REMEDIAL ACTION PLAN

73 and 79 Railway Lane, Wickham NSW

Prepared for ADW Johnson
On behalf of 22A Park Avenue Pty Ltd

Prepared by RCA Australia

RCA ref 12101b-301/1

November 2016

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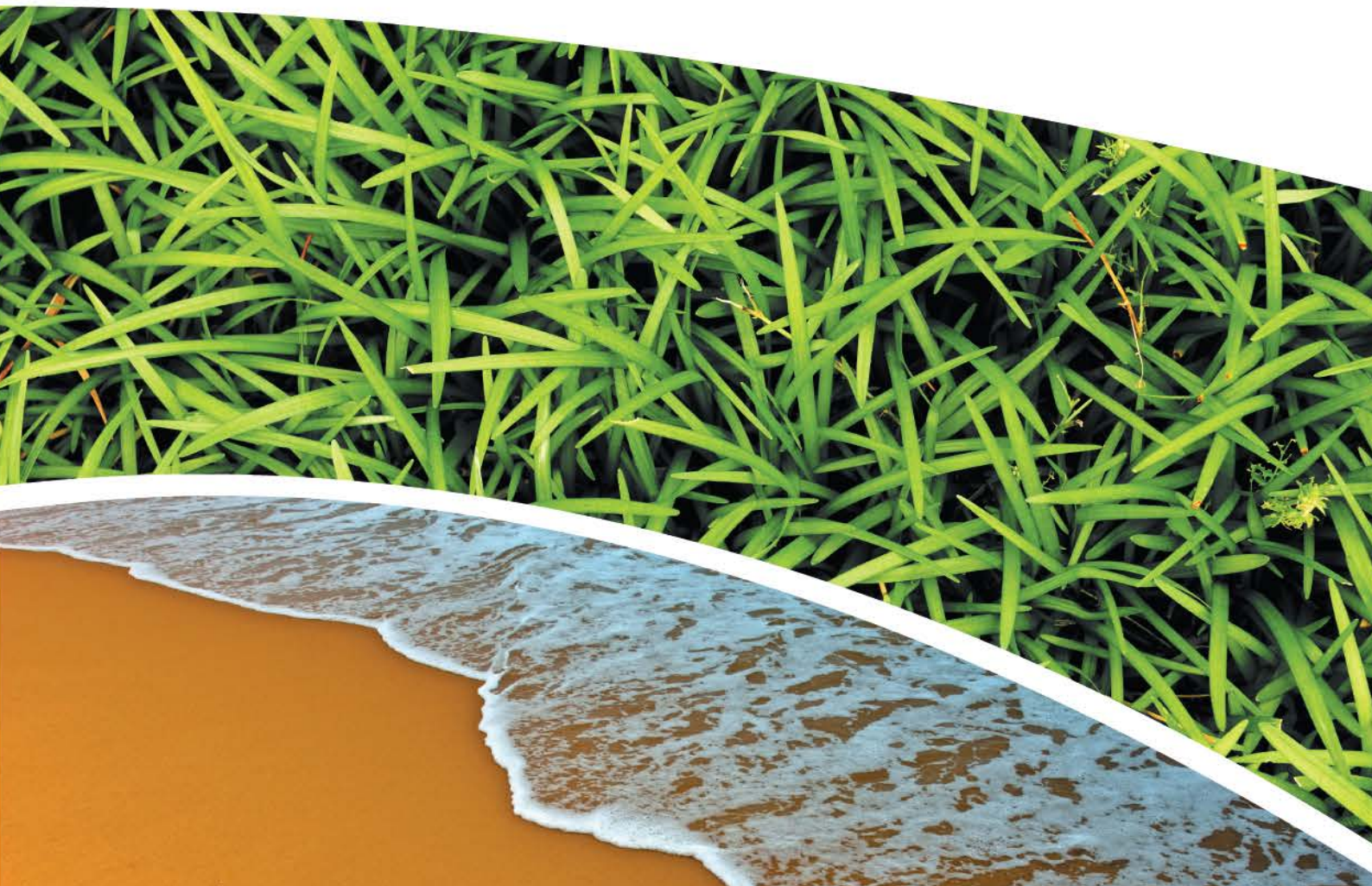

