISSION

Most soils should be chilled to <4˚C or <6˚C (guideline dependent) and transported to the laboratory within 24 hours. Sediments may also benefit from being frozen. ALS recommends placing samples on ice immediately upon sampling for best practice chilling with either repacking into another esky or draining of free water and replacement of ice just prior to dispatch. Chilling overnight in a fridge may also benefit. The post-chilling addition of ice bricks is also recommended where samples are air freighted or dispatched long distance and where couriers will not freight ice.

Please note that where possible samples should be submitted to the laboratory with at least half the recommended holding time remaining and it is preferable to avoid submitting holding time critical tests and full VOC suites late on Fridays without prior arrangement.

GENERAL NOTES

The following soil testing services are centralized in specialist laboratory locations. These tests require additional separate jars or bags to optimize service delivery and holding time compliance;

- Dioxins, Total S, TOC, TBT (Brisbane),
- PFOS/PFOA/AFFFs, PBDEs, Explosives, Herbicides, Pesticides and Ultra trace Organics (Sydney).
- Sizings, Asbestos and Foreign Materials Testing (Newcastle);
- TRH Speciation (Perth and Melbourne),
- ASS/AMD (Perth and Brisbane).

KEY

G	Glass	**G(T)**	Glass Jar with Teflon Lined Lid
(ZH)	Zero Headspace required	**PB**	Plastic (Polyethylene) Bag
HVAS	High Volume Air Sampler Paper	**PTFE**	Polytetrafluoroethylene Filter
PUF	Polyurethane Filter	**P**	Plastic Container

SOIL SAMPLES

INORGANICS, METALS, RADIONUCLIDES, ACID SULFATE SOILS AND PHYSICAL PARAMETERS

Parameter		ALS Preferred Container	Preservation	Holding Time	Reference
General Anions and Cations: Chloride, Bromide, Fluoride, Sulfate, CEC & exchangeable Cations		PB, P or G	Chill, preferably to <6°C	28 days [4]	NEPM 2013
Asbestos		PB (double bagged)	Nil	Indefinite	AS4964-2004
Cyanide		P or G	Chill, Store in dark	14 days [4]	NEPM 2013
Electrical conductivity		PB, P or G	Chill, preferably to <6°C	7 days [4]	NEPM 2013
Gross alpha, Gross beta		PB, P or G	Nil	180 days	ISO9696, ISO9697, ASTM D7283-06.
Hexavalent Chromium (Alkali extract)		P or G	Chill, Store in dark	28 days (plus 7 for extract)	NEPM 2013
Metals - General		PB, P or G	Nil	6 months	NEPM 2013
Mercury		P or G	Chill, Store in dark	28 days	NEPM 2013
Methyl Mercury	Option 1	G(T)	Chill, Store in dark	40 days	Horvat et al, 1993
	Option 2	G(T)	Freeze, Store in dark	8 months	Horvat et al, 1993
Moisture Content		PB, P or G	Chill, preferably to <6°C	14 days	NEPM 2013
Organic Carbon / TOC	Option 1	G	Chill, to <6°C store in dark	28 days	NEPM 2013
	Option 2	G	Freeze for sediments	6 months	NAGD 2009
pH		PB, P or G	Chill, preferably to <6°C	7 days	NEPM 2013
Radium 226, 228		PB or G	Nil	180 days	ISO10703, ASTM D7283-06.
SPOCAS, TOS, Chromium Suite	Option 1	PB (exclude air)	Freeze	Indefinite	AS4969.1-2008
	Option 2		Chill, preferably to <6°C	24 hours	
	Option 3		Dry at 80°C	Indefinite	
Sizings and Foreign Material Tests		PB or G	Nil for sediments	Indefinite	NAGD 2009
Sulfur - total		PB or G	Chill, preferably to <6°C	7 days (6 months once prepared)	NEPM 2013 plus in house
Sulfide		PB or G	Chill, preferably to <6°C	28 days (if Total S hold' time met)	NEPM 2013 plus in house

ORGANICS - SEMIVOLATILE COMPOUNDS (SVOCS)

Parameter	ALS Preferred Container	Preservation	Holding Time	Reference
General less persistent Semi-Volatile Organic chemicals including: • Carbamate Pesticides • Explosive residues • OC, OP Pesticides & PCBs • Phenoxy acid Herbicides • General Herbicides • TRH/TPH (C_{10}-C_{40}), • PAHs and Phenols • Phthalate Esters • Pyrethroids (Synthetic) • Semi Volatile Chlorinated Compound • Tributyl Tin (TBT)	G(T)	Place immediately in the esky and chill to <6°C using ice. Avoid exposure to light	14 days (plus holding of extracts typically for up to 40 days)	NEPM 2013
Dioxins & Furans & PCBs	G(T)		1 year in dark, freeze to -10°C	USEPA 1613
PBDEs	G(T)		1 year in dark, freeze to -10°C	USEPA 1614
PFOS & PFOA/ 6:2-FtS / AFFFs	G(T)		6 months	In house - POPs
Tributyl Tin, OCPs, OPPs, Phenols, PAHs and PCBs	G(T)	Freeze within 12 hours of sampling for sediments	56 days (plus 40 days for extracts)	NAGD 2009

ORGANICS - VOLATILE COMPOUNDS (VOCS)

Parameter	ALS Preferred Container	Preservation	Holding Time	Reference
VOCs *except* vinyl chloride, styrene and/or 2-chloroethyl vinyl ether	G(T)	Rapidly sample, minimize headspace and Chill to <6°C. Avoid exposure to light	14 days	NEPM 2013
Vinyl chloride and styrene	G(T)		**7 days** ***(Previously 14 days under NEPM 1999)***	NEPM 2013

AMBIENT AIR, SOIL GAS AND OCCUPATIONAL HYGIENE

ORGANICS - VOLATILE AND SEMIVOLATILE COMPOUNDS

Parameter	Media	Preservation	Holding Time	Reference
VOCs in whole air samples	Silonite Canister	Nil	30 days	USEPA TO15r
VOCs on Sorbents	Charcoal Tubes/ Passive Badge	Nil	30 Days	NIOSH 1500/1501/1003
Semi-Volatile Organics including: PAHs Chlorinated Benzenes Chlorinated Phenols	XAD-2 Resin	Protect from light. Store in the dark submit as soon as possible	7-14 Days	USEPA TO4A/TO10A/TO13A
				NIOSH 5515/5517
	PTFE/GFF/MCE Filters		7 Days	NIOSH 5515/5517
	PUF		7 Days	USEPA TO4A/TO13A
	HVAS		7 Days	USEPA TO4A/TO13A

NOTES

1. Samples for ZHE TCLP or ASLP require a separate additional jar.
2. TCLP and other leaching procedures need to be conducted within the solid sample holding time of the analyte of interest.
3. When a moisture determination is used for dry weight basis reporting, no holding time applies when performed on the same day as the chemical analytes of interest.
4. Holding times for extracted parameters (e.g. Chloride, Bromide, EC, Sulfate, Sulfide & Cyanide) are until extraction. Extract solution holding times also apply.

ALS
Environmental

ALS RECOMMENDED HOLDING TIMES AND PRESERVATIONS FOR WATER

Version 2 January 2013

APPLICABLE LOCATIONS

The bottles, preservation and holding times following are for the ALS Environmental operations excluding the ALS Water Resources Group Victoria and ACT operations (WRG). The ALS operations covered by this document include;

Adelaide
Unit 2, 1 Burma Road
Pooraka, Adelaide, SA 5095
Phone: 61-8-8162 5130
Email: ALSEnviro.Adelaide@alsglobal.com

Brisbane
2 Byth Street (Corner Byth and Shand St)
Stafford QLD 4053
Phone: 61-7-3243 7222
Email: ALSEnviro.Brisbane@alsglobal.com

Darwin
4/16 Charlton Court
Woolner, NT 0820
Phone: 61-488 073 271
Email: ALSEnviro.Darwin@alsglobal.com

Gladstone
48 Callemondah Drive
Clinton Gladstone, QLD 4680
Phone: 61-7-4971 5600
Email: ALSEnviro.Gladstone@alsglobal.com

Mackay
78 Harbour Road
Mackay, QLD 4740
Phone: 61-7-4944 0177
Email: ALSEnviro.Mackay@alsglobal.com

Melbourne
2 - 4 Westall Road
Springvale VIC 3171
Phone: 61-3-8549 9600
Email: ALSEnviro.Melbourne@alsglobal.com

Mudgee
29 Sydney Road
Mudgee NSW 2850
Phone: 61-2-6372 6735
Email: ALSEnviro.Mudgee@alsglobal.com

Newcastle
5 Rosegum Close
Warabrook NSW 2304
Phone: 61-2-4968 9433
Email: ALSEnviro.Newcastle@alsglobal.com

Nowra
4/13 Geary Place
North Nowra NSW 2541
Phone: 61-2-4423 2063
ALSEnviro.Nowra@alsglobal.com

Perth
10 Hod Way
Malaga WA 6090
Phone: 61-8-9209 7655
Email: ALSEnviro.Perth@alsglobal.com

Roma
Lot 4, 73 Beaumont Drive
Roma QLD 4455
Phone: 61-7-4622 8978
Email: ALSEnviro.Roma@alsglobal.com

Sydney
277-289 Woodpark Road
Smithfield NSW 2164
Phone: 61-2-8784 8555
Email: ALSEnviro.Sydney@alsglobal.com

Townsville
14-15 Desma Court
Bohle, QLD 4818
Phone: 61-7-4796 0600
Email: ALSEnviro.Townsville@alsglobal.com

Wollongong
99 Kenny Street
Wollongong NSW 2500
Phone : 61-2-4225 3125
Email: ALSEnviro.Wollongong@alsglobal.com

SAMPLE PRESERVATION, CHILLING AND SUBMISSION

Care must be taken not to rinse out or spill preservatives during sampling for OH&S reasons and to avoid cross contaminating other bottles (e.g. Nitric acid used for metals can contaminate nitrate analysis). Field filtration is mandatory or recommended for many tests and other tests must have exposure to air minimized to avoid analyte losses. Samples should generally be chilled to <4ºC or <6ºC (guideline dependent) and transported to the laboratory within 24 hours. ALS recommends placing samples in ice immediately upon sampling for best practice chilling with either repacking into another esky or draining of free water and replacement of ice just prior to dispatch. Chilling overnight in a fridge may also benefit. The post-chilling addition of ice bricks is also recommended where samples are air freighted or dispatched long distance and where couriers will not freight ice.

Samples taken from chlorinated water sources require the addition of sodium thiosulfate for microbiological, volatile organics and semi volatile organics. Please advise ALS accordingly to facilitate supply of appropriate containers.

Please note that where possible samples should be submitted to the laboratory with at least half the recommended holding time remaining and it is preferable to avoid submitting holding time critical tests late on Fridays without prior arrangement.

ALS RECOMMENDED HOLDING TIMES AND PRESERVATIONS FOR WATER

Parameter		Container	Preservation	Holding Time	Reference
GENERAL INORGANICS (METALS, NUTRIENTS, CATIONS, ANIONS, PHYSICAL TESTS)					
Acidity / Alkalinity		P	Chill	14 days	APHA Table 1060:I
Ammonia Nitrogen	Option 1	P	H_2SO_4 to pH<2, Chill	28 days	APHA Table 1060:I
	Option 2	P	Chill	1 day	APHA Table 1060:I
Anions General: Chloride, Sulfate, Fluoride, Bromide		P	Chill	28 days	APHA Table 1060:I
BOD		P	Chill	2 days	APHA Table 1060:I
Cations & Hardness: (Calcium, Magnesium, Sodium, Potassium)	Option 1	P	HNO_3 to pH<2, Chill	28 days (All)	AS/NZS 5667.1:1998
	Option 2	P	Nil, Chill	7 days (Ca, Mg, Hardness) 28 days (Na, K)	AS/NZS 5667.1:1998
Carbon Total Organic (TOC)		G	H_2SO_4 to pH<2, Chill	28 days	APHA Table 1060:I
Carbon Dissolved Organic (DOC)		G	H_2SO_4 to pH<2, Field filter$^{(2)}$, Chill	28 days	APHA Table 1060:I
Chlorophyll a		P - Opaque	Chill, Store in dark	2 days	APHA Table 1060:I
			(filter, store filtrate frozen in foil)	28 days	
Chromium VI		P	NaOH, Chill	28 days	USEPA 1669
COD		P	H_2SO_4 to pH<2, Chill	28 days	APHA Table 1060:I
Colour		P	Chill	2 days	APHA Table 1060:I
Conductivity (EC)		P	Chill	28 days	APHA Table 1060:I
Cyanide		P - Opaque	NaOH to pH>12, Chill $^{(1)}$	14 days	APHA 1060:I
Ferrous (Fe^{2+})		P (A)	HCl to pH<2. (ZH), Field filter$^{(2)}$, Chill	7 days	ISO 5667-3:2003
Formaldehyde		P	Chill	2 days	ASTM D6303-98
Mercury	Option 1	P (A)	HNO_3 to pH<2, Chill $^{(2)}$	28 days	APHA Table 1060:I
	Option 2	P (A)	Nil – Lab Acidify in <14 days, Chill $^{(2)}$	28 days	USEPA 200.8
Metals General	Option 1	P (A)	HNO_3 to pH<2, Chill $^{(2)}$	6 months	APHA Table 1060:I
	Option 2	P (A)	Nil - Lab Acidify in <14 days, Chill $^{(2)}$	6 months	USEPA 200.8
Nitrate Nitrogen		P	Chill	2 days	APHA Table 1060:I
Nitrite Nitrogen		P	Chill	2 days	APHA Table 1060:I
Nitrogen - Oxidised Nitrogen (NOx)		P	H_2SO_4 to pH<2, Chill	28 days	APHA Table 1060:I/
			Chill	2 days	AS/NZS 5667.1:1998
Nitrogen and Phosphorous - Total (Persulfate Method)		P	Nil, Chill	1 day	AS/ NZS 5667.1:1998
Nitrogen - Total		P	H_2SO_4 to pH<2, Chill	28 days	APHA Table 1060:I
Oil & Grease		G	$NaHSO_4$ or H_2SO_4 to pH<2,Chill	28 days	APHA Table 1060:I
Perchlorate		P	Filter, Chill, Store in dark	28 days	USEPA 6850
pH		P	Nil	6 hours	AS/NZS 5667.1:1998
Phenols - Total		P, G	H_2SO_4 to pH<2, Chill	28 days	APHA Table 1060:I
Phosphorus - Reactive		P	Nil, Chill	2 days	APHA Table 1060:I
Phosphorus - Total		P	H_2SO_4 to pH<2, Chill	28 days	AS/NZS 5667.1:1998
Radionuclides incl' Gross alpha, Gross beta & Radium 226, 228		P, G	Lab Acidify in <5 days, Chill or HNO_3 to pH<2, Chill	6 months	APHA 7010B
Solids (TS, TSS, TDS)		P	Chill	7 days	APHA Table 1060:I
Surfactants (NIS, MBAS)		G	Chill	2 days	AS/NZS 5667.1:1998
			Chill, submit in 2 days, preserve in Lab	4 days (MBAS) 28 days (NIS)	
Silica		P	Chill	28 days	APHA Table 1060:I
Sulfide		P	Zn Acetate/NaOH, Chill	7 days	AS/NZS 5667.1:1998
Sulfite		P	EDTA/Zn Acetate, Chill	2 days	AS/NZS 5667.1:1998
Speciated Arsenic and Selenium		P (A)	HCl to pH<2, Chill, (Zero Headspace)	28 days	USEPA1632-2001
Thiocyanate		P	HNO_3 to pH<2, Chill	6 months	APHA 4500CN M
TKN (Total Kjeldahl Nitrogen)		P	H_2SO_4 to pH<2, Chill	28 days	APHA Table 1060:I
Turbidity		P	Store in dark, Chill	2 days	APHA Table 1060:I
ALGAE AND MICROBIOLOGICAL TESTS					
Algae Analysis	Option 1	P	Lugols at 1% v/v ratio	6 months	Hotzel and Croome 1999
	Option 2	P	Nil	48 hours	Hotzel and Croome 1999
General Microbiological Tests (e.g. Faecal coliforms, E-coli, HPC etc)		P (sterile)	$Na_2S_2O_3$,(if chlorinated)/ Chill	1 day	APHA 9060B

NOTES

(1) When samples are suspected of containing Sulfide, a Sulfide Pre-treatment bottle (containing Lead Acetate) should be used to remove Sulfide prior to decanting into the 'Cyanide' bottle.

(2) Dissolved Metals, Ferrous Iron and DOC should be field filtered using a 0.45μm filter prior to placing in the container.

KEY			
G	Glass	Amber (T)	Amber Glass Bottle with Teflon Lined Lid
P (A)	Plastic (verified metal free)	P	Plastic (Polyethylene)
(TS)	40mL Vial with Teflon Lined Septum	(ZH)	Zero Headspace required

ORGANICS - SEMIVOLATILE COMPOUNDS (SVOCS)

Parameter	Container	Preservation	Holding Time	Reference
Acrylamide	Amber (T)	Chill	7 days	USEPA SW846 8316 1998
Alkyl phenol Ethoxylates	Amber (T)	Chill	2 days	AS/NZS 5667.1:1998
		Chill, submit in 2 days, preserve in Lab	7 days	In house
Carbamates	Amber (T)	Chill	7 days [3]	USEPA 632
Chlorinated Hydrocarbons (SV)	Amber (T)	Chill	7 days [3]	USEPA SW846 2007
Dioxins	Amber (T)	Chill	1 year	USEPA 1613.B
Explosives	Amber (T)	Chill	7 days [3]	USEPA SW846 2007
Glyphosate	Amber (T)	Chill	14 days [3]	USEPA 547
Glycols	Vial (TS)	Chill	7 days [3]	USEPA SW846 2007
Herbicides (Phenoxy Acid)	Amber (T)	Chill	7 days [3]	USEPA SW846 2007
N-Nitrosodimethylamine (NDMA)	Amber (T)	Chill	7 days [3]	USEPA 607
Organochlorine Pesticides & PCBs	Amber (T)	Chill	7 days [3]	USEPA SW846 2007
Organophosphorus Pesticides	Amber (T)	Chill	7 days [3]	USEPA SW846 2007
Paraquat/Diquat	P	Chill	7 days [3]	USEPA SW846 2007
Petroleum Hydrocarbons (C_{10}-C_{40})	Amber (T)	Chill	7 days [3]	USEPA SW846 2007
Phenols and Phthalate Esters	Amber (T)	Chill	7 days [3]	USEPA SW846 2007
PFOS & PFOA/ 6:2-FTS and AFFFs	P (PTFE free)	Chill	6 months	In house - POPs
Polyaromatic Hydrocarbons (PAHs)	Amber (T)	Chill	7 days [3]	USEPA SW846 2007
PPCPs	Amber (T)	Nil	7 days [3]	AGWR 2008, USEPA 1694
Synthetic Pyrethroids	Amber (T)	Chill	7 days [3]	USEPA SW846-8270D
Tributyl Tin (TBT)	Amber (T)	Chill	7 days [3]	USEPA SW846 2007

ORGANICS - VOLATILE COMPOUNDS (VOCS) / DISSOLVED GASES

Parameter	Container	Preservation	Holding Time	Reference
BTEXN plus TRH/TPH Hydrocarbons (C_6-C_{10})	Vial (TS)	H_2SO_4 or $NaHSO_4$ to pH<2, Chill, (ZH)	14 days	USEPA SW846 2007
C_1-C_4 Gases (including Methane)	Vial (TS)	H_2SO_4 or $NaHSO_4$ to pH<2, Chill, (ZH)	14 days	USEPA SW846 2007/ NATATTEN.WPD 2002
Chloroacetic Acids	Vial (TS)	NH_4Cl, Chill, (ZH)	28 days	USEPA 552.1
Acrylonitrile, 1,4-Dioxane, Pyridine	Vial (TS)	H_2SO_4 or $NaHSO_4$ to pH<2, Chill, (ZH)	14 days	USEPA 603, 1671 & 524.2, USEPA SW846 2007
Acrolein	Vial (TS)	Chill, (ZH)	3 days	USEPA 603
		Chill, submit in 3 days, preserve in Lab	14 days	
Halo Acetic Acids	Vial (TS)	NH_4Cl, Chill, (ZH)	28 days	USEPA 552.1
MIB/Geosmin	Vial (TS)	Chill, (ZH)	3 days	APHA 6040
		Chill, submit in 3 days, preserve in Lab	7 days	
VOCs including: Halogenated Aliphatics, Aromatics, Monocyclic Aromatics (MAHs), Trihalomethanes (THMs) and Alcohols	Vial (TS)	H_2SO_4 or $NaHSO_4$ to pH<2, Chill, (ZH)	14 days	USEPA SW846 2007

KEY

G	Glass	Amber (T)	Amber Glass Bottle with Teflon Lined Lid
P (A)	Plastic (verified metal free)	P	Plastic (Polyethylene)
(TS)	40mL Vial with Teflon Lined Septum	(ZH)	Zero Headspace required

NOTES

(3) Samples can also be extracted within 7 days and the resulting extracts analysed within 40 days.

APPENDIX K

LABORATORY CERTIFICATES

ASE156812/S9992/1-8

AARGUS PTY LTD
446 Parramatta Road
PETERSHAM NSW 2049
P O Box 398 Tel: 1300 137 038
DRUMMOYNE NSW 1470 Fax: 1300 136 038

Laboratory Test Request / Chain of Custody Record

Email to: cynthia@aargus.net; dereck@aargus.net; mark.kelly@aargus.net; ningye@aargus.net

1 of 1

TO: **ASET - Australian Safer Environment & Technology Pty Ltd, Sydney**
Suite 710 / 90 George Street **PO Box 1644**
HORNSBY, NSW 2077 **HORNSBY WESTFIELD NSW 1635**

PH: **02 9987 2183** **FAX:** **02 9987 2151**
ATTN: **Samples Receipt** **EMAIL** aset@bigpond.net.au

Sampling Date:	13.05.17	**Job No:**	ES6874
Sampled By:	NZ	**Project:**	PSI
Project Manager:	MK	**Location:**	Annandale

Results required by: (Standard Turnaround)

Sampling details			**Sample type**												
Location	Depth (m)	Date	Soil Samples	**Metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn)**	**TPH**	**BTEX**					**Asbestos presence/absence**	**Asbestos %w/w**	**Analysis Suite(s)**	**KEEP SAMPLE ?**
1 BH1	0.2-0.4	13.05.17	DSP									✓		YES
2 BH2	0.2-0.3	13.05.17	DSP									✓		YES
3 BH3	0.2-0.3	13.05.17	DSP									✓		YES
4 BH4	0.2-0.3	13.05.17	DSP									✓		YES
5 BH5	0.2-0.3	13.05.17	DSP									✓		YES
6 BH6	0.2-0.3	13.05.17	DSP									✓		YES
7 BH7	0.2-0.3	13.05.17	DSP									✓		YES
8 D1	-	13.05.17	DSP									✓		YES

Relinquished by		
Name	Signature	Date
Ningye	NZ	15.05.17

Received by		
~~Name~~	~~Signature~~	Date
Sosh		18/5 5:30PM

Legend:

WG	Water sample, glass bottle	USG	Undisturbed soil sample (glass jar)	DSP	Disturbed soil sample (small plastic bag)
WP	Water sample, plastic bottle	DSG	Disturbed soil sample (glass jar)	✓	Test required
GV	Glass vial	OTH	Other	ACAN	Air sample, canister

@ mole H+/tonne

RECEIVED
18 MAY 2017
BY: SW

AUSTRALIAN SAFER ENVIRONMENT & TECHNOLOGY PTY LTD
ABN 36 088 095 112

Our ref: ASET56812 / 59992 / 1 - 8
Your ref: ES6874 - PSI - Annandale
NATA Accreditation No: 14484

NATA
WORLD RECOGNISED
ACCREDITATION

Accredited for compliance with ISO/IEC 17025.

22 May 2017

Aargus Pty Ltd.
446 Parramatta Road
Petersham NSW 2049

Attn: Mr Ningye Zhang

Dear Ningye

Asbestos Identification
This report presents the results of eight samples, forwarded by Aargus Pty Ltd. on 18 May 2017, for analysis for asbestos.

1.Introduction: Eight samples forwarded were examined and analysed for the presence of asbestos.

2. Methods: The samples were examined under a Stereo Microscope and selected fibres were analysed by Polarized Light Microscopy in conjunction with Dispersion Staining method **(Australian Standard AS 4964 - 2004 and Safer Environment Method 1 as the supplementary work instruction) (Qualitative Analysis only).**

The report also provides approximate weights and percentages, categories of asbestos forms appearing in the sample, such as **AF** (Asbestos Fines), **FA** (Friable Asbestos) and **ACM** (Asbestos Containing Material), also satisfying the requirements of the WA/ NEPM Guidelines.

3. Results: **Sample No. 1. ASET56812 / 59992 / 1. BH1 - 0.2-0.4.**
Approx dimensions 10.0 cm x10.0 cm x 5.8 cm
Approx total dry weight of soil = 590.0g
The sample consisted of a mixture of sandy soil, stones, sandstone, plant matter, fragments of brick and cement.
No asbestos detected.

Sample No. 2. ASET56812 / 59992 / 2. BH2 - 0.2-0.3.
Approx dimensions 10.0 cm x 10.0 cm x 8.6 cm
The sample consisted of a mixture of clayish soil, stones, plant matter, fibres^, fragments of cement and glass.
Chrysotile^ (Estimated Approximate weight= 0.01g) asbestos detected.
Approximate total weight of asbestos (AF / Loose fibres) = 0.01g
Approximate total weight of soil sample = 871.0g
Approximate w/w % = 0.001%

Sample No. 3. ASET56812 / 59992 / 3. BH3 - 0.2-0.3.
Approx dimensions 10.0 cm x 10.0 cm x 9.0 cm
Approx total dry weight of soil = 940.0g
The sample consisted of a mixture of sandy soil, stones, sandstone and plant matter.
No asbestos detected.

SUITE 710 / 90 GEORGE STREET, HORNSBY NSW 2077 – P.O. BOX 1644 HORNSBY WESTFIELD NSW 1635
PHONE: (02) 99872183 FAX: (02)99872151 EMAIL: info@ausset.com.au WEBSITE: www.Ausset.com.au
OCCUPATIONAL HEALTH & SAFETY STUDIES • INDOOR AIR QUALITY SURVEYS • HAZARDOUS MATERIAL SURVEYS • RADIATION SURVEYS • ASBESTOS SURVEYS
ASBESTOS DETECTION & IDENTIFICATION • REPAIR & CALIBRATION OF SCIENTIFIC EQUIPMENT • AIRBORNE FIBRE & SILICA MONITORING

Page 1 of 3

Sample No. 4. ASET56812 / 59992 / 4. BH4 - 0.2-0.3.
Approx dimensions 10.0 cm x 10.0 cm x 6.4 cm
Approx total dry weight of soil = 652.0g
The sample consisted of a mixture of sandy soil, stones, sandstone, plant matter, fragments of cement.
No asbestos detected.

Sample No. 5. ASET56812 / 59992 / 5. BH5 - 0.2-0.3.
Approx dimensions 10.0 cm x 10.0 cm x 6.6 cm
Approx total dry weight of soil = 675.0g
The sample consisted of a mixture of sandy soil, stones and plant matter.
No asbestos detected.

Sample No. 6. ASET56812 / 59992 / 6. BH6 - 0.2-0.3.
Approx dimensions 10.0 cm x 10.0 cm x 9.4 cm
Approx total dry weight of soil = 950.0g
The sample consisted of a mixture of sandy soil, stones, sandstone and plant matter, fragments of cement.
No asbestos detected.

Sample No. 7. ASET56812 / 59992 / 7. BH7 - 0.2-0.3.
Approx dimensions 10.0 cm x 10.0 cm x 7.6 cm
Approx total dry weight of soil = 757.0g
The sample consisted of a mixture of clayish soil, stones, sandstone and plant matter.
No asbestos detected.

Sample No. 8. ASET56812 / 59992 / 8. D1.
Approx dimensions 10.0 cm x 10.0 cm x 8.6 cm
Approx total dry weight of soil = 875.0g
The sample consisted of a mixture of sandy soil, stones, synthetic mineral fibres, sandstone and fragments of cement.
No asbestos detected.

Analysed and reported by,

Chamath Annakkage. BSc
Analyst / Approved Identifier

Mahen De Silva. BSc, MSc, Grad Dip (Occ Hyg)
Occupational Hygienist / Approved Signatory

NATA
WORLD RECOGNISED
ACCREDITATION

Accredited for compliance with ISO/IEC 17025.

This report is consistent with the analytical procedures and reporting recommendations in the Western Australia Guidelines for the Assessment Remediation and Management of Asbestos contaminated sites in Western Australia and it also satisfies the requirements of the current NEPM Guidelines. NATA Accreditation does not cover the performance of this service (NATA ISO/IEC17025 AUG 2014).

Disclaimers;

The approx; weights given above can be used only as a guide. They do not represent absolute weights of each kind of asbestos, as it is impossible to extract all loose fibres from soil and other asbestos containing building material samples using this method. However above figures may be used as closest approximations to the exact values in each case. Estimation and/ or reporting of asbestos fibre weights in asbestos containing materials and soil is out of the Scope of the NATA Accreditation. NATA Accreditation only covers the qualitative part of the results reported. This weight disclaimer also covers weight / weight percentages given.

The results contained in this report relate only to the sample/s submitted for testing. Australian Safer Environment & Technology accepts no responsibility for whether or not the submitted sample/s is/are representative. Results indicating "No asbestos detected" indicates a reporting limit specified in AS4964 -2004 which is 0.1g/ Kg (0.01%). Any amounts detected at assumed lower level than that would be reported, however those assumed lower levels may be treated as "No asbestos detected" as specified and recommended by AS4964-2004. Trace / respirable level asbestos will be reported only when detected.

Estimation of asbestos weights involves the use of following assumptions;
Volume of each kind of Asbestos present in broken edges have been visually estimated and its been assumed that volumes remain similar throughout the binding matrix and those volumes are only approximate and not exact. Material densities have been assumed to be similar to commonly found similar materials and may not be exact.

ACM - Asbestos Containing Material - Products or materials that contain asbestos in an inert bound matrix such as cement or resin. Here taken to be sound material, even as fragments and not fitting through a 7mm X 7 mm sieve.

AF	**-Includes asbestos free fibres, small fibre bundles and also ACM fragments that pass through a 7mm X 7 mm sieve.**
FA	**-Friable asbestos material such as severely weathered ACM, and asbestos in the form of loose fibrous material such as insulation products.**

^ denotes loose fibres of relevant asbestos types detected in soil/dust and fragments of ACM smaller than 7mm diameter.
*** denotes asbestos detected in ACM in bonded form.**
 # denotes FA.

All samples indicating "No asbestos detected" are assumed to be less than 0.001 % unless the actual approximate weight is given.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order : **EM1706281**
Client : **AARGUS PTY LTD**
Contact : MR MARK KELLY
Address : PO BOX 398
DRUMMOYNE NSW, AUSTRALIA 2047
Telephone : 1300137038
Project : ES6874
Order number : ----
C-O-C number : ----
Sampler : NZ
Site : Annandale
Quote number : SY/258/14 V2
No. of samples received : 1
No. of samples analysed : 1

Page : 1 of 8
Laboratory : Environmental Division Melbourne
Contact :
Address : 4 Westall Rd Springvale VIC Australia 3171
Telephone : +61-3-8549 9600
Date Samples Received : 18-May-2017 09:00
Date Analysis Commenced : 18-May-2017
Issue Date : 24-May-2017 14:00

ilac-MRA NATA

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Descriptive Results
- Surrogate Control Limits

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Emily Daos	Approved Asbestos Identifier	Melbourne Asbestos, Springvale, VIC
Nancy Wang	Senior Semivolatile Instrument Chemist	Melbourne Organics, Springvale, VIC

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

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

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

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EA200N: Asbestos weights and percentages are not covered under the Scope of NATA Accreditation.
  Weights of Asbestos are based on extracted bulk asbestos, fibre bundles, and/or ACM and do not include respirable fibres (if present)
  The Friable Asbestos weight is calculated from the extracted Fibrous Asbestos and Asbestos Fines as an equivalent weight of 100% Asbestos
  Percentages for Asbestos content in ACM are based on the 2013 NEPM default values.
  All calculations of percentage Asbestos under this method are approximate and should be used as a guide only.
- EA200 'Am' Amosite (brown asbestos)
- EA200 'Cr' Crocidolite (blue asbestos)
- EA200 'Trace' - Asbestos fibres ("Free Fibres") detected by trace analysis per AS4964. The result can be interpreted that the sample contains detectable 'respirable' asbestos fibres
- EA200: Asbestos Identification Samples were analysed by Polarised Light Microscopy including dispersion staining.
- EA200 Legend
- EA200 'Ch' Chrysotile (white asbestos)
- EA200: 'UMF' Unknown Mineral Fibres. "-" indicates fibres detected may or may not be asbestos fibres. Confirmation by alternative techniques is recommended.
- EA200: Negative results for vinyl tiles should be confirmed by an independent analytical technique.
- EA200N: ALS laboratory procedures and methods used for the identification and quantitation of asbestos are consistent with AS4964-2004 and the requirements of the 2013 NEPM for Assessment of Site Contamination
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.
- EA200: For samples larger than 30g, the <2mm fraction may be sub-sampled prior to trace analysis as outlined in ISO23909:2008(E) Sect 6.3.2-2
- EA200: 'Yes' - Asbestos detected by polarised light microscopy including dispersion staining.
- EA200: 'No*' - No asbestos found, at the reporting limit of 0.1g/kg, by polarised light microscopy including dispersion staining. Asbestos material was detected and positively identified at concentrations estimated to be below 0.1g/kg.
- EA200: 'No' - No asbestos found at the reporting limit 0.1g/kg, by polarised light microscopy including dispersion staining.

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			*Client sample ID*	**SS1**	**----**	**----**	**----**	**----**
			Client sampling date / time	13-May-2017 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EM1706281-001**	--------	--------	--------	--------
				Result	----	----	----	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1	%	**12.8**	----	----	----	----
EA200: AS 4964 - 2004 Identification of Asbestos in Soils								
Asbestos Detected	1332-21-4	0.1	g/kg	**No**	----	----	----	----
Asbestos Type	1332-21-4	-	--	**-**	----	----	----	----
Sample weight (dry)	----	0.01	g	**720**	----	----	----	----
APPROVED IDENTIFIER:	----	-	--	**E.DAOS**	----	----	----	----
EA200N: Asbestos Quantification (non-NATA)								
Free Fibres	----	5	Fibres	**No**	----	----	----	----
Friable Asbestos	1332-21-4	0.0004	g	<0.0004	----	----	----	----
Friable Asbestos (as Asbestos in Soil)	1332-21-4	0.001	% (w/w)	<0.001	----	----	----	----
Asbestos Containing Material	1332-21-4	0.1	g	<0.1	----	----	----	----
Asbestos Containing Material (as 15% Asbestos in ACM >7mm)	1332-21-4	0.01	% (w/w)	<0.01	----	----	----	----
Weight Used for % Calculation	----	0.0001	kg	**0.720**	----	----	----	----
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	**6**	----	----	----	----
Cadmium	7440-43-9	1	mg/kg	**1**	----	----	----	----
Chromium	7440-47-3	2	mg/kg	**18**	----	----	----	----
Copper	7440-50-8	5	mg/kg	**216**	----	----	----	----
Lead	7439-92-1	5	mg/kg	**193**	----	----	----	----
Nickel	7440-02-0	2	mg/kg	**16**	----	----	----	----
Zinc	7440-66-6	5	mg/kg	**265**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**0.3**	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	----	----	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	----	----	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	----	----	----	----
beta-BHC	319-85-7	0.05	mg/kg	<0.05	----	----	----	----
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	----	----	----	----

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

			Client sample ID	**SS1**	----	----	----	----
			Client sampling date / time	13-May-2017 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EM1706281-001**	--------	--------	--------	--------
				Result	----	----	----	----
EP068A: Organochlorine Pesticides (OC) - Continued								
delta-BHC	319-86-8	0.05	mg/kg	<0.05	----	----	----	----
Heptachlor	76-44-8	0.05	mg/kg	<0.05	----	----	----	----
Aldrin	309-00-2	0.05	mg/kg	<0.05	----	----	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	----	----	----	----
^ Total Chlordane (sum)	----	0.05	mg/kg	<0.05	----	----	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	----	----	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	----	----	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	----	----	----	----
Dieldrin	60-57-1	0.05	mg/kg	<0.05	----	----	----	----
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	----	----	----	----
Endrin	72-20-8	0.05	mg/kg	<0.05	----	----	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	----	----	----	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	----	----	----	----
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	----	----	----	----
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	----	----	----	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	----	----	----	----
4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	----	----	----	----
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	----	----	----	----
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	----	----	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	----	----	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	0.5	mg/kg	<0.5	----	----	----	----
2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	----	----	----	----
2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	----	----	----	----
3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	----	----	----	----
2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	----	----	----	----
2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	----	----	----	----
2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	----	----	----	----
2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	----	----	----	----
Pentachlorophenol	87-86-5	2	mg/kg	<2	----	----	----	----

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL)**			*Client sample ID*	**SS1**	**----**	**----**	**----**	**----**
			Client sampling date / time	13-May-2017 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EM1706281-001**	**--------**	**--------**	**--------**	**--------**
				Result	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	----	----	----	----
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	----	----	----	----
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	----	----	----	----
Fluorene	86-73-7	0.5	mg/kg	<0.5	----	----	----	----
Phenanthrene	85-01-8	0.5	mg/kg	**1.0**	----	----	----	----
Anthracene	120-12-7	0.5	mg/kg	<0.5	----	----	----	----
Fluoranthene	206-44-0	0.5	mg/kg	**1.2**	----	----	----	----
Pyrene	129-00-0	0.5	mg/kg	**1.1**	----	----	----	----
Benz(a)anthracene	56-55-3	0.5	mg/kg	**0.6**	----	----	----	----
Chrysene	218-01-9	0.5	mg/kg	**0.5**	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	**0.6**	----	----	----	----
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg	**0.5**	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	----	----	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	mg/kg	**5.5**	----	----	----	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	mg/kg	**0.6**	----	----	----	----
^ **Benzo(a)pyrene TEQ (half LOR)**	----	0.5	mg/kg	**0.9**	----	----	----	----
^ **Benzo(a)pyrene TEQ (LOR)**	----	0.5	mg/kg	**1.2**	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	----	----	----	----
C10 - C14 Fraction	----	50	mg/kg	<50	----	----	----	----
C15 - C28 Fraction	----	100	mg/kg	**180**	----	----	----	----
C29 - C36 Fraction	----	100	mg/kg	**140**	----	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	mg/kg	**320**	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	----	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	10	mg/kg	<10	----	----	----	----
>C10 - C16 Fraction	----	50	mg/kg	<50	----	----	----	----
>C16 - C34 Fraction	----	100	mg/kg	**270**	----	----	----	----
>C34 - C40 Fraction	----	100	mg/kg	<100	----	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg	**270**	----	----	----	----

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			*Client sample ID*	**SS1**	**----**	**----**	**----**	**----**
			Client sampling date / time	13-May-2017 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EM1706281-001**	**--------**	**--------**	**--------**	**--------**
				Result	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	50	mg/kg	<50	----	----	----	----
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	----	----	----	----
Toluene	108-88-3	0.5	mg/kg	**1.1**	----	----	----	----
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	----	----	----	----
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	----	----	----	----
^ **Sum of BTEX**	----	0.2	mg/kg	**1.1**	----	----	----	----
^ **Total Xylenes**	1330-20-7	0.5	mg/kg	<0.5	----	----	----	----
Naphthalene	91-20-3	1	mg/kg	<1	----	----	----	----
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	**115**	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.05	%	**110**	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.05	%	**104**	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	**97.8**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	0.5	%	**79.1**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	0.5	%	**85.1**	----	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	**110**	----	----	----	----
Anthracene-d10	1719-06-8	0.5	%	**110**	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.5	%	**106**	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	**95.4**	----	----	----	----
Toluene-D8	2037-26-5	0.2	%	**86.0**	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.2	%	**91.8**	----	----	----	----

Analytical Results

Descriptive Results

Sub-Matrix: **SOIL**

Method: Compound	*Client sample ID - Client sampling date / time*	*Analytical Results*
EA200: AS 4964 - 2004 Identification of Asbestos in Soils		
EA200: Description	SS1 - 13-May-2017 00:00	Brown soil with rock matter plus organic and synthetic mineral fibre bundles.

Surrogate Control Limits

Sub-Matrix: **SOIL**

Compound	CAS Number	Recovery Limits (%) Low	Recovery Limits (%) High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	36	140
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	38	128
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	33	139
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	54	125
2-Chlorophenol-D4	93951-73-6	65	123
2.4.6-Tribromophenol	118-79-6	34	122
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	61	125
Anthracene-d10	1719-06-8	62	130
4-Terphenyl-d14	1718-51-0	67	133
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	51	125
Toluene-D8	2037-26-5	55	125
4-Bromofluorobenzene	460-00-4	56	124

ALS Environmental

QUALITY CONTROL REPORT

Work Order : **EM1706281**

Client : **AARGUS PTY LTD**
Contact : MR MARK KELLY
Address : PO BOX 398
DRUMMOYNE NSW, AUSTRALIA 2047
Telephone : 1300137038
Project : ES6874
Order number : ----
C-O-C number : ----
Sampler : NZ
Site : Annandale
Quote number : SY/258/14 V2
No. of samples received : 1
No. of samples analysed : 1

Page : 1 of 9

Laboratory : Environmental Division Melbourne
Contact :
Address : 4 Westall Rd Springvale VIC Australia 3171
Telephone : +61-3-8549 9600
Date Samples Received : 18-May-2017
Date Analysis Commenced : 18-May-2017
Issue Date : 24-May-2017

ilac-MRA NATA

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

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

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Emily Daos	Approved Asbestos Identifier	Melbourne Asbestos, Springvale, VIC
Nancy Wang	Senior Semivolatile Instrument Chemist	Melbourne Organics, Springvale, VIC

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key :
Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA055: Moisture Content (QC Lot: 895888)									
EM1706278-002	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1	%	13.0	13.1	0.00	0% - 50%
EM1706278-014	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1	%	20.7	24.6	17.0	0% - 20%
EG005T: Total Metals by ICP-AES (QC Lot: 897665)									
EM1706278-014	Anonymous	EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	83	85	2.48	0% - 20%
		EG005T: Nickel	7440-02-0	2	mg/kg	225	216	4.23	0% - 20%
		EG005T: Arsenic	7440-38-2	5	mg/kg	11	12	9.95	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	45	44	2.43	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	6	7	0.00	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	68	59	14.2	0% - 50%
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 897664)									
EM1706275-005	Anonymous	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EM1706278-010	Anonymous	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 900480)									
EM1706215-008	Anonymous	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.00	No Limit
EM1706278-010	Anonymous	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.00	No Limit
EP066: Polychlorinated Biphenyls (PCB) (QC Lot: 900670)									
EM1706233-001	Anonymous	EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP068A: Organochlorine Pesticides (OC) (QC Lot: 900671)									
EM1706416-009	Anonymous	EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP068A: Organochlorine Pesticides (OC) (QC Lot: 900671) - continued									
EM1706416-009	Anonymous	EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
EM1706233-001	Anonymous	EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
EP075(SIM)A: Phenolic Compounds (QC Lot: 900672)									
EM1706233-001	Anonymous	EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP075(SIM)A: Phenolic Compounds (QC Lot: 900672) - continued									
EM1706233-001	Anonymous	EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.00	No Limit
		EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	<2	0.00	No Limit
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 900672)									
EM1706233-001	Anonymous	EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 895600)									
EM1706053-001	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EP1705106-001	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 900673)									
EM1706233-001	Anonymous	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
		EP071: C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 895600)									
EM1706053-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
EP1705106-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 900673)									
EM1706233-001	Anonymous	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
		EP071: >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	0.00	No Limit
EP080: BTEXN (QC Lot: 895600)									
EM1706053-001	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit
EP1705106-001	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	*Laboratory Control Spike (LCS) Report*			
					Spike	*Spike Recovery (%)*	*Recovery Limits (%)*	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EG005T: Total Metals by ICP-AES (QCLot: 897665)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	21.7 mg/kg	93.6	79	113
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	4.64 mg/kg	96.5	85	109
EG005T: Chromium	7440-47-3	2	mg/kg	<2	43.9 mg/kg	99.4	89	113
EG005T: Copper	7440-50-8	5	mg/kg	<5	32 mg/kg	97.5	84	116
EG005T: Lead	7439-92-1	5	mg/kg	<5	40 mg/kg	96.3	85	107
EG005T: Nickel	7440-02-0	2	mg/kg	<2	55 mg/kg	96.9	89	111
EG005T: Zinc	7440-66-6	5	mg/kg	<5	60.8 mg/kg	102	89	111
EG035T: Total Recoverable Mercury by FIMS (QCLot: 897664)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	2.57 mg/kg	97.9	85	103
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 900480)								
EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	20 mg/kg	90.2	89	108
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 900670)								
EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	1 mg/kg	102	55	135
EP068A: Organochlorine Pesticides (OC) (QCLot: 900671)								
EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	0.5 mg/kg	100	45	131
EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	0.5 mg/kg	106	45	125
EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	0.5 mg/kg	105	46	134
EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	0.5 mg/kg	102	49	133
EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	0.5 mg/kg	80.3	52	128
EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	0.5 mg/kg	94.6	48	128
EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	0.5 mg/kg	102	52	128
EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	0.5 mg/kg	103	52	130
EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	0.5 mg/kg	108	51	131
EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	0.5 mg/kg	108	57	135
EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	0.5 mg/kg	108	51	131
EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	0.5 mg/kg	97.0	51	131
EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	0.5 mg/kg	104	51	131
EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	0.5 mg/kg	98.2	41	131
EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	0.5 mg/kg	106	52	132
EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	0.5 mg/kg	111	50	134
EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	0.5 mg/kg	106	49	130
EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	0.5 mg/kg	112	50	132
EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	0.5 mg/kg	107	38	140
EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	0.5 mg/kg	106	64	132