RCA Australia
92 Hill Street, Carrington NSW 2294

Telephone: (02 4902 9200
Fax: (02) 4902 9299
Email: administrator@rca.com.au
Internet: www.rca.com.au

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22A Park Avenue Pty Ltd
c/o ADW Johnson
7/335 Hillsborough Road
WARNERS BAY NSW 2282

Attention Kristy Sibanda

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REMEDIAL ACTION PLAN
73 AND 79 RAILWAY LANE, WICKHAM NSW

EXECUTIVE SUMMARY

In March 2016, RCA Australia (RCA) prepared a Phase 1 environmental site assessment (ESA) report for 73 and 79 Railway Lane, Wickham NSW at the request of ADW Johnson on behalf of 22A Park Avenue Pty Ltd. The assessment was undertaken to determine the suitability of the site for a proposed multi-storey commercial and residential development with a dual basement carpark. The report concluded there were potential sources of contamination at the site from:

- historical filling at the site;
- potential for on site migration of contamination in groundwater from a neighbouring site;
- potential asbestos impacts at the site due to the use asbestos containing building materials in the existing structure and fragments of suspected bonded asbestos observed at the site surface; and
- the likely presence of acid sulfate soils in the underlying natural soil profile of the site.

A subsequent Phase 2 ESA was undertaken in September 2016 to assess for the presence of contaminants at the site. The Phase 2 ESA identified the following:

- Historical filling at the site to a depth of approximately 1.0m below the existing surface which included construction and demolition waste.
- Groundwater present on site within the underlying natural soil profile at a depth of approximately 2.0m below the existing surface.
- The presence of elevated concentrations of total recoverable hydrocarbons (TRH), polycyclic aromatic hydrocarbons (PAH), lead and zinc within the fill profile of the site.

- Fragments of bonded asbestos at the site surface and at a depth of 0.4m below the existing surface in one location (BH6).
- The presence of elevated concentrations of arsenic and zinc in groundwater across the site.
- The presence of acid sulfate soil (ASS) at the site within the underlying natural soil profile.

Due to the identification of contamination at the site, it was recommended that a remedial action plan (RAP) be developed for the site, that describes the remediation required on site and the remedial strategy for the management of the contaminants identified at the site.

Due to the nature of the development, specifically the basement carpark, the majority of remedial options were limited as the identified impacted materials would require off site disposal. A potential option exists to treat ASS in situ but requires further evaluation. The recommended remedial strategy generally consists of the following:

- Installation of sheet piling and shoring which will provide support to excavation walls and restrict groundwater ingress during site works.
- Classification and off site disposal of all fill material present on site (including consideration of asbestos impacts).
- Excavations, treatment, classification and off site disposal of underlying ASS material requiring off site disposal to make way for the proposed development.
    - There may be potential for in situ treatment of ASS as an option if found to be viable for the site, however this would require further consideration and an amendment to the RAP.
- Dewatering of the excavation and off site disposal of groundwater through a trade waste agreement or alternative suitable disposal method.
- Validation of site works through sampling as required, material tracking, disposal dockets and progressive photographs.

Following the remediation works described in this RAP, RCA considers the site would be suitable for the proposed development with consideration to the contamination risks.

There are however, likely to be other development constraints which do not fall under the jurisdiction of the RAP such as the structural integrity of excavation works, foundation design for the proposed development due to mine subsidence and maintaining access to the neighbouring residential property.

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1 SCOPE OF WORK

The scope of works completed by RCA in the preparation of this remedial action plan (RAP) included the following:

- Review and summarise the existing data for the site and define the remediation area.
- Develop a remedial strategy and validation plan for the site; and
- outline the required information to be contained within the site management plan (SMP), to be developed prior to on site works.

2 SITE IDENTIFICATION AND DESCRIPTION

The site consists of Lot 11 DP 1106378 and Lot 110 DP 1018454. Both Lots are located on Railway Lane, Wickham NSW, with street numbers 73 and 79 respectively.

A summary of the site details is shown below in **Table 1**.