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP068A: Organochlorine Pesticides (OC) (QCLot: 900671) - continued								
EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	0.5 mg/kg	106	41	141
EP075(SIM)A: Phenolic Compounds (QCLot: 900672)								
EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	3 mg/kg	96.7	65	125
EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	3 mg/kg	96.4	74	124
EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	3 mg/kg	97.9	76	123
EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	6 mg/kg	99.0	70	123
EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	3 mg/kg	84.5	56	120
EP075(SIM): 2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	3 mg/kg	99.0	66	125
EP075(SIM): 2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	3 mg/kg	96.5	61	120
EP075(SIM): 2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	3 mg/kg	99.0	70	123
EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	3 mg/kg	95.1	57	122
EP075(SIM): 2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	3 mg/kg	90.2	54	120
EP075(SIM): 2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	3 mg/kg	99.5	57	119
EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	6 mg/kg	77.6	20	112
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 900672)								
EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	3 mg/kg	100	80	121
EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	3 mg/kg	96.0	70	130
EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	3 mg/kg	94.6	80	120
EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	3 mg/kg	97.1	70	124
EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	3 mg/kg	99.0	80	122
EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	3 mg/kg	101	80	126
EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	3 mg/kg	99.5	70	128
EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	3 mg/kg	103	80	125
EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	3 mg/kg	95.9	70	130
EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	3 mg/kg	102	80	126
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	3 mg/kg	89.3	70	124
EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	3 mg/kg	100	75	125
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	3 mg/kg	85.1	65	125
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	3 mg/kg	108	65	128
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	3 mg/kg	109	65	126
EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	3 mg/kg	109	65	127
EP080/071: Total Petroleum Hydrocarbons (QCLot: 895600)								
EP080: C6 - C9 Fraction	----	10	mg/kg	<10	36 mg/kg	103	70	127
EP080/071: Total Petroleum Hydrocarbons (QCLot: 900673)								
EP071: C10 - C14 Fraction	----	50	mg/kg	<50	734 mg/kg	100.0	65	131
EP071: C15 - C28 Fraction	----	100	mg/kg	<100	3091 mg/kg	106	70	126
EP071: C29 - C36 Fraction	----	100	mg/kg	<100	1507 mg/kg	104	70	122

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EP080/071: Total Petroleum Hydrocarbons (QCLot: 900673) - continued								
EP071: C10 - C36 Fraction (sum)	----	50	mg/kg	<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 895600)								
EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	45 mg/kg	101	68	125
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 900673)								
EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	1101 mg/kg	106	68	130
EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	3914 mg/kg	103	72	116
EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	283 mg/kg	94.4	38	132
EP071: >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	----	----	----	----
EP080: BTEXN (QCLot: 895600)								
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	2 mg/kg	104	74	124
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	2 mg/kg	105	77	125
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	2 mg/kg	101	73	125
EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	4 mg/kg	108	77	128
EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	2 mg/kg	109	81	128
EP080: Naphthalene	91-20-3	1	mg/kg	<1	0.5 mg/kg	94.3	66	130

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EG005T: Total Metals by ICP-AES (QCLot: 897665)							
EM1706278-017	Anonymous	EG005T: Arsenic	7440-38-2	50 mg/kg	90.6	78	124
		EG005T: Cadmium	7440-43-9	50 mg/kg	96.5	84	116
		EG005T: Chromium	7440-47-3	50 mg/kg	104	79	121
		EG005T: Copper	7440-50-8	50 mg/kg	104	82	124
		EG005T: Lead	7439-92-1	50 mg/kg	112	76	124
		EG005T: Nickel	7440-02-0	50 mg/kg	111	78	120
		EG005T: Zinc	7440-66-6	50 mg/kg	108	74	128
EG035T: Total Recoverable Mercury by FIMS (QCLot: 897664)							
EM1706275-006	Anonymous	EG035T: Mercury	7439-97-6	5 mg/kg	82.7	76	116
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 900480)							
EM1706215-014	Anonymous	EK026SF: Total Cyanide	57-12-5	20 mg/kg	91.3	77	113
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 900670)							

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 900670) - continued							
EM1706233-003	Anonymous	EP066: Total Polychlorinated biphenyls	----	1 mg/kg	111	44	144
EP068A: Organochlorine Pesticides (OC) (QCLot: 900671)							
EM1706233-003	Anonymous	EP068: gamma-BHC	58-89-9	0.5 mg/kg	79.4	22	139
		EP068: Heptachlor	76-44-8	0.5 mg/kg	55.7	18	130
		EP068: Aldrin	309-00-2	0.5 mg/kg	107	23	136
		EP068: Dieldrin	60-57-1	0.5 mg/kg	91.9	42	136
		EP068: Endrin	72-20-8	0.5 mg/kg	84.1	23	146
		EP068: 4.4`-DDT	50-29-3	0.5 mg/kg	43.6	20	133
EP075(SIM)A: Phenolic Compounds (QCLot: 900672)							
EM1706233-007	Anonymous	EP075(SIM): Phenol	108-95-2	3 mg/kg	96.0	63	117
		EP075(SIM): 2-Chlorophenol	95-57-8	3 mg/kg	92.4	65	123
		EP075(SIM): 2-Nitrophenol	88-75-5	3 mg/kg	90.4	40	134
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	3 mg/kg	94.3	56	122
		EP075(SIM): Pentachlorophenol	87-86-5	3 mg/kg	88.8	15	139
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 900672)							
EM1706233-007	Anonymous	EP075(SIM): Acenaphthene	83-32-9	3 mg/kg	88.8	67	117
		EP075(SIM): Pyrene	129-00-0	3 mg/kg	98.1	52	148
EP080/071: Total Petroleum Hydrocarbons (QCLot: 895600)							
EM1706053-003	Anonymous	EP080: C6 - C9 Fraction	----	28 mg/kg	66.8	42	131
EP080/071: Total Petroleum Hydrocarbons (QCLot: 900673)							
EM1706233-005	Anonymous	EP071: C10 - C14 Fraction	----	734 mg/kg	95.5	53	123
		EP071: C15 - C28 Fraction	----	3091 mg/kg	94.2	70	124
		EP071: C29 - C36 Fraction	----	1507 mg/kg	95.2	64	118
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 895600)							
EM1706053-003	Anonymous	EP080: C6 - C10 Fraction	C6_C10	33 mg/kg	63.6	39	129
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 900673)							
EM1706233-005	Anonymous	EP071: >C10 - C16 Fraction	----	1101 mg/kg	94.6	65	123
		EP071: >C16 - C34 Fraction	----	3914 mg/kg	93.7	67	121
		EP071: >C34 - C40 Fraction	----	283 mg/kg	86.2	44	126
EP080: BTEXN (QCLot: 895600)							
EM1706053-003	Anonymous	EP080: Benzene	71-43-2	2 mg/kg	88.2	50	136
		EP080: Toluene	108-88-3	2 mg/kg	83.6	56	139

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EM1706281**	Page	: 1 of 6
Client	: **AARGUS PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR MARK KELLY	Telephone	: +61-3-8549 9600
Project	: ES6874	Date Samples Received	: 18-May-2017
Site	: Annandale	Issue Date	: 24-May-2017
Sampler	: NZ	No. of samples received	: 1
Order number	: ----	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	*Sample Date*	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)		*Date extracted*	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EA055: Moisture Content							
Soil Glass Jar - Unpreserved (EA055-103)							
SS1	**13-May-2017**	----	----	----	**18-May-2017**	27-May-2017	✓
EA200: AS 4964 - 2004 Identification of Asbestos in Soils							
Snap Lock Bag: Separate bag received (EA200)							
SS1	**13-May-2017**	----	----	----	**19-May-2017**	09-Nov-2017	✓
EA200N: Asbestos Quantification (non-NATA)							
Snap Lock Bag: Separate bag received (EA200N)							
SS1	**13-May-2017**	----	----	----	**19-May-2017**	09-Nov-2017	✓
EG005T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T)							
SS1	**13-May-2017**	**19-May-2017**	09-Nov-2017	✓	**19-May-2017**	09-Nov-2017	✓
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T)							
SS1	**13-May-2017**	**19-May-2017**	10-Jun-2017	✓	**23-May-2017**	10-Jun-2017	✓
EK026SF: Total CN by Segmented Flow Analyser							
Soil Glass Jar - Unpreserved (EK026SF)							
SS1	**13-May-2017**	**22-May-2017**	27-May-2017	✓	**23-May-2017**	05-Jun-2017	✓
EP066: Polychlorinated Biphenyls (PCB)							
Soil Glass Jar - Unpreserved (EP066)							
SS1	**13-May-2017**	**22-May-2017**	27-May-2017	✓	**23-May-2017**	01-Jul-2017	✓
EP068A: Organochlorine Pesticides (OC)							
Soil Glass Jar - Unpreserved (EP068)							
SS1	**13-May-2017**	**22-May-2017**	27-May-2017	✓	**23-May-2017**	01-Jul-2017	✓
EP075(SIM)A: Phenolic Compounds							
Soil Glass Jar - Unpreserved (EP075(SIM))							
SS1	**13-May-2017**	**22-May-2017**	27-May-2017	✓	**23-May-2017**	01-Jul-2017	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Soil Glass Jar - Unpreserved (EP075(SIM))							
SS1	**13-May-2017**	**22-May-2017**	27-May-2017	✓	**23-May-2017**	01-Jul-2017	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	**Sample Date**	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)		*Date extracted*	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EP080/071: Total Petroleum Hydrocarbons							
Soil Glass Jar - Unpreserved (EP080) SS1	**13-May-2017**	**18-May-2017**	27-May-2017	✓	**19-May-2017**	27-May-2017	✓
Soil Glass Jar - Unpreserved (EP071) SS1	**13-May-2017**	**22-May-2017**	27-May-2017	✓	**23-May-2017**	01-Jul-2017	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Soil Glass Jar - Unpreserved (EP080) SS1	**13-May-2017**	**18-May-2017**	27-May-2017	✓	**19-May-2017**	27-May-2017	✓
Soil Glass Jar - Unpreserved (EP071) SS1	**13-May-2017**	**22-May-2017**	27-May-2017	✓	**23-May-2017**	01-Jul-2017	✓
EP080: BTEXN							
Soil Glass Jar - Unpreserved (EP080) SS1	**13-May-2017**	**18-May-2017**	27-May-2017	✓	**19-May-2017**	27-May-2017	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Moisture Content	EA055-103	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
PAH/Phenols (SIM)	EP075(SIM)	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
PAH/Phenols (SIM)	EP075(SIM)	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
PAH/Phenols (SIM)	EP075(SIM)	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Moisture Content	EA055-103	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Asbestos Identification in Soils	EA200	SOIL	AS 4964 - 2004 Method for the qualitative identification of asbestos in bulk samples Analysis by Polarised Light Microscopy including dispersion staining
Asbestos Classification and Quantitation per NEPM 2013	EA200N	SOIL	Asbestos Classification and Quantitation per NEPM 2013 with Confirmation of Identification by AS 4964 - 2004 Gravimetric determination of Asbestos Containing Material, Friable Asbestos and sample weight and calculation of percentage concentrations per NEPM protocols. Friable Asbestos is reported as the equivalent weight in the sample received after accounting for sub-sampling (where applicable for the <7mm and/or <2mm fractions).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Cyanide by Segmented Flow Analyser	EK026SF	SOIL	In house: Referenced to APHA 4500-CN C / ASTM D7511. Caustic leachates of soil samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (2013) Schedule B(3)
Polychlorinated Biphenyls (PCB)	EP066	SOIL	In house: Referenced to USEPA SW 846 - 8270D Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3) (Method 504)
Pesticides by GCMS	EP068	SOIL	In house: Referenced to USEPA SW 846 - 8270D Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM (2013) Schedule B(3) (Method 504,505)
TRH - Semivolatile Fraction	EP071	SOIL	In house: Referenced to USEPA SW 846 - 8015A Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C40.
PAH/Phenols (SIM)	EP075(SIM)	SOIL	In house: Referenced to USEPA SW 846 - 8270D Extracts are analysed by Capillary GC/MS in Selective Ion Mode (SIM) and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3) (Method 502 and 507)

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
TRH Volatiles/BTEX	EP080	SOIL	In house: Referenced to USEPA SW 846 - 8260B Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve.

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
NaOH leach for CN in Soils	CN-PR	SOIL	In house: APHA 4500 CN. Samples are extracted by end-over-end tumbling with NaOH.
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (2013) Schedule B(3) (Method 202)
Methanolic Extraction of Soils for Purge and Trap	ORG16	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids	ORG17	SOIL	In house: Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.

AARGUS PTY LTD
446 Parramatta Road
PETERSHAM NSW 2049
P O Box 398 Tel: 1300 137 038
DRUMMOYNE NSW 1470 Fax: 1300 136 038

Laboratory Test Request / Chain of Custody Record

Email reports: cynthia@aargus.net; mark.kelly@aargus.net; dereck@aargus.net; ningye@aargus.net
Email invoices: anika@aargus.net; cynthia@aargus.net; mark.kelly@aargus.net; dereck@aargus.net; ningye@aargus.net

1 of 1

TO:	**ALS (Australian Laboratory Services) | Environmental** **2-4 Westall Road** **SPRINGVALE VIC 3171**	**Sampling Date:** 13.05.17	**Job No:** ES6874
		Sampled By: NZ	**Project:** PSI
PH:	**03 8549 9600** **FAX:** **03 8549 9601**	**Project Manager:** MK	**Location:** Annandale
ATTN:	**Samples Receipt**		

Results required by: STANDARD TAT
Quotation Number (if applicable): SY/258/14 V2

Sampling details			**Sample type**												
Location	Depth (m)	Date	Soil	Water	**Metals (As, Cd, Cr, Cu, Hg, Pb, Ni, Zn)**	**TPH & BTEX**	**PAH**	**OC**	**PCB**	**Phenols & Cyanide**			**Asbestos %w/w**	**Analysis Suite(s)**	**KEEP SAMPLE ?**
SS1 ①	-	13.05.17	DSG DSP		✓	✓	✓	✓	✓	✓			✓	S2+S17	YES

Relinquished by			Received by		
Name	Signature	Date	Name	Signature	Date
Ningye Zhang	NZ	15.05.17			

Legend:

WG	Water sample, glass bottle	USG	Undisturbed soil sample (glass jar)	DSP	Disturbed soil sample (small plastic bag)
WP	Water sample, plastic bottle	DSG	Disturbed soil sample (glass jar)	✓	Test required
GV	Glass vial	OTH	Other	ACAN	Air sample, canister

@ mole H^+/tonne

Aaron (AM) 18/5, 9.00

Environmental Division
Melbourne
Work Order Reference
EM1706281

Telephone : + 61-3-8549 9600

SampleCod	Sampled_D	Field_ID	Blank1	Depth	Blank2	Matrix_Typ	Sample_Ty	Parent_Sar
EM170628	########	SS1				SOIL	Normal	
QC-895600	########					SOIL	LCS	
QC-895600	########					SOIL	MB	
QC-895600	########					SOIL	LAB_D	EM170605
QC-895600	########					SOIL	MS	EM170605
QC-895600	########					SOIL	LAB_D	EP1705106
QC-895888	########					SOIL	LAB_D	EM170627
QC-895888	########					SOIL	LAB_D	EM170627
QC-897665	########					SOIL	MB	
QC-897665	########					SOIL	LCS	
QC-897665	########					SOIL	LAB_D	EM170627
QC-897665	########					SOIL	MS	EM170627
QC-900480	########					SOIL	LCS	
QC-900480	########					SOIL	LAB_D	EM170621
QC-900480	########					SOIL	MS	EM170621
QC-900480	########					SOIL	LAB_D	EM170627
QC-900670	########					SOIL	LCS	
QC-900670	########					SOIL	MS	EM170623
QC-900671	########					SOIL	LCS	
QC-900671	########					SOIL	MS	EM170623
QC-900671	########					SOIL	LAB_D	EM170641
QC-900672	########					SOIL	LCS	
QC-900672	########					SOIL	MS	EM170623
QC-900673	########					SOIL	LCS	
QC-900673	########					SOIL	MS	EM170623
QC-MRG2-	########					SOIL	MB	
QC-MRG2-	########					SOIL	LCS	
QC-MRG2-	########					SOIL	LAB_D	EM170627
QC-MRG2-	########					SOIL	MS	EM170627
QC-MRG2-	########					SOIL	LAB_D	EM170627
QC-MRG2-	########					SOIL	MB	
QC-MRG4-	########					SOIL	MB	
QC-MRG4-	########					SOIL	LAB_D	EM170623
EM170605	########					SOIL	NCP	
EM170621	########					SOIL	NCP	
EM170623	########					SOIL	NCP	
EM170627	########					SOIL	NCP	
EM170627	########					SOIL	NCP	
EM170627	########					SOIL	NCP	
EM170627	########					SOIL	NCP	
EM170641	########					SOIL	NCP	
EP1705106	########					SOIL	NCP	

Blank3	SDG	Lab_Name	Lab_Sampl	Lab_Comm	Lab_Report_Number
########	ALSE-Melb	ALSE-Melb	EM1706281001		EM1706281
		ALSE-Melb	QC-895600-001		EM1706281
		ALSE-Melb	QC-895600-002		EM1706281
3001_EM1706281		ALSE-Melb	QC-895600-004		EM1706281
3003_EM1706281		ALSE-Melb	QC-895600-006		EM1706281
001_EM1706281		ALSE-Melb	QC-895600-016		EM1706281
3002_EM1706281		ALSE-Melb	QC-895888-002		EM1706281
3014_EM1706281		ALSE-Melb	QC-895888-013		EM1706281
		ALSE-Melb	QC-897665-001		EM1706281
		ALSE-Melb	QC-897665-002		EM1706281
3014_EM1706281		ALSE-Melb	QC-897665-004		EM1706281
3017_EM1706281		ALSE-Melb	QC-897665-006		EM1706281
		ALSE-Melb	QC-900480-002		EM1706281
5008_EM1706281		ALSE-Melb	QC-900480-005		EM1706281
5014_EM1706281		ALSE-Melb	QC-900480-007		EM1706281
3010_EM1706281		ALSE-Melb	QC-900480-017		EM1706281
		ALSE-Melb	QC-900670-001		EM1706281
3003_EM1706281		ALSE-Melb	QC-900670-006		EM1706281
		ALSE-Melb	QC-900671-001		EM1706281
3003_EM1706281		ALSE-Melb	QC-900671-006		EM1706281
5009_EM1706281		ALSE-Melb	QC-900671-016		EM1706281
		ALSE-Melb	QC-900672-001		EM1706281
3007_EM1706281		ALSE-Melb	QC-900672-006		EM1706281
		ALSE-Melb	QC-900673-001		EM1706281
3005_EM1706281		ALSE-Melb	QC-900673-006		EM1706281
		ALSE-Melb	QC-MRG2-897663001		EM1706281
		ALSE-Melb	QC-MRG2-897663002		EM1706281
5005_EM1706281		ALSE-Melb	QC-MRG2-897664005		EM1706281
5006_EM1706281		ALSE-Melb	QC-MRG2-897664007		EM1706281
3010_EM1706281		ALSE-Melb	QC-MRG2-897664017		EM1706281
		ALSE-Melb	QC-MRG2-900480001		EM1706281
		ALSE-Melb	QC-MRG4-900670002		EM1706281
3001_EM1706281		ALSE-Melb	QC-MRG4-900670004		EM1706281
########		ALSE-Melb	EM1706053001		EM1706281
########		ALSE-Melb	EM1706215008		EM1706281
########		ALSE-Melb	EM1706233001		EM1706281
########		ALSE-Melb	EM1706275005		EM1706281
########		ALSE-Melb	EM1706278002		EM1706281
########		ALSE-Melb	EM1706278010		EM1706281
########		ALSE-Melb	EM1706278014		EM1706281
########		ALSE-Melb	EM1706416009		EM1706281
########		ALSE-Melb	EP1705106001		EM1706281

ALS Environmental
A trading name of Australian Laboratory Services Pty Ltd ABN 84 009 936 029. An ALS Limited Company www.alsglobal.com

TAX INVOICE: L496720

AARGUS PTY LTD
MR MARK KELLY
PO BOX 398
DRUMMOYNE
NSW, AUSTRALIA 2047

Page : 1 of 1

Work Order	Project / Overall Description	Site	Order number	C-O-C number	Contact
EM1706281	ES6874 / PSI	Annandale	----	----	MR MARK KELLY

Issue Date : **24-May-2017**

Due Date : **23-Jun-2017**

Taxable value	: **AUD$**	**329.00**
Tax Incurred (GST)	: **AUD$**	**32.90**
Amount Payable	: **AUD$**	**361.90**

Work Order Breakdown

Method	Sale Item Descriptions	Quantity	Unit Value (AUD$)	Value (AUD$)	GST (AUD$)	Line Total (AUD$)
Work Order: **EM1706281**	Quote number: **SY/258/14 V2**				Submatrix summary:	**1 SOIL**
*Misc	Workorder Admin Fee	1.00	40.00	40.00	4.00	44.00
EA200N	Asbestos in Soils - (<1kg samples ONLY) Quantitation by WA/NEPM Guidelines Non-NATA	1.00	95.00	95.00	9.50	104.50
EK026SF (Solids)	Total Cyanide By Segmented Flow Analyser	1.00	28.00	28.00	2.80	30.80
S-02	8 Metals (incl. Digestion)	1.00	26.00	26.00	2.60	28.60
S-17	TRH/BTEXN/PAH/Phenols/OC/PCB	1.00	140.00	140.00	14.00	154.00

** denotes non-discountable item*

- **Please direct all queries to Environmental Division Melbourne on +61-3-8549 9600.**

REMITTANCE ADVICE

POST TO: Australian Laboratory Services Pty Ltd
P.O. Box 66 Everton Park
QLD 4053 Australia

EMAIL TO: remittances@alsglobal.com

Vendor bank details

Bank:	**Commonwealth Bank**
BSB:	**064 000**
Account:	**12672843**
Swift Code:	**CTBAAU2S**

or Credit Card
Visa
Mastercard

or Cheque
Payable to Australian Laboratory Services Pty Ltd

Amount Payable
AUD$ 361.90

ALS Client Reference
AARGUS

TAX INVOICE
L496720

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order : **ES1711675**
Client : **AARGUS PTY LTD**
Contact : MR MARK KELLY
Address : PO BOX 398
DRUMMOYNE NSW, AUSTRALIA 2047
Telephone : 1300137038
Project : ES6874 PSI
Order number : ----
C-O-C number : ----
Sampler : NINGYE ZHANG
Site : Annandale
Quote number : SY/258/14 V2
No. of samples received : 15
No. of samples analysed : 10

Page : 1 of 13
Laboratory : Environmental Division Sydney
Contact : Customer Services ES
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61-2-8784 8555
Date Samples Received : 15-May-2017 15:40
Date Analysis Commenced : 16-May-2017
Issue Date : 23-May-2017 16:02

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

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

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

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

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

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EG005T: Poor precision was obtained for Copper on sample ES1711675 #008 due to sample heterogeneity. Results have been confirmed by re-extraction and reanalysis.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			*Client sample ID*	**BH1 0.2-0.4**	**BH2 0.2-0.3**	**BH3 0.2-0.3**	**BH4 0.2-0.3**	**BH5 0.2-0.3**
			Client sampling date / time	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES1711675-001**	**ES1711675-007**	**ES1711675-008**	**ES1711675-009**	**ES1711675-010**
				Result	Result	Result	Result	Result
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1	%	**10.0**	**12.1**	**18.4**	**14.7**	**12.3**
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	**7**	**6**	<5	<5	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	**5**	<1	<1
Chromium	7440-47-3	2	mg/kg	**14**	**14**	**24**	**3**	**3**
Copper	7440-50-8	5	mg/kg	**94**	**167**	**338**	<5	<5
Lead	7439-92-1	5	mg/kg	**177**	**172**	**757**	<5	<5
Nickel	7440-02-0	2	mg/kg	**5**	**12**	**26**	**2**	**4**
Zinc	7440-66-6	5	mg/kg	**167**	**176**	**481**	<5	**7**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**0.4**	**0.4**	**0.2**	<0.1	<0.1
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	<1	**1**	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ **Total Chlordane (sum)**	----	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ **Endosulfan (sum)**	115-29-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			*Client sample ID*	**BH1 0.2-0.4**	**BH2 0.2-0.3**	**BH3 0.2-0.3**	**BH4 0.2-0.3**	**BH5 0.2-0.3**
			Client sampling date / time	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES1711675-001**	**ES1711675-007**	**ES1711675-008**	**ES1711675-009**	**ES1711675-010**
				Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued								
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ **Sum of Aldrin + Dieldrin**	309-00-2/60-57-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ **Sum of DDD + DDE + DDT**	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	<1	----	----
2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
Pentachlorophenol	87-86-5	2	mg/kg	<2	<2	<2	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	**1.1**	**0.7**	**2.2**	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	**1.6**	**1.1**	**1.5**	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	**1.5**	**1.0**	**2.2**	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	**0.9**	**0.6**	**0.8**	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	**0.8**	**0.5**	**1.1**	<0.5	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	**1.4**	**1.0**	**1.2**	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	**0.6**	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	**1.0**	**0.6**	**0.7**	<0.5	<0.5

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL)**			*Client sample ID*	**BH1 0.2-0.4**	**BH2 0.2-0.3**	**BH3 0.2-0.3**	**BH4 0.2-0.3**	**BH5 0.2-0.3**
			Client sampling date / time	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**ES1711675-001**	**ES1711675-007**	**ES1711675-008**	**ES1711675-009**	**ES1711675-010**
				Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	**8.9**	**5.5**	**9.7**	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	**1.3**	**0.8**	**0.9**	<0.5	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	**1.6**	**1.1**	**1.2**	**0.6**	**0.6**
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	**1.8**	**1.4**	**1.5**	**1.2**	**1.2**
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	**500**	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	**620**	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	**1120**	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	**140**	**930**	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	**430**	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	**140**	**1360**	<50	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	**1.7**	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg	<0.2	**1.7**	<0.2	<0.2	<0.2
^ Total Xylenes	1330-20-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	**120**	**96.8**	**113**	**94.0**	**109**

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL)**

			Client sample ID	**BH1 0.2-0.4**	**BH2 0.2-0.3**	**BH3 0.2-0.3**	**BH4 0.2-0.3**	**BH5 0.2-0.3**
			Client sampling date / time	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00
Compound	CAS Number	LOR	Unit	**ES1711675-001**	**ES1711675-007**	**ES1711675-008**	**ES1711675-009**	**ES1711675-010**
				Result	Result	Result	Result	Result
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.05	%	**112**	**123**	**90.9**	**125**	**123**
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.05	%	**73.8**	**73.5**	**69.2**	**62.8**	**63.3**
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	**83.3**	**83.2**	**87.7**	**86.1**	**76.6**
2-Chlorophenol-D4	93951-73-6	0.5	%	**85.7**	**85.5**	**91.6**	**91.2**	**72.1**
2.4.6-Tribromophenol	118-79-6	0.5	%	**79.9**	**79.9**	**90.1**	**76.7**	**46.8**
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	**80.9**	**88.3**	**87.5**	**85.6**	**85.5**
Anthracene-d10	1719-06-8	0.5	%	**90.1**	**90.4**	**88.3**	**99.8**	**84.8**
4-Terphenyl-d14	1718-51-0	0.5	%	**93.1**	**94.6**	**91.9**	**91.8**	**92.6**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	**107**	**107**	**111**	**104**	**103**
Toluene-D8	2037-26-5	0.2	%	**120**	**115**	**120**	**112**	**108**
4-Bromofluorobenzene	460-00-4	0.2	%	**112**	**104**	**106**	**105**	**93.8**

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			*Client sample ID*	**BH6 0.2-0.3**	**BH7 0.2-0.3**	**D1**	**Trip BLANK**	**----**
			Client sampling date / time	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1711675-011**	**ES1711675-012**	**ES1711675-013**	**ES1711675-015**	--------
				Result	Result	Result	Result	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1	%	**20.5**	**16.3**	**11.8**	**2.5**	----
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	**13**	**7**	**6**	----	----
Cadmium	7440-43-9	1	mg/kg	**3**	**3**	<1	----	----
Chromium	7440-47-3	2	mg/kg	**50**	**68**	**15**	----	----
Copper	7440-50-8	5	mg/kg	**508**	**1300**	**129**	----	----
Lead	7439-92-1	5	mg/kg	**484**	**342**	**170**	----	----
Nickel	7440-02-0	2	mg/kg	**43**	**30**	**7**	----	----
Zinc	7440-66-6	5	mg/kg	**1090**	**368**	**136**	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**0.8**	<0.1	**0.4**	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	----	<1	<1	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	<0.1	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
^ **Total Chlordane (sum)**	----	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
^ **Endosulfan (sum)**	115-29-7	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	<0.05	----	----

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			*Client sample ID*	**BH6 0.2-0.3**	**BH7 0.2-0.3**	**D1**	**Trip BLANK**	----
			Client sampling date / time	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1711675-011**	**ES1711675-012**	**ES1711675-013**	**ES1711675-015**	--------
				Result	Result	Result	Result	----
EP068A: Organochlorine Pesticides (OC) - Continued								
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	<0.2	----	----
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	<0.2	----	----
^ **Sum of Aldrin + Dieldrin**	309-00-2/60-57-1	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
^ **Sum of DDD + DDE + DDT**	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	<0.05	<0.05	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	0.5	mg/kg	----	<0.5	<0.5	----	----
2-Chlorophenol	95-57-8	0.5	mg/kg	----	<0.5	<0.5	----	----
2-Methylphenol	95-48-7	0.5	mg/kg	----	<0.5	<0.5	----	----
3- & 4-Methylphenol	1319-77-3	1	mg/kg	----	<1	<1	----	----
2-Nitrophenol	88-75-5	0.5	mg/kg	----	<0.5	<0.5	----	----
2.4-Dimethylphenol	105-67-9	0.5	mg/kg	----	<0.5	<0.5	----	----
2.4-Dichlorophenol	120-83-2	0.5	mg/kg	----	<0.5	<0.5	----	----
2.6-Dichlorophenol	87-65-0	0.5	mg/kg	----	<0.5	<0.5	----	----
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	----	<0.5	<0.5	----	----
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	----	<0.5	<0.5	----	----
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	----	<0.5	<0.5	----	----
Pentachlorophenol	87-86-5	2	mg/kg	----	<2	<2	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
Phenanthrene	85-01-8	0.5	mg/kg	**1.7**	<0.5	**0.9**	----	----
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
Fluoranthene	206-44-0	0.5	mg/kg	**3.2**	<0.5	**1.5**	----	----
Pyrene	129-00-0	0.5	mg/kg	**3.0**	<0.5	**1.4**	----	----
Benz(a)anthracene	56-55-3	0.5	mg/kg	**1.8**	<0.5	**0.8**	----	----
Chrysene	218-01-9	0.5	mg/kg	**1.6**	<0.5	**0.8**	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	**2.9**	<0.5	**1.3**	----	----
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	**1.1**	<0.5	**0.6**	----	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg	**1.9**	<0.5	**0.9**	----	----

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL)**			*Client sample ID*	**BH6 0.2-0.3**	**BH7 0.2-0.3**	**D1**	**Trip BLANK**	**----**
			Client sampling date / time	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1711675-011**	**ES1711675-012**	**ES1711675-013**	**ES1711675-015**	--------
				Result	Result	Result	Result	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	**0.7**	<0.5	<0.5	----	----
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	----
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	**0.8**	<0.5	<0.5	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	mg/kg	**18.7**	<0.5	**8.2**	----	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	mg/kg	**2.6**	<0.5	**1.2**	----	----
^ **Benzo(a)pyrene TEQ (half LOR)**	----	0.5	mg/kg	**2.8**	**0.6**	**1.4**	----	----
^ **Benzo(a)pyrene TEQ (LOR)**	----	0.5	mg/kg	**3.1**	**1.2**	**1.7**	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	----
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	----
C15 - C28 Fraction	----	100	mg/kg	**190**	<100	<100	<100	----
C29 - C36 Fraction	----	100	mg/kg	**150**	<100	<100	<100	----
^ **C10 - C36 Fraction (sum)**	----	50	mg/kg	**340**	<50	<50	<50	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	----
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	----
>C16 - C34 Fraction	----	100	mg/kg	**280**	<100	**120**	<100	----
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	----
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg	**280**	<50	**120**	<50	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	50	mg/kg	<50	<50	<50	<50	----
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	----
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	**0.6**	<0.5	----
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
^ **Sum of BTEX**	----	0.2	mg/kg	<0.2	<0.2	**0.6**	<0.2	----
^ **Total Xylenes**	1330-20-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	----
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	**115**	**108**	**105**	----	----

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL)**

			Client sample ID	**BH6 0.2-0.3**	**BH7 0.2-0.3**	**D1**	**Trip BLANK**	----
			Client sampling date / time	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00	13-May-2017 00:00	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1711675-011**	**ES1711675-012**	**ES1711675-013**	**ES1711675-015**	--------
				Result	Result	Result	Result	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.05	%	**112**	**113**	**122**	----	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.05	%	**78.2**	**73.8**	**72.7**	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	**89.9**	**85.8**	**90.9**	----	----
2-Chlorophenol-D4	93951-73-6	0.5	%	**92.4**	**93.7**	**96.4**	----	----
2.4.6-Tribromophenol	118-79-6	0.5	%	**88.4**	**87.6**	**95.8**	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	**86.8**	**94.1**	**94.7**	----	----
Anthracene-d10	1719-06-8	0.5	%	**93.9**	**92.2**	**97.9**	----	----
4-Terphenyl-d14	1718-51-0	0.5	%	**97.4**	**92.7**	**107**	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	**109**	**103**	**99.0**	**103**	----
Toluene-D8	2037-26-5	0.2	%	**117**	**106**	**106**	**108**	----
4-Bromofluorobenzene	460-00-4	0.2	%	**107**	**101**	**98.4**	**102**	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**R1**	----	----	----	----
			Client sampling date / time	13-May-2017 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1711675-014**	--------	--------	--------	--------
				Result	----	----	----	----
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1	µg/L	<1.0	----	----	----	----
Acenaphthylene	208-96-8	1	µg/L	<1.0	----	----	----	----
Acenaphthene	83-32-9	1	µg/L	<1.0	----	----	----	----
Fluorene	86-73-7	1	µg/L	<1.0	----	----	----	----
Phenanthrene	85-01-8	1	µg/L	<1.0	----	----	----	----
Anthracene	120-12-7	1	µg/L	<1.0	----	----	----	----
Fluoranthene	206-44-0	1	µg/L	<1.0	----	----	----	----
Pyrene	129-00-0	1	µg/L	<1.0	----	----	----	----
Benz(a)anthracene	56-55-3	1	µg/L	<1.0	----	----	----	----
Chrysene	218-01-9	1	µg/L	<1.0	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	1	µg/L	<1.0	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	1	µg/L	<1.0	----	----	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	µg/L	<0.5	----	----	----	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	µg/L	<0.5	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	----	----	----	----
C10 - C14 Fraction	----	50	µg/L	<50	----	----	----	----
C15 - C28 Fraction	----	100	µg/L	<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L	<50	----	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	<50	----	----	----	----

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**R1**	**----**	**----**	**----**	**----**
			Client sampling date / time	13-May-2017 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1711675-014**	--------	--------	--------	--------
				Result	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	----	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	<20	----	----	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	----	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	<100	----	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L	<100	----	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	----	----	----	----
Toluene	108-88-3	2	µg/L	<2	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	----	----	----	----
^ **Total Xylenes**	1330-20-7	2	µg/L	<2	----	----	----	----
^ **Sum of BTEX**	----	1	µg/L	<1	----	----	----	----
Naphthalene	91-20-3	5	µg/L	<5	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1	%	**17.6**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	1	%	**49.6**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	1	%	**39.4**	----	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1	%	**51.1**	----	----	----	----
Anthracene-d10	1719-06-8	1	%	**70.6**	----	----	----	----
4-Terphenyl-d14	1718-51-0	1	%	**66.7**	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**100**	----	----	----	----
Toluene-D8	2037-26-5	2	%	**116**	----	----	----	----
4-Bromofluorobenzene	460-00-4	2	%	**118**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **SOIL**

		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	39	149
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	49	147
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	35	143
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	63	123
2-Chlorophenol-D4	93951-73-6	66	122
2.4.6-Tribromophenol	118-79-6	40	138
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	70	122
Anthracene-d10	1719-06-8	66	128
4-Terphenyl-d14	1718-51-0	65	129
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	73	133
Toluene-D8	2037-26-5	74	132
4-Bromofluorobenzene	460-00-4	72	130

Sub-Matrix: **WATER**

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

ALS Environmental

QUALITY CONTROL REPORT

Work Order : **ES1711675**
Page : 1 of 12

Client : **AARGUS PTY LTD**
Contact : MR MARK KELLY
Address : PO BOX 398
DRUMMOYNE NSW, AUSTRALIA 2047
Telephone : 1300137038
Project : ES6874 PSI
Order number : ----
C-O-C number : ----
Sampler : NINGYE ZHANG
Site : Annandale
Quote number : SY/258/14 V2
No. of samples received : 15
No. of samples analysed : 10

Laboratory : Environmental Division Sydney
Contact : Customer Services ES
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61-2-8784 8555
Date Samples Received : 15-May-2017
Date Analysis Commenced : 16-May-2017
Issue Date : 23-May-2017

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

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

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

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

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA055: Moisture Content (QC Lot: 894560)									
ES1711671-005	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1	%	17.3	17.0	2.01	0% - 50%
ES1711678-002	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1	%	22.8	23.3	1.90	0% - 20%
EG005T: Total Metals by ICP-AES (QC Lot: 897752)									
ES1711665-028	Anonymous	EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	15	15	0.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	10	10	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	7	7	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	12	8	32.4	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	42	48	14.9	No Limit
ES1711675-008	BH3 0.2-0.3	EG005T: Cadmium	7440-43-9	1	mg/kg	5	5	0.00	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	24	19	23.9	0% - 50%
		EG005T: Nickel	7440-02-0	2	mg/kg	26	18	37.4	0% - 50%
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	338	# 254	28.1	0% - 20%
		EG005T: Lead	7439-92-1	5	mg/kg	757	690	9.24	0% - 20%
		EG005T: Zinc	7440-66-6	5	mg/kg	481	496	3.08	0% - 20%
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 897753)									
ES1711665-028	Anonymous	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
ES1711675-008	BH3 0.2-0.3	EG035T: Mercury	7439-97-6	0.1	mg/kg	0.2	0.2	0.00	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 889830)									
ES1711259-002	Anonymous	EK026SF: Total Cyanide	57-12-5	1	mg/kg	106	108	1.79	0% - 20%
ES1711675-012	BH7 0.2-0.3	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.00	No Limit
EP066: Polychlorinated Biphenyls (PCB) (QC Lot: 889899)									

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP066: Polychlorinated Biphenyls (PCB) (QC Lot: 889899) - continued									
ES1711675-001	BH1 0.2-0.4	EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP068A: Organochlorine Pesticides (OC) (QC Lot: 889898)									
ES1711675-001	BH1 0.2-0.4	EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
EP075(SIM)A: Phenolic Compounds (QC Lot: 889897)									
ES1711675-001	BH1 0.2-0.4	EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.00	No Limit
		EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	<2	0.00	No Limit
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 889897)									
ES1711675-001	BH1 0.2-0.4	EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 889897) - continued									
ES1711675-001	BH1 0.2-0.4	EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	1.1	0.8	28.5	No Limit
		EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	1.6	1.5	7.11	No Limit
		EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	1.5	1.4	0.00	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	0.9	0.9	0.00	No Limit
		EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	0.8	0.8	0.00	No Limit
		EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	1.4	1.4	0.00	No Limit
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	0.6	0.6	0.00	No Limit
		EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	1.0	0.9	0.00	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	8.9	8.3	6.98	0% - 50%
		EP075(SIM): Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	1.3	1.2	8.01	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 889896)									
ES1711675-001	BH1 0.2-0.4	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 894695)									
ES1711636-001	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
ES1711834-001	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 889896)									
ES1711675-001	BH1 0.2-0.4	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 894695)									
ES1711636-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
ES1711834-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
EP080: BTEXN (QC Lot: 894695)									
ES1711636-001	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP080: BTEXN (QC Lot: 894695) - continued									
ES1711834-001	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020T: Total Metals by ICP-MS (QC Lot: 895178)									
ES1711641-002	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.196	0.195	0.869	0% - 20%
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
ES1711876-005	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.032	0.030	7.19	0% - 20%
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 895132)									
ES1711693-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
ES1711694-002	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 895132)									
ES1711693-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
ES1711694-002	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EP080: BTEXN (QC Lot: 895132)									
ES1711693-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
ES1711694-002	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
				Laboratory Duplicate (DUP) Report					
EP080: BTEXN (QC Lot: 895132) - continued									
ES1711694-002	Anonymous	EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EG005T: Total Metals by ICP-AES (QCLot: 897752)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	21.7 mg/kg	101	86	126
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	4.64 mg/kg	95.7	83	113
EG005T: Chromium	7440-47-3	2	mg/kg	<2	43.9 mg/kg	86.4	76	128
EG005T: Copper	7440-50-8	5	mg/kg	<5	32 mg/kg	97.1	86	120
EG005T: Lead	7439-92-1	5	mg/kg	<5	40 mg/kg	98.0	80	114
EG005T: Nickel	7440-02-0	2	mg/kg	<2	55 mg/kg	96.3	87	123
EG005T: Zinc	7440-66-6	5	mg/kg	<5	60.8 mg/kg	89.4	80	122
EG035T: Total Recoverable Mercury by FIMS (QCLot: 897753)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	2.57 mg/kg	93.7	70	105
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 889830)								
EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	20 mg/kg	112	81	129
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 889899)								
EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	1 mg/kg	108	62	126
EP068A: Organochlorine Pesticides (OC) (QCLot: 889898)								
EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	0.5 mg/kg	95.0	69	113
EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	0.5 mg/kg	99.6	65	117
EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	0.5 mg/kg	93.2	67	119
EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	0.5 mg/kg	95.7	68	116
EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	0.5 mg/kg	93.9	65	117
EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	0.5 mg/kg	92.5	67	115
EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	0.5 mg/kg	94.8	69	115
EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	0.5 mg/kg	87.6	62	118
EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	0.5 mg/kg	89.9	63	117
EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	0.5 mg/kg	98.5	66	116
EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	0.5 mg/kg	93.1	64	116
EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	0.5 mg/kg	98.9	66	116
EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	0.5 mg/kg	100	67	115
EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	0.5 mg/kg	96.6	67	123
EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	0.5 mg/kg	102	69	115
EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	0.5 mg/kg	98.9	69	121
EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	0.5 mg/kg	106	56	120
EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	0.5 mg/kg	100	62	124
EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	0.5 mg/kg	94.1	66	120
EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	0.5 mg/kg	99.4	64	122

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP068A: Organochlorine Pesticides (OC) (QCLot: 889898) - continued								
EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	0.5 mg/kg	93.3	54	130
EP075(SIM)A: Phenolic Compounds (QCLot: 889897)								
EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	6 mg/kg	95.8	71	125
EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	6 mg/kg	102	72	124
EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	6 mg/kg	102	71	123
EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	12 mg/kg	116	67	127
EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	6 mg/kg	73.4	54	114
EP075(SIM): 2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	6 mg/kg	87.3	68	126
EP075(SIM): 2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	6 mg/kg	84.6	66	120
EP075(SIM): 2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	6 mg/kg	96.4	70	120
EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	6 mg/kg	87.8	70	116
EP075(SIM): 2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	6 mg/kg	84.0	54	114
EP075(SIM): 2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	6 mg/kg	81.8	60	114
EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	12 mg/kg	16.6	10	57
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 889897)								
EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	6 mg/kg	101	77	125
EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	6 mg/kg	107	72	124
EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	6 mg/kg	99.1	73	127
EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	6 mg/kg	104	72	126
EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	6 mg/kg	104	75	127
EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	6 mg/kg	97.8	77	127
EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	6 mg/kg	106	73	127
EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	6 mg/kg	101	74	128
EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	6 mg/kg	104	69	123
EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	6 mg/kg	108	75	127
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	6 mg/kg	106	68	116
EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	6 mg/kg	108	74	126
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	6 mg/kg	105	70	126
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	6 mg/kg	74.5	61	121
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	6 mg/kg	71.0	62	118
EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	6 mg/kg	69.2	63	121
EP080/071: Total Petroleum Hydrocarbons (QCLot: 889896)								
EP071: C10 - C14 Fraction	----	50	mg/kg	<50	200 mg/kg	104	75	129
EP071: C15 - C28 Fraction	----	100	mg/kg	<100	300 mg/kg	111	77	131
EP071: C29 - C36 Fraction	----	100	mg/kg	<100	200 mg/kg	100	71	129
EP080/071: Total Petroleum Hydrocarbons (QCLot: 894695)								
EP080: C6 - C9 Fraction	----	10	mg/kg	<10	26 mg/kg	97.4	68	128

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 889896)								
EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	250 mg/kg	107	77	125
EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	350 mg/kg	103	74	138
EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	150 mg/kg	101	63	131
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 894695)								
EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	31 mg/kg	98.0	68	128
EP080: BTEXN (QCLot: 894695)								
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	1 mg/kg	92.9	62	116
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	1 mg/kg	93.2	67	121
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	1 mg/kg	91.6	65	117
EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	2 mg/kg	92.8	66	118
EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	1 mg/kg	88.4	68	120
EP080: Naphthalene	91-20-3	1	mg/kg	<1	1 mg/kg	96.9	63	119

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EG020T: Total Metals by ICP-MS (QCLot: 895178)								
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	93.4	82	114
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	96.1	84	112
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	97.3	86	116
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	104	83	118
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	96.0	85	115
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	94.8	84	116
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	83.4	79	117
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 889774)								
EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	5 µg/L	68.6	50	94
EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	5 µg/L	72.8	64	114
EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	5 µg/L	71.4	62	113
EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	5 µg/L	69.1	64	115
EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	5 µg/L	72.2	63	116
EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	5 µg/L	78.3	64	116
EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	5 µg/L	81.5	64	118
EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	5 µg/L	87.4	63	118
EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	5 µg/L	80.5	64	117
EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	5 µg/L	68.5	63	116
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	5 µg/L	75.1	62	119
EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	5 µg/L	88.3	63	115