Table 1 *Site Details*

Current zoning	Both Lots are currently under B4 - mixed use zoning.
Current use	Lot 11 DP 1106378 – vacant of buildings, used for storage of trucks and shipping containers. Lot 110 DP 1018454 – a car detailing business on one side of the building and storage for a loans business on the other.
Proposed use	Multi-storey mixed commercial and residential development
Size of site	Lot 11 DP 1106378 – approx. 2,608m^2 Lot 110 DP 1018454 – approx. 1,974m^2
Land use to the: North	Lubrication and automotive oil manufacturer (B4 - mixed use zoning)
South	SP2 - Heavy railway Line that is understood to be currently undergoing redevelopment as a light rail terminal
East	Residential housing and a public house (B4 - mixed use zoning)
West	Temporary demountable offices and vacant land (B4 - mixed use zoning)
Nearest sensitive receptor (human health)	Residential housing located directly east of Lot 11 DP 1106378. Preschool situated approx. 280m north of the site.
Nearest sensitive receptor (environmental)	Hunter River approximately 500m east of the site

Drawing 1, **Appendix A** shows the locality and the layout of the site.

3 GEOLOGY AND HYDROGEOLOGY

During RCA's Phase 1 assessment of the site (Ref [1]), published geological maps and New South Wales Office of Water (NOW) groundwater bore search data were reviewed. The findings are summarised in **Table 2**. Further details, including the bore search results, are provided in (Ref [1]).

Table 2 *Geology and Hydrogeology*

Soil type	Based on the Newcastle 1:100,000 Soil Landscape Maps, the site is within the Hamilton (hm(a)) landscape characterised as: • Loamy sand overlies loose, pale, coarse sand which overlies sandy pan. • Wind erosion hazard. • Non-cohesive soils. • High run-on. • Flood hazard. • Foundation hazard. • Groundwater pollution hazard. Surrounding areas are consistent with the site.
Geology type	The site is judged to be situated in Quaternary sand, characterised by Gravels Sands and Silts soil types, overlying clay deposits (Ref [2]). Reference to the Newcastle Coalfield Regional Geology maps indicates that rock will be in the order of 25 to 40m below the current ground surface (Ref [2]).
Acid sulfate soil	Based on the Newcastle Acid Sulfate Soils Risk Map, the majority of the site is located within a 'High Probability' area for ASS. ASS in this area may be widespread and encountered within one metre of the ground surface. A small portion in the south western corner of the site is low probability of ASS greater than 3m metres below the ground surface (Ref [3]). Based on the Newcastle LEP 2012 Acid Sulfate Soils Map, the area is classified as predominantly a 'Class 3' risk area, however the south western portion of Lot 110 DP 1018454 is classified as 'Class 4'.
Groundwater use	Not applicable. No registered groundwater bores were noted as being used on site. Groundwater bores located in the surrounding area have been identified primarily as monitoring bores or for domestic use.
Number of monitoring wells on site	One existing groundwater monitoring well was observed on site in the vacant land of Lot 10. Five (5) groundwater monitoring wells were installed by RCA in September 2016.

Nearby wells (within 500m of site boundary)	Seven (7) registered groundwater bores were identified within 500m of the site. Two bores (GW201711 and GW201710) are located approximately east of the site within a commercial core zoned area. These bores are for monitoring purposes and specify that the water bearing zone is within sand or silty sand strata. Five (5) of the bores (GW054766, GW202915, GW200855, GW56149, and GW058805) are located south to south east of the site. These bores are located within residentially zoned areas exception for GW200855 which is within a commercial area. These bores were registered generally for domestic use, with one test bore now cancelled (GW200855) and another's purpose was undisclosed. The water bearing strata was identified as sand in two of the wells, with one in mud. The rest of the bores did not disclose the information.
Rate of groundwater flow	Unknown. Expected to be generally from west to east towards Hunter River.
Background water quality	Unknown.

4 SUMMARY OF PREVIOUS INVESTIGATIONS

RCA has previously undertaken historical and intrusive investigations at the site, which have been summarised in the following sub-sections.

4.1 RCA, PHASE 1 ENVIRONMENTAL SITE ASSESSMENT (MARCH 2016)

RCA's Phase 1 assessment of the site consisted of a detailed desktop assessment and limited site inspection for a multi-storey development with basement car parking. It is noted that site access was not granted during the Phase 1 assessment and the inspection was limited to the property boundary and surrounding areas with public access. The Phase 1 assessment included consideration of potential contamination from the site surface, subsurface and surroundings.