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 889774) - continued								
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	5 µg/L	78.1	63	117
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	5 µg/L	78.4	60	118
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	1	µg/L	<1.0	5 µg/L	83.5	61	117
EP075(SIM): Benzo(g.h.i)perylene	191-24-2	1	µg/L	<1.0	5 µg/L	79.4	59	118
EP080/071: Total Petroleum Hydrocarbons (QCLot: 889775)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	2000 µg/L	91.5	76	116
EP071: C15 - C28 Fraction	----	100	µg/L	<100	3000 µg/L	93.8	83	109
EP071: C29 - C36 Fraction	----	50	µg/L	<50	2000 µg/L	99.9	75	113
EP080/071: Total Petroleum Hydrocarbons (QCLot: 895132)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	91.8	75	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 889775)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	2500 µg/L	91.2	76	114
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	3500 µg/L	97.2	81	111
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	1500 µg/L	105	77	119
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 895132)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	310 µg/L	93.2	75	127
EP080: BTEXN (QCLot: 895132)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	92.5	70	122
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	97.8	69	123
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	95.8	70	120
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	10 µg/L	95.6	69	121
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	97.7	72	122
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	94.1	70	120

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EG005T: Total Metals by ICP-AES (QCLot: 897752)							
ES1711665-028	Anonymous	EG005T: Arsenic	7440-38-2	50 mg/kg	105	70	130
		EG005T: Cadmium	7440-43-9	50 mg/kg	97.9	70	130
		EG005T: Chromium	7440-47-3	50 mg/kg	102	70	130
		EG005T: Copper	7440-50-8	250 mg/kg	101	70	130
		EG005T: Lead	7439-92-1	250 mg/kg	98.4	70	130

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EG005T: Total Metals by ICP-AES (QCLot: 897752) - continued							
ES1711665-028	Anonymous	EG005T: Nickel	7440-02-0	50 mg/kg	97.9	70	130
		EG005T: Zinc	7440-66-6	250 mg/kg	95.5	70	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 897753)							
ES1711665-028	Anonymous	EG035T: Mercury	7439-97-6	5 mg/kg	105	70	130
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 889830)							
ES1711259-002	Anonymous	EK026SF: Total Cyanide	57-12-5	20 mg/kg	# Not Determined	70	130
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 889899)							
ES1711675-001	BH1 0.2-0.4	EP066: Total Polychlorinated biphenyls	----	1 mg/kg	122	70	130
EP068A: Organochlorine Pesticides (OC) (QCLot: 889898)							
ES1711675-001	BH1 0.2-0.4	EP068: gamma-BHC	58-89-9	0.5 mg/kg	93.4	70	130
		EP068: Heptachlor	76-44-8	0.5 mg/kg	84.8	70	130
		EP068: Aldrin	309-00-2	0.5 mg/kg	95.6	70	130
		EP068: Dieldrin	60-57-1	0.5 mg/kg	83.6	70	130
		EP068: Endrin	72-20-8	2 mg/kg	95.7	70	130
		EP068: 4.4`-DDT	50-29-3	2 mg/kg	89.2	70	130
EP075(SIM)A: Phenolic Compounds (QCLot: 889897)							
ES1711675-001	BH1 0.2-0.4	EP075(SIM): Phenol	108-95-2	10 mg/kg	87.1	70	130
		EP075(SIM): 2-Chlorophenol	95-57-8	10 mg/kg	96.3	70	130
		EP075(SIM): 2-Nitrophenol	88-75-5	10 mg/kg	88.9	60	130
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	10 mg/kg	96.3	70	130
		EP075(SIM): Pentachlorophenol	87-86-5	10 mg/kg	55.4	20	130
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 889897)							
ES1711675-001	BH1 0.2-0.4	EP075(SIM): Acenaphthene	83-32-9	10 mg/kg	95.6	70	130
		EP075(SIM): Pyrene	129-00-0	10 mg/kg	88.0	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 889896)							
ES1711675-001	BH1 0.2-0.4	EP071: C10 - C14 Fraction	----	523 mg/kg	83.7	73	137
		EP071: C15 - C28 Fraction	----	2319 mg/kg	95.6	53	131
		EP071: C29 - C36 Fraction	----	1714 mg/kg	104	52	132
EP080/071: Total Petroleum Hydrocarbons (QCLot: 894695)							
ES1711636-001	Anonymous	EP080: C6 - C9 Fraction	----	32.5 mg/kg	107	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 889896)							
ES1711675-001	BH1 0.2-0.4	EP071: >C10 - C16 Fraction	----	860 mg/kg	82.8	73	137
		EP071: >C16 - C34 Fraction	----	3223 mg/kg	99.5	53	131
		EP071: >C34 - C40 Fraction	----	1058 mg/kg	105	52	132
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 894695)							

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 894695) - continued							
ES1711636-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	37.5 mg/kg	112	70	130
EP080: BTEXN (QCLot: 894695)							
ES1711636-001	Anonymous	EP080: Benzene	71-43-2	2.5 mg/kg	102	70	130
		EP080: Toluene	108-88-3	2.5 mg/kg	97.3	70	130
		EP080: Ethylbenzene	100-41-4	2.5 mg/kg	101	70	130
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2.5 mg/kg	95.3	70	130
		EP080: ortho-Xylene	95-47-6	2.5 mg/kg	89.8	70	130
		EP080: Naphthalene	91-20-3	2.5 mg/kg	92.8	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EG020T: Total Metals by ICP-MS (QCLot: 895178)							
ES1711641-003	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	94.3	70	130
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	100	70	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	98.6	70	130
		EG020A-T: Copper	7440-50-8	1 mg/L	109	70	130
		EG020A-T: Lead	7439-92-1	1 mg/L	95.9	70	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	98.0	70	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	92.0	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 895132)							
ES1711693-001	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	93.0	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 895132)							
ES1711693-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	94.4	70	130
EP080: BTEXN (QCLot: 895132)							
ES1711693-001	Anonymous	EP080: Benzene	71-43-2	25 µg/L	77.0	70	130
		EP080: Toluene	108-88-3	25 µg/L	87.3	70	130
		EP080: Ethylbenzene	100-41-4	25 µg/L	92.7	70	130
		EP080: meta- & para-Xylene	108-38-3 106-42-3	25 µg/L	91.5	70	130
		EP080: ortho-Xylene	95-47-6	25 µg/L	95.5	70	130
		EP080: Naphthalene	91-20-3	25 µg/L	105	70	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ES1711675**	Page	: 1 of 9
Client	: **AARGUS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR MARK KELLY	Telephone	: +61-2-8784 8555
Project	: ES6874 PSI	Date Samples Received	: 15-May-2017
Site	: Annandale	Issue Date	: 23-May-2017
Sampler	: NINGYE ZHANG	No. of samples received	: 15
Order number	: ----	No. of samples analysed	: 10

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Duplicate outliers exist - please see following pages for full details.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Duplicate (DUP) RPDs							
EG005T: Total Metals by ICP-AES	ES1711675--008	BH3 0.2-0.3	**Copper**	7440-50-8	28.1 %	0% - 20%	**RPD exceeds LOR based limits**
Matrix Spike (MS) Recoveries							
EK026SF: Total CN by Segmented Flow Analyser	ES1711259--002	Anonymous	**Total Cyanide**	57-12-5	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type Method	Count		Rate (%)		Quality Control Specification
	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
PAH/Phenols (GC/MS - SIM)	0	13	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	12	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
PAH/Phenols (GC/MS - SIM)	0	13	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	12	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method *Container / Client Sample ID(s)*		*Sample Date*	*Extraction / Preparation*			*Analysis*		
			Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EA055: Moisture Content								
Soil Glass Jar - Unpreserved (EA055-103)								
BH1 0.2-0.4, BH3 0.2-0.3, BH5 0.2-0.3, BH7 0.2-0.3, Trip BLANK	BH2 0.2-0.3, BH4 0.2-0.3, BH6 0.2-0.3, D1,	**13-May-2017**	----	----	----	**18-May-2017**	27-May-2017	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method *Container / Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	**Date analysed**	*Due for analysis*	*Evaluation*
EG005T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T) BH1 0.2-0.4, BH2 0.2-0.3, BH3 0.2-0.3, BH4 0.2-0.3, BH5 0.2-0.3, BH6 0.2-0.3, BH7 0.2-0.3, D1	**13-May-2017**	**19-May-2017**	09-Nov-2017	✓	**19-May-2017**	09-Nov-2017	✓
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T) BH1 0.2-0.4, BH2 0.2-0.3, BH3 0.2-0.3, BH4 0.2-0.3, BH5 0.2-0.3, BH6 0.2-0.3, BH7 0.2-0.3, D1	**13-May-2017**	**19-May-2017**	10-Jun-2017	✓	**19-May-2017**	10-Jun-2017	✓
EK026SF: Total CN by Segmented Flow Analyser							
Soil Glass Jar - Unpreserved (EK026SF) BH1 0.2-0.4, BH2 0.2-0.3, BH3 0.2-0.3, BH7 0.2-0.3, D1	**13-May-2017**	**17-May-2017**	27-May-2017	✓	**17-May-2017**	31-May-2017	✓
EP066: Polychlorinated Biphenyls (PCB)							
Soil Glass Jar - Unpreserved (EP066) BH1 0.2-0.4, BH2 0.2-0.3, BH3 0.2-0.3, BH4 0.2-0.3, BH5 0.2-0.3, BH6 0.2-0.3, BH7 0.2-0.3, D1	**13-May-2017**	**18-May-2017**	27-May-2017	✓	**18-May-2017**	27-Jun-2017	✓
EP068A: Organochlorine Pesticides (OC)							
Soil Glass Jar - Unpreserved (EP068) BH1 0.2-0.4, BH2 0.2-0.3, BH3 0.2-0.3, BH4 0.2-0.3, BH5 0.2-0.3, BH6 0.2-0.3, BH7 0.2-0.3, D1	**13-May-2017**	**18-May-2017**	27-May-2017	✓	**18-May-2017**	27-Jun-2017	✓
EP075(SIM)A: Phenolic Compounds							
Soil Glass Jar - Unpreserved (EP075(SIM)) BH1 0.2-0.4, BH2 0.2-0.3, BH3 0.2-0.3, BH7 0.2-0.3, D1	**13-May-2017**	**18-May-2017**	27-May-2017	✓	**18-May-2017**	27-Jun-2017	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Soil Glass Jar - Unpreserved (EP075(SIM)) BH1 0.2-0.4, BH2 0.2-0.3, BH3 0.2-0.3, BH4 0.2-0.3, BH5 0.2-0.3, BH6 0.2-0.3, BH7 0.2-0.3, D1	**13-May-2017**	**18-May-2017**	27-May-2017	✓	**18-May-2017**	27-Jun-2017	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method *Container / Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EP080/071: Total Petroleum Hydrocarbons							
Soil Glass Jar - Unpreserved (EP071) BH1 0.2-0.4, BH2 0.2-0.3, BH3 0.2-0.3, BH4 0.2-0.3, BH5 0.2-0.3, BH6 0.2-0.3, BH7 0.2-0.3, D1, Trip BLANK	**13-May-2017**	**18-May-2017**	27-May-2017	✓	**18-May-2017**	27-Jun-2017	✓
Soil Glass Jar - Unpreserved (EP080) BH1 0.2-0.4, BH2 0.2-0.3, BH3 0.2-0.3, BH4 0.2-0.3, BH5 0.2-0.3, BH6 0.2-0.3, BH7 0.2-0.3, D1, Trip BLANK	**13-May-2017**	**18-May-2017**	27-May-2017	✓	**19-May-2017**	27-May-2017	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Soil Glass Jar - Unpreserved (EP071) BH1 0.2-0.4, BH2 0.2-0.3, BH3 0.2-0.3, BH4 0.2-0.3, BH5 0.2-0.3, BH6 0.2-0.3, BH7 0.2-0.3, D1, Trip BLANK	**13-May-2017**	**18-May-2017**	27-May-2017	✓	**18-May-2017**	27-Jun-2017	✓
Soil Glass Jar - Unpreserved (EP080) BH1 0.2-0.4, BH2 0.2-0.3, BH3 0.2-0.3, BH4 0.2-0.3, BH5 0.2-0.3, BH6 0.2-0.3, BH7 0.2-0.3, D1, Trip BLANK	**13-May-2017**	**18-May-2017**	27-May-2017	✓	**19-May-2017**	27-May-2017	✓
EP080: BTEXN							
Soil Glass Jar - Unpreserved (EP080) BH1 0.2-0.4, BH2 0.2-0.3, BH3 0.2-0.3, BH4 0.2-0.3, BH5 0.2-0.3, BH6 0.2-0.3, BH7 0.2-0.3, D1, Trip BLANK	**13-May-2017**	**18-May-2017**	27-May-2017	✓	**19-May-2017**	27-May-2017	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method *Container / Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T) R1	**13-May-2017**	**18-May-2017**	09-Nov-2017	✓	**18-May-2017**	09-Nov-2017	✓
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035T) R1	**13-May-2017**	----	----	----	**18-May-2017**	10-Jun-2017	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method ***Container*** */ Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP075(SIM)) R1	**13-May-2017**	**18-May-2017**	20-May-2017	✓	**18-May-2017**	27-Jun-2017	✓
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071) R1	**13-May-2017**	**18-May-2017**	20-May-2017	✓	**18-May-2017**	27-Jun-2017	✓
Amber VOC Vial - Sulfuric Acid (EP080) R1	**13-May-2017**	**18-May-2017**	27-May-2017	✓	**18-May-2017**	27-May-2017	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - Unpreserved (EP071) R1	**13-May-2017**	**18-May-2017**	20-May-2017	✓	**18-May-2017**	27-Jun-2017	✓
Amber VOC Vial - Sulfuric Acid (EP080) R1	**13-May-2017**	**18-May-2017**	27-May-2017	✓	**18-May-2017**	27-May-2017	✓
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP080) R1	**13-May-2017**	**18-May-2017**	27-May-2017	✓	**18-May-2017**	27-May-2017	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Moisture Content	EA055-103	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
PAH/Phenols (SIM)	EP075(SIM)	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
PAH/Phenols (SIM)	EP075(SIM)	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
PAH/Phenols (SIM)	EP075(SIM)	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	13	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	12	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	13	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	12	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Moisture Content	EA055-103	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Cyanide by Segmented Flow Analyser	EK026SF	SOIL	In house: Referenced to APHA 4500-CN C / ASTM D7511. Caustic leachates of soil samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (2013) Schedule B(3)
Polychlorinated Biphenyls (PCB)	EP066	SOIL	In house: Referenced to USEPA SW 846 - 8270D Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3) (Method 504)
Pesticides by GCMS	EP068	SOIL	In house: Referenced to USEPA SW 846 - 8270D Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM (2013) Schedule B(3) (Method 504,505)
TRH - Semivolatile Fraction	EP071	SOIL	In house: Referenced to USEPA SW 846 - 8015A Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C40.
PAH/Phenols (SIM)	EP075(SIM)	SOIL	In house: Referenced to USEPA SW 846 - 8270D Extracts are analysed by Capillary GC/MS in Selective Ion Mode (SIM) and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3) (Method 502 and 507)
TRH Volatiles/BTEX	EP080	SOIL	In house: Referenced to USEPA SW 846 - 8260B Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	Method	Matrix	Method Descriptions
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
NaOH leach for CN in Soils	CN-PR	SOIL	In house: APHA 4500 CN. Samples are extracted by end-over-end tumbling with NaOH.
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (2013) Schedule B(3) (Method 202)
Methanolic Extraction of Soils for Purge and Trap	* ORG16	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids	ORG17	SOIL	In house: Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.

ALS Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **ES1711675**

Client	: **AARGUS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR MARK KELLY	Contact	: Customer Services ES
Address	: PO BOX 398 DRUMMOYNE NSW, AUSTRALIA 2047	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: mark.kelly@aargus.net	E-mail	: ALSEnviro.Sydney@alsglobal.com
Telephone	: 1300137038	Telephone	: +61-2-8784 8555
Facsimile	: 1300136038	Facsimile	: +61-2-8784 8500
Project	: ES6874 PSI	Page	: 1 of 4
Order number	: ----	Quote number	: ES2014AARGUS0129 (SY/258/14 V2)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: Annandale		
Sampler	: NINGYE ZHANG		

Dates

Date Samples Received	: 15-May-2017 15:40	Issue Date	: 15-May-2017
Client Requested Due Date	: 22-May-2017	Scheduled Reporting Date	: **22-May-2017**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Not intact.
No. of coolers/boxes	: 1	Temperature	: 8.3 - Ice Bricks present
Receipt Detail	:	No. of samples received / analysed	: 15 / 10

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- **Sample(s) requiring volatile organic compound analysis received in airtight containers (ZHE).**
- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	(On Hold) SOIL No analysis requested	SOIL - EA055-103 Moisture Content	SOIL - EK026SF (Solids) Total Cyanide By Segmented Flow Analyser	SOIL - S-02 8 Metals (incl. Digestion)	SOIL - S-08 TRH/BTEXN/PAH/OC/PCB/8 Metals	SOIL - S-17 TRH/BTEXN/PAH/Phenols/OC/PCB
ES1711675-001	13-May-2017 00:00	BH1 0.2-0.4		✓	✓	✓		✓
ES1711675-002	13-May-2017 00:00	BH1 1.1-1.2	✓					
ES1711675-003	13-May-2017 00:00	BH1 1.8-1.9	✓					
ES1711675-004	13-May-2017 00:00	BH1 2.5-2.6	✓					
ES1711675-005	13-May-2017 00:00	BH1 3.9-4.0	✓					
ES1711675-006	13-May-2017 00:00	BH1 4.8-4.9	✓					
ES1711675-007	13-May-2017 00:00	BH2 0.2-0.3		✓	✓	✓		✓
ES1711675-008	13-May-2017 00:00	BH3 0.2-0.3		✓	✓	✓		✓
ES1711675-009	13-May-2017 00:00	BH4 0.2-0.3		✓			✓	
ES1711675-010	13-May-2017 00:00	BH5 0.2-0.3		✓			✓	
ES1711675-011	13-May-2017 00:00	BH6 0.2-0.3		✓			✓	
ES1711675-012	13-May-2017 00:00	BH7 0.2-0.3		✓	✓	✓		✓
ES1711675-013	13-May-2017 00:00	D1		✓	✓	✓		✓
ES1711675-015	13-May-2017 00:00	Trip BLANK		✓				

Matrix: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	SOIL - S-04 TRH/BTEXN
ES1711675-015	13-May-2017 00:00	Trip BLANK	✓

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - W-26T TRH/BTEXN/PAH/Total 8 Metals
ES1711675-014	13-May-2017 00:00	R1	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

ALL REPORTS (CYNTHIA)		
- *AU Certificate of Analysis - NATA (COA)	Email	cynthia@aargus.net
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	cynthia@aargus.net
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	cynthia@aargus.net
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	cynthia@aargus.net
- A4 - AU Tax Invoice (INV)	Email	cynthia@aargus.net
- Chain of Custody (CoC) (COC)	Email	cynthia@aargus.net
- EDI Format - ENMRG (ENMRG)	Email	cynthia@aargus.net
- EDI Format - ESDAT (ESDAT)	Email	cynthia@aargus.net
- EDI Format - XTab (XTAB)	Email	cynthia@aargus.net
ANIKA		
- A4 - AU Tax Invoice (INV)	Email	anika@aargus.net
DERECK @AARGUS		
- *AU Certificate of Analysis - NATA (COA)	Email	dereck@aargus.net
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	dereck@aargus.net
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	dereck@aargus.net
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	dereck@aargus.net
- A4 - AU Tax Invoice (INV)	Email	dereck@aargus.net
- Chain of Custody (CoC) (COC)	Email	dereck@aargus.net
- EDI Format - ENMRG (ENMRG)	Email	dereck@aargus.net
- EDI Format - ESDAT (ESDAT)	Email	dereck@aargus.net
- EDI Format - XTab (XTAB)	Email	dereck@aargus.net
MARK KELLY		
- *AU Certificate of Analysis - NATA (COA)	Email	mark.kelly@aargus.net
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	mark.kelly@aargus.net
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	mark.kelly@aargus.net
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	mark.kelly@aargus.net
- A4 - AU Tax Invoice (INV)	Email	mark.kelly@aargus.net
- Chain of Custody (CoC) (COC)	Email	mark.kelly@aargus.net
- EDI Format - ENMRG (ENMRG)	Email	mark.kelly@aargus.net
- EDI Format - ESDAT (ESDAT)	Email	mark.kelly@aargus.net
- EDI Format - XTab (XTAB)	Email	mark.kelly@aargus.net
NINGYE ZHANG		
- *AU Certificate of Analysis - NATA (COA)	Email	ningye@aargus.net
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	ningye@aargus.net
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	ningye@aargus.net
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	ningye@aargus.net
- A4 - AU Tax Invoice (INV)	Email	ningye@aargus.net
- Chain of Custody (CoC) (COC)	Email	ningye@aargus.net
- EDI Format - ENMRG (ENMRG)	Email	ningye@aargus.net
- EDI Format - ESDAT (ESDAT)	Email	ningye@aargus.net
- EDI Format - XTab (XTAB)	Email	ningye@aargus.net

AARGUS PTY LTD

Laboratory Test Request / Chain of Custody Record

446 Parramatta Road
PETERSHAM NSW 2049

P O Box 398 Tel: 1300 137 038
DRUMMOYNE NSW 1470 Fax: 1300 136 038

Email reports: cynthia@aargus.net; dereck@aargus.net; mark.kelly@aargus.net;ningye@aargus.net
Email invoices: anika@aargus.net; cynthia@aargus.net; dereck@aargus.net; mark.kelly@aargus.net; ningye@aargus.net

1 of 1

TO:	ALS (Australian Laboratory Services) | Environmental 277 - 289 Woodpark Road SMITHFIELD, NSW 2164	Sampling Date:	13.05.17	Job No:	ES6874
		Sampled By:	NZ	Project:	PSI
PH:	02 8784 8555 FAX: 02 8784 8500	Project Manager:	MK	Location:	Annandale
ATTN:	Samples Receipt				

Results required by: Standard TAT
Quotation Number (if applicable): SY/258/14 V2

Sampling details				Sample type													
Location		Depth (m)	Date	Soil	Water (Filled Up)	Air	Metals (As, Cd, Cr, Cu, Hg, Pb, Ni, Zn)	TPH & BTEX	PAH	OC	PCB	Phenols & Cyanide	pH, EC, %CLAY			Analysis Suite(s)	KEEP SAMPLE ?
BH1	1	0.2-0.4	13.05.17	DSG			✓	✓	✓	✓	✓	✓				S2+S17	YES
BH1	2	1.1-1.2	13.05.17	DSG													YES
BH1	3	1.8-1.9	13.05.17	DSG													YES
BH1	4	2.5-2.6	13.05.17	DSG													YES
BH1	5	3.9-4.0	13.05.17	DSG													YES
BH1	6	4.8-4.9	13.05.17	DSG													YES
BH2	7	0.2-0.3	13.05.17	DSG			✓	✓	✓	✓	✓	✓				S2+S17	YES
BH3	8	0.2-0.3	13.05.17	DSG			✓	✓	✓	✓	✓	✓				S2+S17	YES
BH4	9	0.2-0.3	13.05.17	DSG			✓	✓	✓	✓	✓					S8	YES
BH5	10	0.2-0.3	13.05.17	DSG			✓	✓	✓	✓	✓					S8	YES
BH6	11	0.2-0.3	13.05.17	DSG			✓	✓	✓	✓	✓					S8	YES
BH7	12	0.2-0.3	13.05.17	DSG			✓	✓	✓	✓	✓	✓				S2+S17	YES
D1	13	-	13.05.17	DSG			✓	✓	✓	✓	✓	✓				S2+S17	YES
R1	14	-	13.05.17	WG/WP			✓	✓	✓							W26	YES
Trip BLANK	15	-	13.05.17				Please test for TRH F1 and BTEX										

Relinquished by			Received by		
Name	Signature	Date	Name	Signature	Date
Ningye Zhang	NZ	15.05.17	[illegible]		15/5/17 1540 23C

Legend:

WG	Water sample, glass bottle	USG	Undisturbed soil sample (glass jar)	DSP	Disturbed soil sample (small plastic bag)
WP	Water sample, plastic bottle	DSG	Disturbed soil sample (glass jar)	✓	Test required
GV	Glass vial	OTH	Other	ACAN	Air sample, canister

@ mole H+/tonne

Environmental Division
Sydney
Work Order Reference
ES1711675

Telephone : + 61-2-8784 8555

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order : **ES1712147**
Client : **AARGUS PTY LTD**
Contact : MR MARK KELLY
Address : PO BOX 398
DRUMMOYNE NSW, AUSTRALIA 2047
Telephone : 1300137038
Project : ES6874 DSI
Order number : ----
C-O-C number : ----
Sampler : SP
Site : Camperdown
Quote number : SY/258/14 V2
No. of samples received : 1
No. of samples analysed : 1

Page : 1 of 5
Laboratory : Environmental Division Sydney
Contact : Customer Services ES
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61-2-8784 8555
Date Samples Received : 18-May-2017 16:50
Date Analysis Commenced : 23-May-2017
Issue Date : 25-May-2017 16:23

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

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

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

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP132-LL : Particular samples required dilution due to sample matrix . LOR values have been adjusted accordingly.
- EP080: Particular sample required dilution due to sample matrix . LOR values have been adjusted accordingly.

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**GW1**	**----**	**----**	**----**	**----**
			Client sampling date / time	18-May-2017 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1712147-001**	--------	--------	--------	--------
				Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	**0.006**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	**0.0002**	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.015**	----	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.836**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.018**	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.577**	----	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	**3340**	----	----	----	----
C10 - C14 Fraction	----	50	µg/L	**100**	----	----	----	----
C15 - C28 Fraction	----	100	µg/L	**1200**	----	----	----	----
C29 - C36 Fraction	----	50	µg/L	**90**	----	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	**1390**	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	**3480**	----	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	**3380**	----	----	----	----
>C10 - C16 Fraction	----	100	µg/L	**310**	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L	**1120**	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	----	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	**1430**	----	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L	**310**	----	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<20	----	----	----	----
Toluene	108-88-3	2	µg/L	**68**	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<20	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	**32**	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<20	----	----	----	----
^ **Total Xylenes**	1330-20-7	2	µg/L	**32**	----	----	----	----
^ **Sum of BTEX**	----	1	µg/L	**100**	----	----	----	----
Naphthalene	91-20-3	5	µg/L	<20	----	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**GW1**	**----**	**----**	**----**	**----**
			Client sampling date / time	18-May-2017 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1712147-001**	**--------**	**--------**	**--------**	**--------**
				Result	----	----	----	----
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.02	µg/L	**0.09**	----	----	----	----
Acenaphthylene	208-96-8	0.02	µg/L	<0.02	----	----	----	----
Acenaphthene	83-32-9	0.02	µg/L	<0.02	----	----	----	----
Fluorene	86-73-7	0.02	µg/L	<0.02	----	----	----	----
Phenanthrene	85-01-8	0.02	µg/L	**0.03**	----	----	----	----
Anthracene	120-12-7	0.02	µg/L	<0.02	----	----	----	----
Fluoranthene	206-44-0	0.02	µg/L	<0.02	----	----	----	----
Pyrene	129-00-0	0.02	µg/L	<0.02	----	----	----	----
Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	----	----	----	----
Chrysene	218-01-9	0.02	µg/L	<0.02	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L	<0.02	----	----	----	----
Benzo(k)fluoranthene	207-08-9	0.02	µg/L	<0.02	----	----	----	----
Benzo(a)pyrene	50-32-8	0.005	µg/L	<0.021	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L	<0.02	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	0.02	µg/L	<0.02	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	0.02	µg/L	<0.02	----	----	----	----
^ **Total PAH**	----	0.005	µg/L	**0.120**	----	----	----	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.005	µg/L	<0.021	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**94.8**	----	----	----	----
Toluene-D8	2037-26-5	2	%	**113**	----	----	----	----
4-Bromofluorobenzene	460-00-4	2	%	**96.6**	----	----	----	----
EP132T: Base/Neutral Extractable Surrogates								
2-Fluorobiphenyl	321-60-8	0.02	%	**118**	----	----	----	----
Anthracene-d10	1719-06-8	0.02	%	**102**	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.02	%	**122**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	*CAS Number*	*Recovery Limits (%)*	
		Low	*High*
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128
EP132T: Base/Neutral Extractable Surrogates			
2-Fluorobiphenyl	321-60-8	54	136
Anthracene-d10	1719-06-8	66	134
4-Terphenyl-d14	1718-51-0	63	135

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **ES1712147**	Page	: 1 of 6
Client	: **AARGUS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR MARK KELLY	Contact	: Customer Services ES
Address	: PO BOX 398 DRUMMOYNE NSW, AUSTRALIA 2047	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: 1300137038	Telephone	: +61-2-8784 8555
Project	: ES6874 DSI	Date Samples Received	: 18-May-2017
Order number	: ----	Date Analysis Commenced	: 23-May-2017
C-O-C number	: ----	Issue Date	: 25-May-2017
Sampler	: SP		
Site	: Camperdown		
Quote number	: SY/258/14 V2		
No. of samples received	: 1		
No. of samples analysed	: 1		

ilac-MRA

NATA

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

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

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 904799)									
EW1702210-008	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.003	0.003	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.004	0.004	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.006	<0.005	0.00	No Limit
ES1712036-004	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.002	0.003	71.7	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 904797)									
EP1705108-002	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 902996)									
ES1712076-022	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
ES1712232-012	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 902996)									
ES1712076-022	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
ES1712232-012	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EP080: BTEXN (QC Lot: 902996)									
ES1712076-022	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP080: BTEXN (QC Lot: 902996) - continued									
ES1712076-022	Anonymous	EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
ES1712232-012	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	*Laboratory Control Spike (LCS) Report*			
					Spike	*Spike Recovery (%)*	*Recovery Limits (%)*	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EG020F: Dissolved Metals by ICP-MS (QCLot: 904799)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	91.1	85	114
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	94.8	84	110
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	100.0	85	111
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	90.0	81	111
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	95.4	83	111
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	95.4	82	112
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	102	81	117
EG035F: Dissolved Mercury by FIMS (QCLot: 904797)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	94.0	83	105
EP080/071: Total Petroleum Hydrocarbons (QCLot: 899384)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	2000 µg/L	87.4	76	116
EP071: C15 - C28 Fraction	----	100	µg/L	<100	3000 µg/L	95.8	83	109
EP071: C29 - C36 Fraction	----	50	µg/L	<50	2000 µg/L	101	75	113
EP080/071: Total Petroleum Hydrocarbons (QCLot: 902996)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	103	75	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 899384)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	2500 µg/L	101	76	114
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	3500 µg/L	91.4	81	111
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	1500 µg/L	104	77	119
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 902996)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	310 µg/L	108	75	127
EP080: BTEXN (QCLot: 902996)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	101	70	122
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	102	69	123
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	104	70	120
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	10 µg/L	104	69	121
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	106	72	122
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	112	70	120
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 899383)								
EP132-LL: Naphthalene	91-20-3	0.02	µg/L	<0.02	0.025 µg/L	113	62	136
EP132-LL: Acenaphthylene	208-96-8	0.02	µg/L	<0.02	0.025 µg/L	106	68	128
EP132-LL: Acenaphthene	83-32-9	0.02	µg/L	<0.02	0.025 µg/L	105	69	121

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low	 High
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 899383) - continued								
EP132-LL: Fluorene	86-73-7	0.02	µg/L	<0.02	0.025 µg/L	122	69	131
EP132-LL: Phenanthrene	85-01-8	0.02	µg/L	<0.02	0.025 µg/L	116	69	137
EP132-LL: Anthracene	120-12-7	0.02	µg/L	<0.02	0.025 µg/L	107	64	120
EP132-LL: Fluoranthene	206-44-0	0.02	µg/L	<0.02	0.025 µg/L	129	63	129
EP132-LL: Pyrene	129-00-0	0.02	µg/L	<0.02	0.025 µg/L	118	67	127
EP132-LL: Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	0.025 µg/L	100	72	132
EP132-LL: Chrysene	218-01-9	0.02	µg/L	<0.02	0.025 µg/L	118	65	125
EP132-LL: Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L	<0.02	0.025 µg/L	97.4	66	130
EP132-LL: Benzo(k)fluoranthene	207-08-9	0.02	µg/L	<0.02	0.025 µg/L	124	64	130
EP132-LL: Benzo(a)pyrene	50-32-8	0.005	µg/L	<0.005	0.025 µg/L	117	61	125
EP132-LL: Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L	<0.02	0.025 µg/L	106	67	131
EP132-LL: Dibenz(a.h)anthracene	53-70-3	0.02	µg/L	<0.02	0.025 µg/L	108	67	135
EP132-LL: Benzo(g.h.i)perylene	191-24-2	0.02	µg/L	<0.02	0.025 µg/L	112	66	130
EP132-LL: Total PAH	----	0.005	µg/L	<0.005	----	----	----	----

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report Spike Concentration	SpikeRecovery(%) MS	Recovery Limits (%) Low	 High
EG020F: Dissolved Metals by ICP-MS (QCLot: 904799)							
ES1712036-005	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	98.4	70	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	102	70	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	110	70	130
		EG020A-F: Copper	7440-50-8	1 mg/L	97.6	70	130
		EG020A-F: Lead	7439-92-1	1 mg/L	96.8	70	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	102	70	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	100	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 904797)							
EP1705108-001	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	84.9	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 902996)							
ES1712076-022	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	99.6	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 902996)							
ES1712076-022	Anonymous	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	94.0	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EP080: BTEXN (QCLot: 902996)							
ES1712076-022	Anonymous	EP080: Benzene	71-43-2	25 µg/L	87.4	70	130
		EP080: Toluene	108-88-3	25 µg/L	88.7	70	130
		EP080: Ethylbenzene	100-41-4	25 µg/L	83.5	70	130
		EP080: meta- & para-Xylene	108-38-3 106-42-3	25 µg/L	84.1	70	130
		EP080: ortho-Xylene	95-47-6	25 µg/L	90.8	70	130
		EP080: Naphthalene	91-20-3	25 µg/L	98.5	70	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ES1712147**	Page	: 1 of 4
Client	: **AARGUS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR MARK KELLY	Telephone	: +61-2-8784 8555
Project	: ES6874 DSI	Date Samples Received	: 18-May-2017
Site	: Camperdown	Issue Date	: 25-May-2017
Sampler	: SP	No. of samples received	: 1
Order number	: ----	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type Method	Count QC	 Regular	Rate (%) Actual	 Expected	Quality Control Specification
Laboratory Duplicates (DUP)					
PAH Compounds in Water	0	1	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	1	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
PAH Compounds in Water	0	1	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	1	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method *Container / Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation* *Date extracted*	 *Due for extraction*	 *Evaluation*	*Analysis* *Date analysed*	 *Due for analysis*	 *Evaluation*
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Natural (EG020A-F)							
GW1	**18-May-2017**	----	----	----	**24-May-2017**	14-Nov-2017	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Natural (EG035F)							
GW1	**18-May-2017**	----	----	----	**25-May-2017**	15-Jun-2017	✓
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - unpreserved for LCMS/MS (EP071)							
GW1	**18-May-2017**	**23-May-2017**	25-May-2017	✓	**23-May-2017**	02-Jul-2017	✓
Amber VOC Vial - Sulfuric Acid (EP080)							
GW1	**18-May-2017**	**23-May-2017**	01-Jun-2017	✓	**24-May-2017**	01-Jun-2017	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - unpreserved for LCMS/MS (EP071)							
GW1	**18-May-2017**	**23-May-2017**	25-May-2017	✓	**23-May-2017**	02-Jul-2017	✓
Amber VOC Vial - Sulfuric Acid (EP080)							
GW1	**18-May-2017**	**23-May-2017**	01-Jun-2017	✓	**24-May-2017**	01-Jun-2017	✓
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP080)							
GW1	**18-May-2017**	**23-May-2017**	01-Jun-2017	✓	**24-May-2017**	01-Jun-2017	✓
EP132B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - unpreserved for LCMS/MS (EP132-LL)							
GW1	**18-May-2017**	**23-May-2017**	25-May-2017	✓	**23-May-2017**	02-Jul-2017	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Dissolved Mercury by FIMS	EG035F	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	6	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH Compounds in Water	EP132-LL	0	1	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	1	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Dissolved Mercury by FIMS	EG035F	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH Compounds in Water	EP132-LL	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Dissolved Mercury by FIMS	EG035F	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH Compounds in Water	EP132-LL	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Dissolved Mercury by FIMS	EG035F	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH Compounds in Water	EP132-LL	0	1	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	1	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
PAH Compounds in Water	EP132-LL	WATER	In house: Referenced to USEAP SW846 8270D GCMS, LVI, Capiliary column, SIM mode. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Sep. Funnel Extraction /Acetylation of Phenolic Compounds	ORG14-AC	WATER	In house: Referenced to USEPA 3510 (Extraction) / In-house (Acetylation): A 1L sample is extracted into dichloromethane and concentrated to 1 mL with echange into cyclohexane. Phenolic compounds are reacted with acetic anhydride to yield phenyl acetates suitable for ultra-trace analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.

AARGUS PTY LTD

446 Parramatta Road
PETERSHAM NSW 2049

P O Box 398 Tel: 1300 137 038
DRUMMOYNE NSW 1470 Fax: 1300 136 038

Laboratory Test Request / Chain of Custody Record

Email reports: cynthia@aargus.net; dereck@aargus.net; mark.kelly@aargus.net;allen@aargus.net
Email invoices: anika@aargus.net; cynthia@aargus.net; dereck@aargus.net; mark.kelly@aargus.net; allen@aargus.net

Setareh@aargus.net

1 of 1

TO: **ALS (Australian Laboratory Services) | Environmental**
277 - 289 Woodpark Road
SMITHFIELD, NSW 2164

PH: **02 8784 8555**
FAX: **02 8784 8500**
ATTN: **Samples Receipt**

Sampling Date: 18.05.2017
Sampled By: SP
Project Manager: MK
Job No: ES6874
Project: DSI
Location: Camperdown

Results required by: Standard
Quotation Number (if applicable): SY/258/14 V2

Sampling details			**Sample type**													
Location	Depth (m)	Date	Soil	Water (Filled Up)	Air	**Metals (As, Cd, Cr, Cu, Hg, Pb, Ni, Zn)**	**TPH**	**BTEXN**	**PAH super ultra trace EP132LL**	**PAH**					**Analysis Suite(s)**	**KEEP SAMPLE ?**
GW1	-	18.05.2017		WG/WP		✓	✓	✓	✓	✗					W5+EP132LL	YES

Relinquished by			Received by		
Name	Signature	Date	Name	Signature	Date
Setareh	Setareh	18.05.2017	Frank		18-5-17 1850

Legend:

WG	Water sample, glass bottle	USG	Undisturbed soil sample (glass jar)	DSP	Disturbed soil sample (small plastic bag)
WP	Water sample, plastic bottle	DSG	Disturbed soil sample (glass jar),	✓	Test required
GV	Glass vial	OTH	Other	ACAN	Air sample, canister

@ mole H⁺/tonne

Environmental Division
Sydney
Work Order Reference
ES1712147

Telephone : + 61-2-8784 8555

Saman Taeidi

From: Setareh Kazemi <Setareh@aargus.net>
Sent: Friday, 19 May 2017 12:20 PM
To: Saman Taeidi
Cc: Mark Kelly; Ningye Zhang
Subject: Re: PAH

Hi saman

Could you please test for ultra trace PAH. And could you please filter the sample before testing metal? Thanks

Regards

Sent from my iPhone

> On 19 May 2017, at 11:57 am, "Saman Taeidi" <Saman.Taeidi@alsglobal.com> wrote:
>
> Good Afternoon,
>
> Can you please check the attached COC. There is PAH ticked but in the analysis suite there is a comment for EP132LL which is the low level method.
>
> Can you please confirm whether PAH low level was needed instead of standard level?
>
> Kind Regards,
> Saman Taeidi
> Sample Administration Coordinator, Environmental Sydney
>
> T +61 2 8784 8555 D +61 2 8784 8504
> F +61 2 8784 8500
> saman.taeidi@alsglobal.com
> 277-289 Woodpark Road
> Smithfield NSW 2164
> AUSTRALIA
> Subscribe   Follow us on LinkedIn
> EnviroMailTM 00 - All Enviromails in one convenient download Right
> Solutions . Right Partner www.alsglobal.com New ALS office at Crows
> Nest is now open to receive samples!
>
>
>
>

> <img-519120212-0001.pdf>

APPENDIX L

QA/QC ASSESSMENT

Aargus

TABLE A
TRIP BLANKS SAMPLES

ANALYTE	TRIP BLANK TB5 (mg/L) 13.05.2017	Practical Quantitation Limits (PQL)
BTEX		
Benzene	<0.2	0.2
Toluene	<0.5	0.5
Ethyl Benzene	<0.5	0.5
Total Xylenes	<0.5	0.5

1 FIELD DATA QUALITY ASSESSMENT SOILS

1.1 Field Data Completeness

Field Sample Category - Soils	**Number (Target)**	**Non-conformances**	**Number (Useable)**	**Overall Completeness %**
Primary Samples	18	0	18	100%
Intra-Lab Duplicates	1	0	1	100%
Inter-Lab Duplicates	1	0	1	100%
Rinsate Blanks	1	0	1	100%
Trip Spikes	1	0	1	100%
Trip Blank	1	0	1	100%

Field Sample Category - Groundwater	**Number (Target)**	**Non-conformances**	**Number (Useable)**	**Overall Completeness %**
Primary Samples	1	0	1	100%
Intra-Lab Duplicates	0	0	0	0%
Inter-Lab Duplicates	0	0	0	0%
Rinsate Blanks	0	0	0	0%
Trip Spikes	0	0	0	0%
Trip Blank	0	0	0	0%

Note: (*) – Overall Completeness is calculated as a percentage of the number of useable samples over the target number of samples required. The required percentage completeness is specified in the DQOs.

Field Consideration	**Yes / No**	**Comments / Non-Conformances**
Were all critical locations sampled?	Y	All critical locations were sampled as per the DQOs.
Were all samples collected from critical densities and depths?	Y	All sampled were recovered as per DQOs.
Were the Standard Operating Procedures (SOPs) appropriate and complied with?	Y	The Aargus Fieldwork Protocols were appropriate and complied with.
Were the samplers adequately experienced?	Y	Sampling was conducted by experienced personnel.
Was field documentation complete and correct?	Y	Field records can be found within their respective appendices of the report.
Were an adequate number of intra-laboratory duplicate samples collected?	Y	100% of intra-laboratory duplicate samples required were collected as the table above.
Were an adequate number of inter-laboratory duplicate samples collected?	Y	100% of inter-laboratory duplicate samples required were collected as per the table above.
Were an adequate number of rinsate samples collected?	Y	100% of rinsate samples required were collected as per the table above.
Were an adequate number of trip blanks collected?	Y	100% of trip blanks required were collected as per the table above.
Were an adequate number of trip spikes collected?	Y	100% of trip spikes required were collected as per the table above.

1.2 Field Data Comparability

Field Consideration	Yes / No	Comments / Non-Conformances
Were the same SOPs used on each occasion?	Y	Aargus Fieldwork Protocols were utilised throughout each sampling event.
Was all sampling undertaken by the same person?	Y	Sampling was undertaken by the same scientist.
Could climatic conditions (such as temperature, rainfall, etc.) influence data comparability?	N	All sampling was undertaken on days without rain.
Were the same types of samples collected (filtered, size, fractions, etc.) for each media?	Y	Samples were collected in the same types of containers provided by the laboratory.
Was each field parameter measured using the same equipment?	Y	Headspace analysis was carried out using the same PID meter.
Was the same method and equipment used for extraction of samples?	Y	Soil samples were recovered by the same hand auger. Groundwater samples were recovered by the same bladder pump.

1.3 Field Data Representativeness

Laboratory Batch	Laboratory	Sample Medium	Container Breakages	Sample Preservation	Headspace / Temperature
ASET56812	ASET	Soil	Compliant	Compliant	Compliant
ES1711675	ALS Sydney	Soil and Water (rinsate)	Compliant	Compliant	Compliant
EM1706281	ALS Melbourne	Soil	Compliant	Compliant	Compliant
ES1712147	ALS Sydney	Groundwater	Compliant	Compliant	Compliant

Field Consideration	Yes / No	Comments / Non-Conformances
Was appropriate media sampled in accordance with the DQOs?	Y	All soil and groundwater samples were sampled in accordance with the DQOs.
Was all media identified in the DQOs sampled?	Y	All soil and groundwater samples specified in the DQO were sampled.
Were all samples the samples appropriately handled?	Y	All samples collected were received by the laboratories intact.
Were all samples preserved appropriately?	Y	All samples collected were received by laboratories in the correct temperature. Where relevant, samples were stored in acid-preserved containers supplied by laboratories.

1.4 Field Data Precision

Field Consideration	Yes / No	Comments / Non-Conformances
Were the SOPs appropriate and complied with?	Y	The recovery of field duplicates was conducted in accordance with Aargus Fieldwork Protocols to allow for the assessment of field precision.

1.5 Field Data Accuracy

Field Consideration	Yes / No	Comments / Non-Conformances
Were the SOPs appropriate and complied with?	Y	The recovery of trip blanks and rinsate blanks was conducted in accordance with Aargus Fieldwork Protocols to allow for the assessment of field accuracy.

2 LABORATORY DATA QUALITY ASSESSMENT

2.1 Laboratory Data Completeness

Laboratory Considerations	Yes / No	Comments / Non-Conformances
Were all critical samples analysed according to the DQOs?	Y	All critical samples analysed according to DQOs.
Were all analytes analysed according to the DQOs?	Y	All analytes analysed according to DQOs.
Were the laboratory methods and PQLs appropriate?	Y	US EPA Analytical Methods were used. PQLs were below their respective assessment criteria
Was sample documentation complete?	Y	The sample documentation was correctly completed on the COC's.
Were sample holding times complied with?	Y	All the samples were within holding time for soil and groundwater samples
Were an adequate number of laboratory duplicates analysed?	Y	An adequate number of laboratory duplicates were analysed.
Were an adequate number of laboratory blank samples analysed?	Y	An adequate number of laboratory blank samples were analysed.
Were an adequate number of Laboratory Control Samples analysed?	Y	An adequate number of Laboratory Control Samples were analysed.
Were an adequate number of laboratory matrix spikes/duplicates analysed?	Y	An adequate number of laboratory matrix spikes/duplicates were analysed.
Were an adequate number of surrogates analysed?	Y	An adequate number of surrogates were analysed.