The Phase 1 assessment identified the following potential contaminants of concern:

- Asbestos, metals, hydrocarbons and surfactants in surface soils and to the extent of any fill material present on site.
- Metals, hydrocarbons and surfactants in deeper soils, with the likelihood of acid sulfate soils (ASS) in the underlying natural soil profile; and
- Hydrocarbons, metals, surfactants, organic compounds and oil and grease in groundwater due to past site use and surrounding site uses.

It was considered that there was potential for contamination to be present across the entire site area as historical filling was evident from observations made during site inspection.

Additionally, it was noted that an adjacent site (Fuchs) was notified as 'under investigation' with the NSWEPA and inspection of the site from a public access area identified the presence of a groundwater monitoring network installed around a storage tank farm on that site suggesting a potential groundwater contamination issue may be present in close proximity to the Railway Lane site.

It was considered possible that off site groundwater contamination may have the potential to migrate on site the site during construction works due to groundwater drawdown from expected dewatering works required to enable construction of the proposed basement car parking. Additionally it was considered that groundwater drawdown may cause exposure of the potential ASS to an oxidising environment which may increase mobility of previously stable contaminants.

A detailed Phase 2 site assessment was recommended to be undertaken at the site to investigate the presence and extent of contamination in site soils and groundwater and also to assess for potential ASS in the natural soil profile.

Further details of historical assessment of the site can be found in the RCA's Phase 1 ESA report (Ref [1])

4.2 RCA, PHASE 2 ENVIRONMENTAL SITE ASSESSMENT (OCTOBER 2016)

RCA undertook detailed intrusive assessment and 73 and 79 Railway Lane during September 2016 to determine the presence and extent of potential contamination in site soils and groundwater.

The site inspection included investigation within the existing site structure, which was noted to contain presumed asbestos building materials as roofing sheets and guttering. Several suspected bonded asbestos fragments were observed on the site surface adjacent to the structure with three (3) samples of material collected and submitted to the laboratory for asbestos identification, which was subsequently confirmed.

During the inspection, a sump was noted within the floor of the eastern portion of the existing site structure which contained what appeared to be oily water and was noted to have hydrocarbon/oil staining around the sump. The sump was connected via pipework to an oily water separator also contained within the structure.

Intrusive investigations involved drilling boreholes at twelve (12) locations across the site to assess site soils using a truck mounted drilling rig and the installation of five (5) groundwater monitoring wells to assess groundwater across the site.

Soil samples were collected from fill and natural materials from between the surface to depths of up to five (5) metres below the existing ground surface (bgl) using a truck-mounted drill rig. Sampling depths were determined based on material types encountered and evidence of visual and/or olfactory contamination.

A total of forty (40) soil samples (primarily of fill materials) were sent to the laboratory for analysis of total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylenes (BTEX), polycyclic aromatic hydrocarbons (PAH) and metals. Eleven (11) soil samples were additionally analysed for PCBs. A fragment of asbestos containing fibre sheeting (confirmed by laboratory analysis) was encountered during drilling works in BH6 at a depth of 0.4 to 0.5m (sample BH6B).

A total of thirty six (36) soil samples of the underlying natural soil profile were collected and sent to the laboratory for acid sulfate soil (ASS) screening analysis and subsequently five (5) of these samples were additionally analysed for SPOCAS which confirmed the presence of ASS at the site.

Groundwater samples were collected from the five (5) installed monitoring wells at the site and sent to the laboratory for analysis of TRH, BTEX, PAH and metals to determine potential groundwater impacts across the site.

Results of analysis indicated several soil samples from across the site reported elevated concentrations of TRH, benzo(a)pyrene (a PAH constituent), lead and zinc. ASS testing confirmed the presence of acid sulfate soils in the underlying natural soil profile. Elevated concentrations of arsenic and zinc in groundwater were reported at all monitoring well locations.

The report concluded that a RAP and acid sulfate soil management plan (ASSMP) would be required to be developed for the site.

A summary of all previous analytical results are provided in **Appendix B**. Locations of identified contamination are shown on **Drawing 2** (Soil) **and Drawing 3** (groundwater), **Appendix A**.

Further details of the intrusive assessment of the site can be found in RCA's Phase 2 ESA report (Ref [4]).