2.2 Laboratory Data Comparability

Laboratory Considerations	Yes / No	Comments / Non-Conformances
Were the same analytical methods used for each analyte?	Y	All analytical methods used between laboratories were based on the USEPA/APHA methods.
Were the PQLs used for each analyte less than 20% of their respective assessment criteria?	Y	The PQLs for analytes in soil samples were below 20% of their respective assessment criteria.
Were the sample PQLs used for each analyte the same?	Y	Sample PQL's were the same within each laboratory.
Were the same laboratories used for analyses of each contaminant type?	Y	ALS Environmental Sydney was the primary laboratory. ALS Environmental Melbourne was the secondary laboratory.
Were the units reported for each analyte the same?	Y	Analytical units of measurement for soil were mg/kg. Analytical units of measurement for groundwater were µg/kg.

2.3 Laboratory Data Representativeness

Laboratory Considerations	Yes / No	Comments / Non-Conformances
Were all samples analysed according to the DQOs?	Y	The majority of the samples were analysed according to the proposal.

2.4 Laboratory Data Precision

Laboratory Considerations	Yes / No	Comments / Non-Conformances
Were the RPDs of the field duplicates within control limits?	Y	The RPDs of the field duplicates were within the control limits.
Were the RPDs of the laboratory duplicates within control limits?	Y	The majority of RPDs of all laboratory duplicates were within control limits, with the exception of Copper (79%), Nickel (105%) and B(a)P 67% for the split sample SS1 to the primary BH1 sample .

Note: Please refer to the tables attached at the end of this QA/QC assessment for calculations of the field RPDs.

2.5 Laboratory Data Accuracy

Laboratory Considerations	Yes / No	Comments / Non-Conformances
Were the rinsates free of contaminants?	Y	The concentrations of the analytes were below the PQLs.
Were the trip blanks free of contaminants?	Y	The test results for the trip blank samples, reported concentrations to be less than the PQL's, therefore cross contamination has not occurred.
Were the laboratory blanks free of contaminants?	Y	Laboratory blanks were free of contaminants.
Were the surrogate spikes within control limits?	Y	Surrogate spikes were within control limits.
Were laboratory control samples within control limits?	Y	Laboratory control samples were within control limits.
Were matrix spike recoveries within control limits?	Y	Matrix spikes were within control limits.
Were the trip spike recoveries within the control limits?	Y	The results show a recovery of trip spike concentrations, ranging between 84-100% in soil and 70-90% in groundwater. Based on the above, it is considered that no loss of volatiles from the recovered samples occurred.

Note: Please refer to the tables attached at the end of this QA/QC assessment for tables showing results of field blanks.

TABLE A: DUPLICATE D1 SAMPLE

ANALYTE	BH1 0.2-0.4 mg/kg	DUPLICATE D1 mg/kg	RELATIVE PERCENTAGE DIFFERENCE %
HEAVY METALS			
Arsenic	7	6	15
Cadmium	<1	<1	-
Chromium	14	15	7
Copper	94	129	31
Nickel	5	7	33
Lead	177	170	4
Zinc	167	136	20
Mercury	0.4	0.40	0
TOTAL PETROLEUM HYDROCARBONS (TPH)			
C6 - C9	<10	<10	-
C10 - C14	<50	<50	-
C15 - C28	<100	120	-
C29-C36	<100	<100	-
BTEX			
Benzene	<0.2	<0.2	-
Toluene	<0.5	<0.5	-
Ethyl Benzene	<0.5	<0.5	-
Total Xylenes	<0.5	<0.5	-
POLYCYCLIC AROMATIC HYDROCARBONS (PAH)			
BENZO(a)PYRENE	1	0.9	11
Total PAH	8.9	8.2	8
ORGANOCHLORINE PESTICIDES (OCP)			
Heptachlor	<0.05	<0.05	-
Aldrin	<0.05	<0.05	-
Dieldrin	<0.05	<0.05	-
DDD	<0.05	<0.05	-
DDE	<0.05	<0.05	-
DDT	<0.05	<0.05	-
Chlordane (trans & cis)	<0.05	<0.05	-
POLYCHLORINATED BIPHENYLS (PCB)			
Total PCB	<0.1	<0.1	-

TABLE B: SPLIT SS1 SAMPLE

ANALYTE	BH1 0.2-0.4 mg/kg ALS (Syd)	SPLIT SS1 mg/kg ALS (Melb)	RELATIVE PERCENTAGE DIFFERENCE %
HEAVY METALS			
Arsenic	7	6	15
Cadmium	<1	1	-
Chromium	14	18	25
Copper	94	216	79
Nickel	5	16	105
Lead	177	193	9
Zinc	167	265	45
Mercury	0.4	0.3	29
TOTAL PETROLEUM HYDROCARBONS (TPH)			
C6 - C9	<10	<10	-
C10 - C14	<50	<50	-
C15 - C28	<100	270	-
C29-C36	<100	<100	-
BTEX			
Benzene	<0.2	<0.2	-
Toluene	<0.5	<0.5	-
Ethyl Benzene	<0.5	<0.5	-
Total Xylenes	<0.5	<0.5	-
POLYCYCLIC AROMATIC HYDROCARBONS (PAH)			
BENZO(a)PYRENE	1	0.5	67
Total PAH	8.9	5.5	47
ORGANOCHLORINE PESTICIDES (OCP)			
Heptachlor	<0.05	<0.05	-
Aldrin	<0.05	<0.05	-
Dieldrin	<0.05	<0.05	-
DDD	<0.05	<0.05	-
DDE	<0.05	<0.05	-
DDT	<0.05	<0.05	-
Chlordane (trans & cis)	<0.05	<0.05	-
POLYCHLORINATED BIPHENYLS (PCB)			
Total PCB	<0.1	<0.1	-

TABLE C: RINSATE SAMPLE

ANALYTE	RINSATE R1 (mg/L) 13.05.2017	Practical Quantitation Limits (PQL)
HEAVY METALS		
Arsenic	<0.001	0.001
Cadmium	<0.0001	0.0001
Chromium	<0.001	0.001
Copper	<0.001	0.001
Nickel	<0.001	0.001
Lead	<0.001	0.001
Zinc	<0.005	0.005
Mercury	<0.0001	0.0001
TOTAL PETROLEUM HYDROCARBONS (TPH)		
C6 - C9	<20	20
C10 - C14	<50	50
C15 - C28	<100	100
C29-C36	<50	50
BTEX		
Benzene	<1	1
Toluene	<2	2
Ethyl Benzene	<2	2
Total Xylenes	<2	2
POLYCYCLIC AROMATIC HYDROCARBONS (PAH)		
BENZO(a)PYRENE	<0.5	0.5
Total PAH	<0.5	0.5

TABLE D: TRIP BLANK SAMPLE

ANALYTE	TRIP BLANK TB5 (mg/L) 13.05.2017	Practical Quantitation Limits (PQL)
BTEX		
Benzene	<0.2	0.2
Toluene	<0.5	0.5
Ethyl Benzene	<0.5	0.5
Total Xylenes	<0.5	0.5

APPENDIX M

IMPORTANT INFORMATION ABOUT YOUR REPORT

Aargus

IMPORTANT INFORMATION ABOUT YOUR ENVIRONMENTAL SITE ASSESSMENT

These notes have been prepared by Aargus (Australia) Pty Ltd and its associated companies using guidelines prepared by ASFE (The Association) of Engineering Firms Practising in the Geo-sciences. They are offered to help you in the interpretation of your Environmental Site Assessment (ESA) reports.

REASONS FOR CONDUCTING AN ESA

ESA's are typically, though not exclusively, carried out in the following circumstances:

- as pre-acquisition assessments, on behalf of either purchaser or vender, when a property is to be sold;
- as pre-development assessments, when a property or area of land is to be redeveloped or have its use changed for example, from a factory to a residential subdivision;
- as pre-development assessments of greenfield sites, to establish "baseline" conditions and assess environmental, geological and hydrological constraints to the development of, for example, a landfill; and
- as audits of the environmental effects of an ongoing operation.

Each of these circumstances requires a specific approach to the assessment of soil and groundwater contamination. In all cases however, the objective is to identify and if possible quantify the risks that unrecognised contamination poses to the proposed activity. Such risks may be both financial, for example, cleanup costs or limitations on site use, and physical, for example, health risks to site users or the public.

THE LIMITATIONS OF AN ESA

Although the information provided by an ESA could reduce exposure to such risks, no ESA, however, diligently carried out can eliminate them. Even a rigorous professional assessment may fail to detect all contamination on a site. Contaminants may be present in areas that were not surveyed or sampled, or may migrate to areas which showed no signs of contamination when sampled.

AN ESA REPORT IS BASED ON A UNIQUE SET OF PROJECT SPECIFIC FACTORS

Your environmental report should not be used:

- when the nature of the proposed development is changed, for example, if a residential development is proposed instead of a commercial one;
- when the size or configuration of the proposed development is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership
- or for application to an adjacent site.

To help avoid costly problems, refer to your consultant to determine how any factors, which have changed subsequent to the date of the report, may affect its recommendations.

ESA "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site assessment identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists who then render an opinion about overall subsurface conditions, the nature and extent of contamination, its likely impact on the proposed development and appropriate remediation measures. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to help minimise its impact. For this reason owners should retain the services of their consultants through the development stage, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Natural processes and the activity of man change subsurface conditions. As an ESA report is based on conditions, which existed at the time of subsurface exploration, decisions should not be based on an ESA report whose adequacy may have been affected by time. Speak with the consultant to learn if additional tests are advisable.

ESA SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Every study and ESA report is prepared in response to a specific brief to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Other persons should not use a report for any purpose, or by the client for a different purpose. No individual other than the client should apply a report even apparently for its intended purpose without first conferring with the consultant. No person should apply a report for any purpose other than that originally contemplated without first conferring with the consultant.

AN ESA REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when design professionals develop their plans based on misinterpretations of an ESA. To help avoid these problems, the environmental consultant should be retained to work with appropriate design professionals to explain relevant findings and to review the adequacy of their plans and specifications relative to contamination issues.

LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final borehole or test pit logs are developed by environmental scientists, engineers or geologists based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final logs customarily included in our reports. These logs should not under any circumstances be redrawn for inclusion in site remediation or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimise the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To reduce the likelihood of boring log misinterpretation, the complete report must be available to persons or organisations involved in the project, such as contractors, for their use. Those who o not provide such access may proceed under the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing all the available information to persons and organisations such as contractors helps prevent costly construction problems and the adversarial attitudes that may aggravate them to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because an ESA is based extensively on judgement and opinion, it is necessarily less exact than other disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, model clauses have been developed for use in transmittals. These are not exculpatory clauses designed to foist liabilities onto some other party. Rather, they are definitive clauses that identify where your consultant's responsibilities begin and end. Their use helps all parties involved recognise their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your ESA report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

Appendix B – Proposed Development Drawings

NOTES

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

DIMENSIONS SHALL NOT BE OBTAINED BY SCALING THE DETAIL FROM THE DRAWING. SURVEYOR MUST BE CONTACTED IF THERE ARE ANY DISCREPANCIES.

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

LEVELS ARE BASED ON AUSTRALIAN HEIGHT DATUM (A.H.D.) USING SSM 56964 R.L. 19.342m.

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

ADJOINING DWELLINGS, BUILDINGS HAVE BEEN PLOTTED FOR DIAGRAMMATIC PURPOSES ONLY.

(A) EASEMENT A965109 (VIDE DP174289)

A	29.06.17		INITIAL ISSUE

RGM property surveys
ABN 37 145 495 825

SCALE: 1 : 150 @ A1
LOCAL GOVERNMENT AREA: INNER-WEST
Huy Thai
HUY THAI – REGISTERED SURVEYOR

SURVEYED BY A.E.	DRAWN BY T.P.
LEVEL BK	DESIGNED BY
DATE OF SURVEY 27.06.17	CHECKED BY R.M.
HEIGHT ORIGIN AHD	APPROVED BY H.T.

CLIENT: CORVAS P/L

PROJECT TITLE: 1-5 CHESTER STREET, ANNANDALE

DRAWING TITLE: PLAN SHOWING LEVELS & DETAIL OVER LOT 11 IN DP 499846

CAD REFERENCE: C:\170832.dwg
DRAWING NO: 170832-001
SHEET 1 OF 1
JOB NAME: 1-5 CHESTER
REV: A

7.0 The Proposal

Floor Space Ratio & Height of Buildings:

- The proposal achieves a floor space ratio of 2.4 : 1 within in a building height of 17M.
- A lower ground level is proposed along Johnstons Creek at RL 5.45, which is above the 1 in 100 year flood level + a 500mm freeboard level. The 6 levels along Johnstons Creek are within the 17m PRCUTS 2016 building height plane from the existing natural ground level.
- The carpark entry is at 8.50RL which is above the probable maximum flood level.

Number of Apartments:

- The proposal includes a total of 43 apartments including 11 X 1 bedroom, 26 X 2 bedroom and 6 X 3 bedroom apartments, with a mix of 26% X 1 bedroom, 61% X 2 bedroom and 13% X 3 bedroom apartments.
- The proposed number of apartments will require a total of 26 car spaces based on the PRCUTS 2016 parking rates.

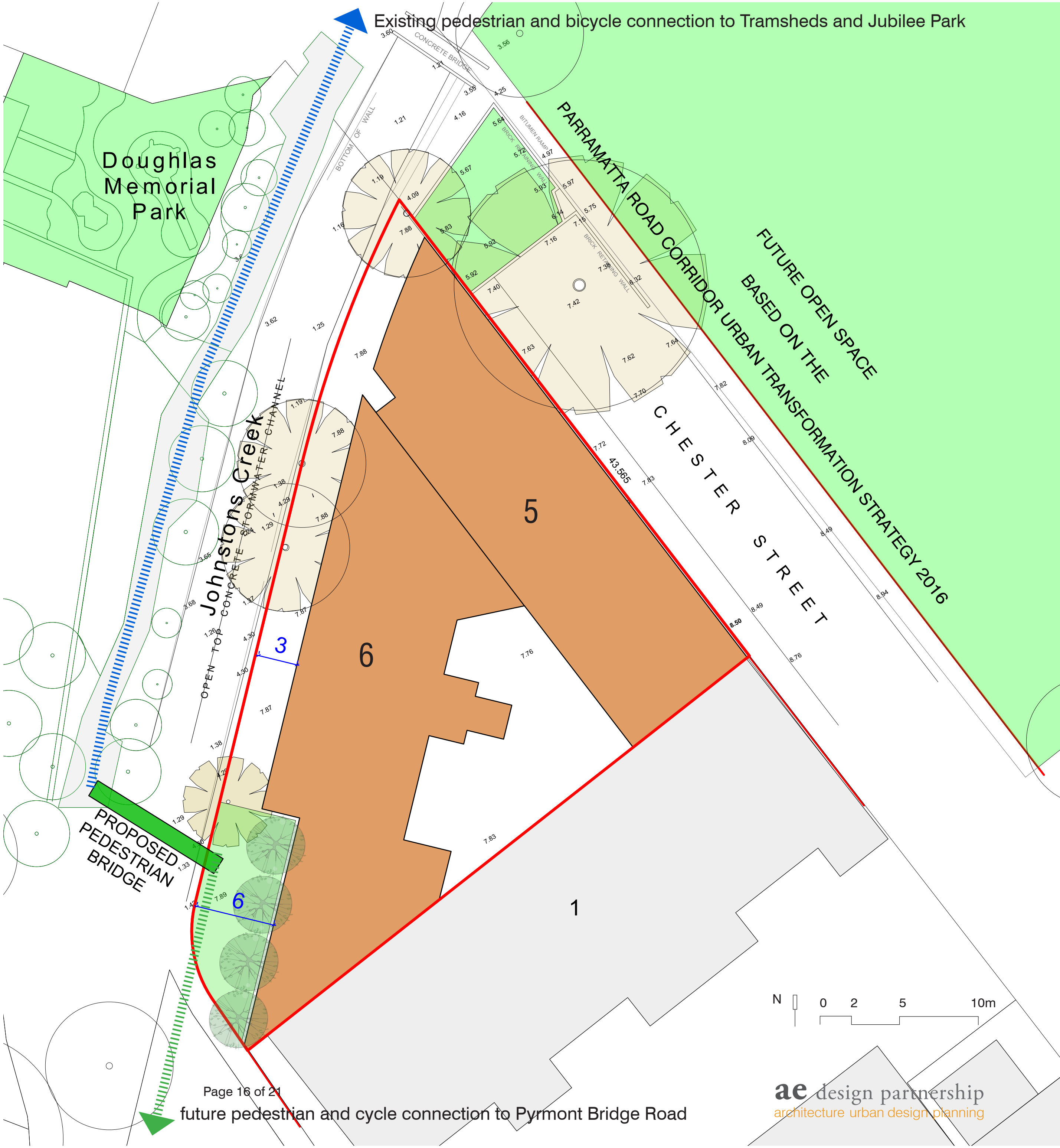
Public Domain:

- A 3m setback along Johnstons Creek provides an opportunity to integrate the proposal with the natural state of Creek.
- A pedestrian bridge is proposed at the southern corner of site connecting to the existing pedestrian and bicycle track within Doughlas Grant Memorial Park, the Tramsheds and Jubilee Park beyond.

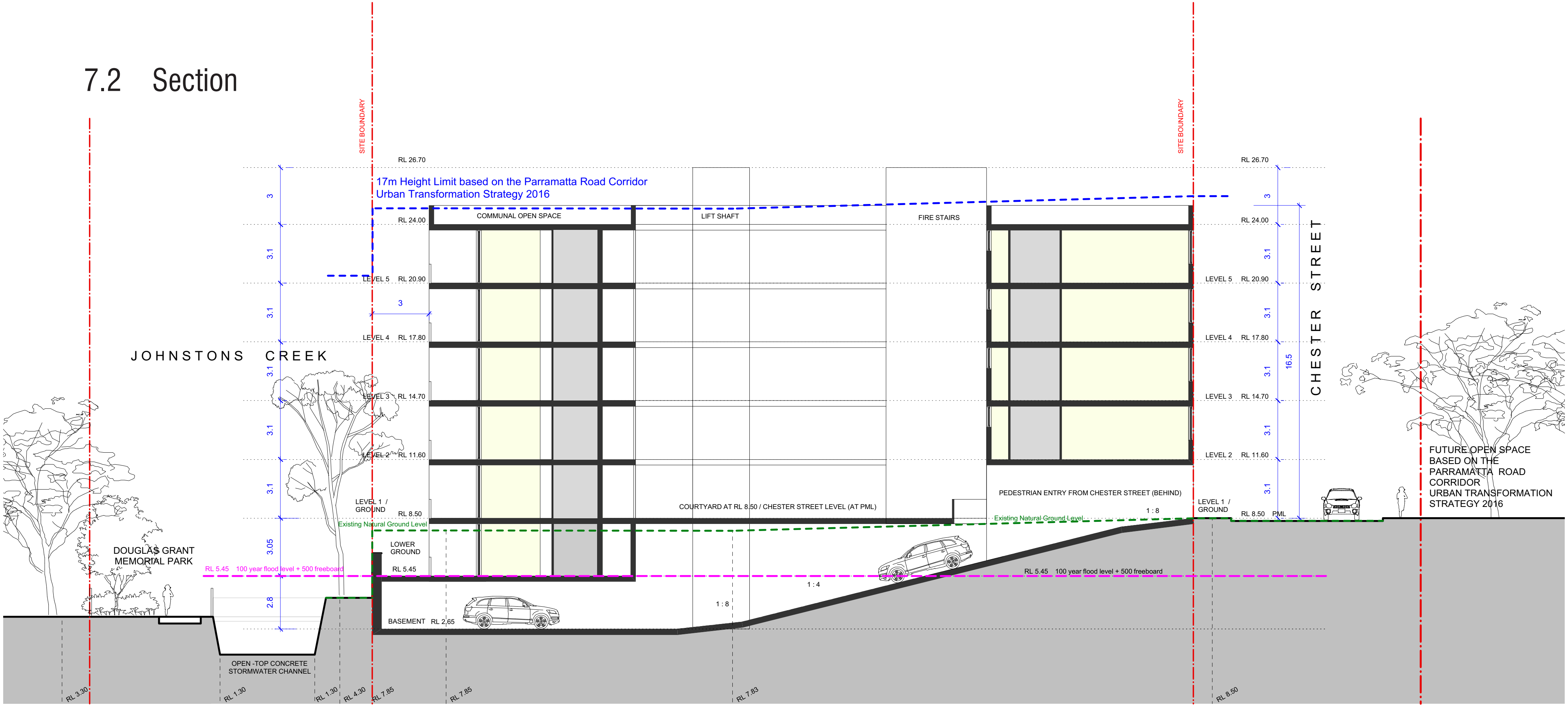
Apartment Design Guide:

The proposal matches the Apartment Design Guide in terms of the following:

1. Proposed apartment mix and minimum apartment sizes,
2. A minimum 2 hour direct solar access to habitable areas of apartments during mid winter, and
3. A rooftop communal open space matching the minimum area requirement and direct sunlight access requirement during mid winter.



7.2 Section


SITE BOUNDARY
RL 26.70
17m Height Limit based on the Parramatta Road Corridor Urban Transformation Strategy 2016
COMMUNAL OPEN SPACE
LIFT SHAFT
FIRE STAIRS
SITE BOUNDARY
RL 26.70
3
RL 24.00
3.1
LEVEL 5
RL 20.90
3
3.1
LEVEL 4
RL 17.80
JOHNSTONS CREEK
3.1
LEVEL 3
RL 14.70
3.1
LEVEL 2
RL 11.60
3.1
LEVEL 1 / GROUND
RL 8.50
Existing Natural Ground Level
3.05
LOWER GROUND
RL 5.45
RL 5.45 100 year flood level + 500 freeboard
2.8
BASEMENT RL 2.65
DOUGLAS GRANT MEMORIAL PARK
OPEN -TOP CONCRETE STORMWATER CHANNEL
RL 3.30
RL 1.30
RL 1.30
RL 4.30
RL 7.85
RL 7.85
COURTYARD AT RL 8.50 / CHESTER STREET LEVEL (AT PML)
PEDESTRIAN ENTRY FROM CHESTER STREET (BEHIND)
1 : 8
Existing Natural Ground Level
1 : 4
1 : 8
RL 5.45 100 year flood level + 500 freeboard
RL 7.83
LEVEL 5 RL 20.90
LEVEL 4 RL 17.80
LEVEL 3 RL 14.70
LEVEL 2 RL 11.60
LEVEL 1 / GROUND
RL 8.50 PML
16.5
CHESTER STREET
FUTURE OPEN SPACE BASED ON THE PARRAMATTA ROAD CORRIDOR URBAN TRANSFORMATION STRATEGY 2016
RL 8.50

Appendix C – Remediation Criteria

Table C.1 Soil remediation criteria

Chemical	Unit	HIL B [1]	HIL C [1]	HSL A&B [10]	EIL [2]	ESL [3,10]
Metals						
Arsenic – As	mg / kg	500	300	-	100	-
Cadmium - Cd	mg / kg	150	90	-	-	-
Chromium(VI) – Cr(VI)	mg / kg	500	300	-	205	-
Copper – Cu	mg / kg	30,000	17,000	-	90	-
Lead – Pb	mg / kg	1,200	600	-	1,260	-
Mercury – Hg (inorganic)	mg / kg	120	80	-	-	-
Nickel – Ni	mg / kg	1,200	1,200	-	35	-
Zinc – Zn	mg / kg	60,000	30,000	-	190	-
Petroleum hydrocarbons						
F1 – TRH [4]	mg / kg	-	-	45 (0m - <1m) 70 (1m - <2m) 110 (2m - <4m) 200 (4m+)	-	180
F2 – TRH [5]	mg / kg	-	-	110 (0m - <1m) 240 (1m - <2m) 440 (2m - <4m) NL (4m+)	-	120 (F2 includes Naphthalene)
F3 – TRH [6]	mg / kg	-	-	-	-	300
F4 – TRH [7]	mg / kg	-	-	-	-	2,800
Polycyclic aromatic hydrocarbons (PAH)						
Naphthalene	mg / kg	-	-	3 (0m - <1m) NL (1m +)	170	-
Benzo(α)pyrene	mg / kg	-	-	-	-	0.7
Carc. PAHs (as B(α)P TEQ) [8]	TEQ	4	3	-	-	-
Total PAHs [9]	mg / kg	400	300	-	-	-
Monocyclic aromatic hydrocarbons (BTEX)						
Benzene	mg / kg	-	-	0.5	-	50
Toluene	mg / kg	-	-	160 (0m - <1m) 220 (1m - <2m) 310 (2m - <4m) 540 (4m+)	-	85
Ethylbenzene	mg / kg	-	-	55 (0m - <1m) NL (1m +)	-	70
Xylenes (total)	mg / kg	-	-	40 (0m - <1m) 60 (1m - <2m) 95 (2m - <4m) 170 (4m+)	-	105

Chemical	Unit	HIL B [1]	HIL C [1]	HSL A&B [10]	EIL [2]	ESL [3] [10]
Asbestos						
Asbestos (friable or fines)	w / w	0.001%	0.001%	-	-	-
Asbestos (bonded)	w / w	0.04%	0.02%	-	-	-
Phenols						
Phenols	mg / kg	45,000	40,000	-	-	-
Organochlorine pesticides						
DDT+DDE+DDD	mg/kg	600	400	-	100 (DDT)	
Aldrin and dieldrin	mg/kg	10	10	-	-	-
Chlordane	mg/kg	90	70	-	-	-
Endosulfan	mg/kg	400	340	-	-	-
Endrin	mg/kg	20	20	-	-	-
Heptachlor	mg/kg	10	10	-	-	-
HCB	mg/kg	15	10	-	-	-
Methoxychlor	mg/kg	500	400	-	-	-
Mirex	mg/kg	20	20	-	-	-
Toxaphene	mg/kg	30	30	-	-	-
Polychlorinated biphenyl						
PCB	mg/kg	1	1	-	-	-

Notes:

1. HIL B - Residential with minimal opportunities for soil access, Ref. NEPM 2013, Schedule B1, Table 1A(1).

   HIL C – Public open space such as parks, playgrounds, playing fields (e.g. ovals), secondary schools and footpaths, Ref. NEPM 2013, Schedule B1, Table 1A(1).
2. EIL – Generic EIL for aged Arsenic and Naphthalene, Calculated EILs for other metals in urban residential and public open space settings with due regard for background concentrations, soil cation exchange capacity, texture and pH, Ref. NEPM 2013, Schedule B1, Tables 1B(1) to 1B(5). See Table C-2 for derivation of EILs.
3. ESL – Ecological Screening Level for F1, F2, F3, F4, BTEX and Benzo(a)pyrene in coarse texture soils in urban residential and public open space settings, Ref. NEPM 2013, Schedule B1, Table 1B(6).
4. F1: concentration of TPH C_6-C_{10} fraction minus the sum of BTEX concentrations.
5. F2: concentration of TPH >C_{10}-C_{16} fraction minus the concentration of Naphthalene.
6. F3: concentration of TPH >C_{16}-C_{34}.
7. F4: concentration of TPH >C_{34}-C_{40}.
8. Carcinogenic PAHs: HIL is based on the 8 carcinogenic PAHs and their TEFs (potency relative to B(a)P) adopted by CCME 2008 (refer Schedule B7). The B(a)P TEQ is calculated by multiplying the concentration of each carcinogenic PAH in the sample by its B(a)P TEF, given below, and summing these products.
9. Total PAHs: HIL is based on the sum of the 16 PAHs most commonly reported for contaminated sites (WHO 1998). The application of the total PAH HIL should consider the presence of carcinogenic PAHs and naphthalene (the most volatile PAH). Carcinogenic PAHs reported in the total PAHs should meet the B(a)P TEQ HIL. Naphthalene reported in the total PAHs should meet the relevant HSL.
10. Soil HSLs for vapour intrusion assuming coarse texture (sand) soils.

Table C.2 Adopted ACL and ABC values for EIL derivation

Chemical	Assumed Values [1]	EIL (mg/kg) [2]
Arsenic	Generic EIL	100
Chromium (III)	ABC - 15 mg/kg (assumes an old NSW high traffic suburb) ACL - 190 mg/kg (assumes clay content <1 %)	205
Copper	ABC - 30 mg/kg (assumes an old NSW high traffic suburb) ACL - 60 mg/kg (assumes pH 4.5)	90
DDT	Generic EIL	180
Lead	ABC - 160 mg/kg (assumes an old NSW high traffic suburb) ACL – 1,100 mg/kg	1,260
Naphthalene	Generic EIL	170
Nickel	ABC - 5 mg/kg (assumes an old NSW high traffic suburb) ACL - 30 mg/kg (assumes CEC 5)	35
Zinc	ABC - 120 mg/kg (assumes an old NSW high traffic suburb) ACL - 70 mg/kg (assumes pH 4 & CEC 5)	190

Note:
ACL - added contaminant limit; ACLs for urban residential and public open space were used for this project
ABC - ambient background concentration
The most stringent ACL values were adopted for Chromium (III), Copper, Lead, Nickel and Zinc, as site soil physiochemical properties (i.e. pH, CEC and clay content) were not tested (Ref. NEPM 2013 Schedule B1, Tables 1B(1), 1B(2), 1B(3) and 1B(4) Soil-specific added contaminant limits).

[1] Assumed values are based on NEPM 2013 Schedule B5(c) Guideline on Ecological Investigation Levels for Arsenic, Chromium (III), Copper, DDT, Lead, Naphthalene, Nickel & Zinc

[2] EIL = ABC + ACL, unless Generic EIL is applicable

Table C.3 Waste classification without leachate testing

Contaminant	Maximum Values of Specific Contaminant Concentration for Classification without TCLP	
	General Solid Waste CT1 (mg/kg)	Restricted Solid Waste CT2 (mg/kg)
Arsenic	100	400
Asbestos	“Special Waste - Asbestos Waste” if ANY Asbestos is present	
Benzene	10	40
Benzo(a)pyrene	0.8	3.2
Cadmium	20	80
Chromium (VI)	100	400
Ethylbenzene	600	2,400
Lead	100	400
Mercury	4	16
Nickel	40	160
Petroleum hydrocarbons C_6-C_9	650	2,600
Petroleum hydrocarbons C_{10}-C_{36}	10,000	40,000
Polychlorinated biphenyls (PCB)	<50	<50
Polycyclic aromatic hydrocarbons (total PAH)	200	800
Toluene	288	1,152
Xylenes (total)	1,000	4,000

Table C.4 Waste classification using TCLP and SCC Values

Contaminant	Maximum Values for Leachable Concentration and Specific Contaminant Concentration when used together			
	General Solid Waste		Restricted Solid Waste	
	Leachable Concentration	Specific Contaminant Concentration	Leachable Concentration	Specific Contaminant Concentration
	TCLP1 (mg/L)	SCC1 (mg/kg)	TCLP2 (mg/L)	SCC2 (mg/kg)
Arsenic	5.0	500	20	2,000
Asbestos	“Special Waste - Asbestos Waste” if ANY Asbestos is present			
Benzene	0.5	18	2	72
Benzo(a)pyrene	0.04	10	0.16	23
Cadmium	1.0	100	4	400
Chromium (VI)	5	1,900	20	7,600
Ethylbenzene	30	1,080	120	4,320
Lead	5	1,500	20	6,000
Mercury	0.2	50	0.8	200
Nickel	2	1,050	8	4,200
Petroleum hydrocarbons C_6-C_9	N/A	650	N/A	2,600
Petroleum hydrocarbons C_{10}-C_{36}	N/A	10,000	N/A	40,000
Polychlorinated biphenyls (PCB)	N/A	<50	N/A	<50
Polycyclic aromatic hydrocarbons (total PAH)	N/A	200	N/A	800
Toluene	14.4	518	57.6	2,073
Xylenes	50	1,800	200	7,200

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

Appendix D – Review of Remedial Options & Technologies

Review of Remediation Options & Technologies

A number of remediation options were reviewed to examine the suitability of each method, with respect to the following aspects:

- Remedial options available;
- Likely impacts to surrounding lands;
- The geological and hydrogeological limitations
- Prioritisation of works in areas of most concern;
- Ability of remedial method to treat contamination with respect to natural and infrastructure limitations;
- Remedial timetable;
- Cost effectiveness;
- Defensible method to ensure the site is remediated to appropriate levels / validation criteria; and
- Regulatory compliance.

The following sections provide details on various remediation options for the contamination found on site.

D.1 Fill & soils

D.1.1 Bioventing

Bioventing stimulates the natural in situ biodegradation of aerobically degradable compounds in soil by increasing oxygen flow to existing soil microorganisms. In contrast to soil vapour vacuum extraction, bioventing uses low air flow rates to provide only enough oxygen to sustain microbial activity. Oxygen is most commonly supplied through direct air injection into residual contamination in soil. In addition to degradation of adsorbed fuel residuals, volatile compounds are biodegraded as vapours move slowly through biologically active soil. Bioventing techniques have been successfully used to remediate soils contaminated by petroleum hydrocarbons, non-chlorinated solvents, some pesticides, wood preservatives, and other organic chemicals.

Factors that may limit the applicability and effectiveness of the process include:

- A high water table within 1-2 m of the surface, saturated soil lenses, or low permeability soils all may reduce bioventing performance.
- Vapours can build up in basements or underneath buildings within the radius of influence of air injection wells. This problem can be alleviated by extracting air near the structure of concern.
- Extremely low soil moisture content may limit biodegradation and the effectiveness of bioventing.
- Monitoring of off-gases at the soil surface may be required.
- Aerobic biodegradation of many chlorinated compounds may not be effective unless there is a co-metabolite present, or an anaerobic cycle.

D.1.2 Enhanced bioremediation

Enhanced bioremediation is a process in which indigenous or inoculated micro-organisms (e.g., fungi, bacteria, and other microbes) degrade organic contaminants found in soil and/or ground water, converting them to harmless end products. Nutrients, oxygen, or other additives are used to enhance bioremediation and contaminant desorption from subsurface materials. In the presence of sufficient oxygen (aerobic conditions), and other nutrient elements, microorganisms will ultimately convert many organic contaminants to carbon dioxide, water, and microbial cell mass. In the absence of oxygen (anaerobic conditions), the organic contaminants will be ultimately metabolized to methane, limited amounts of carbon dioxide, and trace amounts of hydrogen gas. Under sulfate-reduction conditions, sulfate is converted to sulfide or elemental sulfur, and under nitrate-reduction conditions, nitrogen gas is ultimately produced.

Factors that may limit the applicability and effectiveness bio remediation of the process include:

- Interaction between the soil matrix and microorganisms influence the results;
- Contaminants may be subject to leaching requiring treatment of the underlying ground water;
- Preferential flow paths may severely decrease contact between injected fluids and contaminants throughout the contaminated zones. The system should not be used for clay, highly layered, or heterogeneous subsurface environments because of oxygen (or other electron acceptor) transfer limitations.
- High concentrations of heavy metals, highly chlorinated organics, long chain hydrocarbons, or inorganic salts may be toxic to microorganisms;
- A surface treatment system, such as air stripping or carbon adsorption, may be required to treat extracted groundwater prior to re-injection or disposal; and
- The length of time required for treatment can range from 6 months to 5 years and is dependent on many site-specific factors.

D.1.3 Capping and containment

The “cap and contain” method employs a risk minimisation approach similar to “ongoing management”, where impacted soils are managed on site so as not to pose an ongoing risk to the environment or human health. Impacted soils are contained by the placement of an impervious barrier or clean fill materials on top of the impacted material to prevent exposure to site occupiers, workers or the environment. The base of this “clean zone” would be clearly marked by a demarcation barrier to indicate that below this depth workers could potentially be exposed to contamination, which would then trigger additional health, safety and environmental controls.

Capping and containment may be an appropriate remedial option for soil containing both organic and inorganic contaminants that contain residual contamination, particularly if the mix of contaminants is not easily treated. The conditions for this remedial action alternative are:

- The contaminant is relatively non-mobile, including low volatility, insoluble and has low migration potential in a soil matrix;
- The primary exposure route to the contaminant and risk to human health is through direct dermal contact, dust inhalation or soil ingestion;
- The primary exposure route for the environment is mitigated through low leaching potential or migration to groundwater; and
- The contained area can be monitored and incorporated into any final land-use plans.

In the use of capping and containment, the focus of the response is to prevent contact with, or exposure to the contaminated soils by human receptors and/or eliminate transport by water to off-site receptors.

D.1.4 Chemical oxidation/injection

Chemical oxidation remedial strategies involve the addition of an oxidising agent to the soil or groundwater. The rate and extent of degradation of a target chemical of concern is dependent on its susceptibility to oxidative degradation as well as the site conditions, such as pH, temperature, the concentration of oxidant, and the concentration of secondary oxidant-consuming substances such as natural organic matter.

Factors which may limit the applicability and effectiveness of chemical oxidation include:

- Requirement for handling large quantities of hazardous oxidizing chemicals due to the oxidant demand of the target organic chemicals and the unproductive oxidant consumption of the formation;
- Some chemicals of concern are resistant to oxidation; and
- There is a potential for process-induced detrimental effects.

D.1.5 Excavation and off-site disposal

Excavation and disposal of contaminated wastes is a frequently used option, typically used when a rapid site remediation program is required or where significant subsurface contamination exists that is potentially impacting on sensitive off-site receptors. Wastes must be classified in accordance with the NSW EPA Guidelines.

Based on the required disposal of the landfill material, this option would adequately address the remediation goals through the removal of the contaminants from the site. Furthermore, with the removal of any identified contaminated fill soils, the long-term liability associated with soil contamination shall be minimised, along with substantial improvement of subsurface site conditions with regard to contamination of soil and groundwater.

D.1.6 Land farming

Ex situ land-farming is a proven treatment for petroleum hydrocarbon impacted soils. In general the higher the molecular weight or number of rings in a compound, the slower the degradation rate.

Factors that may limit the applicability and effectiveness of the land farming include:

- The large amount of space required;
- Conditions affecting biological degradation of contaminants (e.g., temperature, rain fall) are largely uncontrolled, which increases the length of time to complete remediation.
- Only suitable for organic contaminants.
- Volatile contaminants, such as solvents, must be pre-treated because they would volatilise into the atmosphere, causing air pollution.
- Dust control is an important consideration, especially during tilling and other material handling operations.
- Runoff collection facilities must be constructed and monitored.

D.2 Groundwater

D.2.1 Enhanced bioremediation

Bioremediation is a process in which indigenous micro-organisms (i.e., fungi, bacteria, and other microbes) degrade organic contaminants found in soil and/or ground water.

Enhanced bioremediation attempts to accelerate the natural biodegradation process by providing nutrients, electron acceptors, and competent degrading microorganisms that may otherwise be limiting the rapid conversion of contamination organics to innocuous end products.

Oxygen enhancement can be achieved by either sparging air below the water table or circulating hydrogen peroxide (H_2O_2) throughout the contaminated ground water zone. Under anaerobic conditions, nitrate is circulated throughout the ground water contamination zone to enhance bioremediation. Additionally, solid-phase peroxide products (e.g., oxygen releasing compound (ORC)) can also be used for oxygen enhancement and to increase the rate of biodegradation.

Air sparging below the water table increases ground water oxygen concentration and enhances the rate of biological degradation of organic contaminants by naturally occurring microbes. Air sparging also increases mixing in the saturated zone, which increases the contact between ground water and soil. Oxygen enhancement with air sparging is typically used in conjunction with SVE or bioventing to enhance removal of the volatile component under consideration.

During hydrogen peroxide enhancement, a dilute solution of hydrogen peroxide is circulated through the contaminated ground water zone to increase the oxygen content of ground water and enhance the rate of aerobic biodegradation of organic contaminants by naturally occurring microbes.

Solubilized nitrate is circulated throughout ground water contamination zones to provide an alternative electron acceptor for biological activity and enhance the rate of degradation of organic contaminants. Development of nitrate enhancement is still at the pilot scale. This technology enhances the anaerobic biodegradation through the addition of nitrate.

Bio-enhanced remediation strategies are slow and may take several years for plume clean-up.\

D.2.2 Air sparging

In air sparging, air is injected into a contaminated aquifer where it traverses horizontally and vertically in channels through the soil column, creating an underground stripper that removes contaminants by volatilization. This injected air helps to flush (bubble) the contaminants up into the unsaturated zone where a vapour extraction system is used to remove the vapour phase contamination.

In principal the more volatile a contaminant the more appropriate air sparging as a remediation strategy is. Methane can be added to the system to enhance co-metabolism of chlorinated organics.

Factors that may limit the applicability and effectiveness of the process include:

- Preferential air flow pathways reducing the contact between sparged air and the contaminants;
- Air injection wells must be designed for site-specific conditions; and
- Soil heterogeneity may cause some zones to be relatively unaffected.

D.2.3 Chemical oxidation

In a chemical oxidation system oxidants are added to the system in order to oxidise the chemical of concern to less toxic species. The Chemical oxidants most commonly employed include peroxide, ozone, and permanganate. These oxidants cause the rapid and complete chemical destruction of many toxic organic chemicals while some chemicals are subject to partially degradation and subsequently reduced by bioremediation.

In general oxidants are capable of achieving high treatment efficiencies (e.g., > 90 percent) for unsaturated aliphatic (e.g., trichloroethylene [TCE]) and aromatic compounds (e.g., benzene), with very fast reaction rates (90 percent destruction in minutes). Field applications have clearly affirmed that matching the oxidant and in situ delivery system to the contaminants of concern (COCs) and the site conditions is the key to successful implementation and achieving performance goals.

Oxidation using liquid hydrogen peroxide (H_2O_2) in the presence of native or supplemental ferrous iron (Fe^{+2}) produces Fenton's Reagent which yields free hydroxyl radicals (OH-). These strong, nonspecific oxidants can rapidly degrade a variety of organic compounds. Fenton's Reagent oxidation is most effective under very acidic pH (e.g., pH 2 to 4) and becomes ineffective under moderate to strongly alkaline conditions. The reactions are extremely rapid and follow second-order kinetics.

Ozone gas can oxidize contaminants directly or through the formation of hydroxyl radicals. Like peroxide, ozone reactions are most effective in systems with acidic pH. Due to ozone's high reactivity and instability, O_3 is usually produced onsite, and requires closely spaced delivery points (e.g., air sparging wells). In situ decomposition of the ozone can lead to beneficial oxygenation and bio-stimulation.

The following factors may limit the applicability and effectiveness of chemical oxidation include:

- Requirement for handling large quantities of hazardous oxidizing chemicals due to the oxidant demand of the target organic chemicals and the unproductive oxidant consumption of the formation.
- Some COCs are resistant to oxidation.
- There is a potential for process-induced detrimental effects. Further research and development is ongoing to advance the science and engineering of in situ chemical oxidation and to increase its overall cost effectiveness.

D.2.4 Reactive barrier wall

Construction of a permeable reactive barrier (PRB) involves the subsurface emplacement of reactive materials through which a dissolved contaminant plume enters on one side of the PRB and treated water exits the other side. This in situ method for remediating dissolved-phase contaminants in groundwater combines a passive chemical or biological treatment zone with subsurface fluid flow management.

PRBs can be installed as permanent or semi-permanent units. The most commonly used PRB configuration is that of a continuous trench in which the treatment material is backfilled. The trench is perpendicular to and intersects the groundwater plume.

Alternately low-permeability walls can be used to direct a groundwater plume toward a permeable treatment zone.

D.2.5 Pump and treat

As its name implies a pump and treat remedial involves the pumping of contaminated of ground water pumping include removal of dissolved contaminants from the subsurface, and containment and treatment the water. The treated groundwater is then either re-introduced into the aquifer or disposed off-site.

The criteria for well design, pumping system, and treatment are dependent on the physical site characteristics and contaminant type. While treatment options may include a train of processes such as gravity segregation, air strippers, and activated carbon filters designed to remove specific contaminants.

The first step in determining whether ground water pumping is an appropriate remedial technology is to conduct a site characterization investigation. Site characteristics, such as hydraulic conductivity, will determine the range of remedial options possible. Chemical properties of the site and plume need to be determined to characterize transport of the contaminant and evaluate the feasibility of ground water pumping. To determine if ground water pumping is appropriate for a site, one needs to know the history of the contamination event, the properties of the subsurface, and the biological and chemical contaminant characteristics. Identifying the chemical and physical site characteristics, locating the ground water contaminant plume in three dimensions, and determining aquifer and soil properties are necessary in designing an effective ground water pumping strategy.

The following factors may limit the applicability and effectiveness of ground water pump and treat options as a remedial option:

- The time frame required to achieve the remediation goal;
- The pumping system fail to contain the contaminant plume as predicted;
- Residual saturation of the contaminant in the soil pores cannot be removed by ground water pumping.
- A pump and treat option is not suitable for contaminants with:
- high residual saturation;
- high sorption capabilities; and
- homogeneous aquifers with hydraulic conductivity less than 10^{-5} cm/sec.
- Potential high operating costs;
- Biofouling of the extraction wells and associated treatment stream may severely affect system performance;
- Subsurface heterogeneities, may severely affect system performance;
- Potential toxic effects of residual surfactants in the subsurface;
- Drawdown pumping generally produces large volumes of water requiring storage and or treatment

D.2.6 Excavation

Excavation and disposal of contaminated wastes is a frequently used option, typically used when a rapid site remediation program is required or where significant subsurface contamination exists that is potentially impacting on sensitive off-site receptors. Excavation can also be used to remove primary sources of any groundwater contamination (such as buried tanks or drums and waste disposal areas) and remove the secondary sources of impact (contaminated fill, residual soils and impacted bedrock and bedrock fractures such as joints and bedding planes).

D.3 Remediation options

The various remediation options were reviewed in a technology matrix to assess their suitability against the various subsurface materials at the site and whether the option meets the primary objectives of the remediation works program, as discussed in **Section 5**.