5 SITE CHARACTERISATION

5.1 SOIL

A summary of all analytical results is provided in **Appendix B**.

A copy of exposure scenarios for HIL 'B' residential development with limited access to site soil and HIL 'D' commercial industrial development are provided in **Appendix C**.

5.1.1 FILL

The Phase 2 ESA undertaken by RCA in September 2016 identified the presence of fill material at the site which reported elevated concentrations of TRH, PAH, lead and zinc in excess of NEPM criteria (Ref [5]) criteria.

5.1.1.1 TRH

TRH concentrations in excess of NEPM (Ref [5]) ecological and management limit criteria were reported at sample location BH12, which was excavated in a location observed to have oil staining on the surface. It is anticipated the impacted material at this location may be delineated visually and is localised to the source of impact.

There is considered to be potential for additional localised pockets of hydrocarbon contamination on the site in soils around the sump and oil water separator, drains and hydrocarbon stained concrete slabs.

Exposure to this contaminant would be due to dermal contact, ingestion and inhalation of dust for current site workers and to workers during any construction activities.

No soil TRH contamination is expected to remain on site following completion of remediation works therefore it is considered there will be no contamination source for exposure to final site receptors.

5.1.1.2 METALS AND B(A)P

Lead concentration in excess of NEPM (Ref [5]) human health criteria was reported at sample location BH11C – 1.0m)

Zinc concentrations in excess of the NEPM (Ref [5]) ecological criteria were reported in fill materials at several locations across the site.

Benzo(a)pyrene concentrations in excess of the NEPM (Ref [5]) ecological criteria were reported in fill materials at two (2) locations on site.

Exposure to these contaminants would be due to dermal contact, ingestion and inhalation of dust for current site workers and to workers during any construction activities.

No soil metal or B(a)P contamination is expected to remain on site following completion of remediation works therefore it is considered there will be no contamination source for exposure to final site receptors.

5.1.1.3 ASBESTOS

Fragments of bonded asbestos were observed on the site surface in a number of locations across the site and also at a depth of 0.4m below the site surface at one location (BH6).

It is noted that asbestos containing building materials are present within the existing structures and there is potential for additional surface impacts during demolition works.

It is considered there is potential for asbestos impacts to be present across the site within any fill materials which construction and demolition waste

Exposure to this contaminant would be due to inhalation directly or secondary from adhered fibres on equipment and clothing for current site workers, workers during any demolition or construction activities and neighbouring occupants, workers or public.

No asbestos contamination is expected to remain on site following completion of remediation works therefore it is considered there will be no contamination source for exposure to final site receptors.

5.1.2 NATURAL ALLUVIAL SOILS - ASS

The underlying natural soil profile at the site generally consists of alluvial sands which were confirmed to be ASS following laboratory testing of the material.

It is noted that significant quantities of the natural soil profile will require off site disposal to enable construction of the proposed basement car park.

Excavation of this material, if untreated, may lead to the generation of acid leachate.

Human exposure to this contaminant would be minor and due to dermal contact or ingestion for workers during any construction activities. Ecological impacts could be caused by off site migration of acid leachate.

Additionally acid leachate has the potential to cause corrosion and increase the mobility of some contaminants such as metals.

No disturbed untreated alluvial materials are expected to remain on site following completion of remediation works therefore it is considered there will be no contamination source for exposure to final site receptors.

5.2 GROUNDWATER

A summary of all analytical results is provided in **Appendix B**.

Groundwater was generally observed at a depth of approximately 2.0m below the existing surface during investigation works and was noted to be within the underlying natural soil profile of the site.

Concentrations of metals (including arsenic and zinc) in excess of the NHMRC Australian Drinking Water Guidelines (Ref [7]) and ANZECC 2000 95% Protection Level for marine environments (Ref [8]) were reported in samples collected from the groundwater monitoring wells at locations BH4, BH5, BH7, BH9 and BH10. It is unclear whether the source of these exceedances relates to leaching of contaminants from historical fill materials, historical site practices, local/adjacent groundwater contamination or regional elevated metal concentrations in groundwater.

Exposure to groundwater may occur during the proposed development works at the site through dermal contact and ingestion where excavation of soils exposes the groundwater present at the site. There is no noted use of groundwater on site therefore it is considered there is no pathway for exposure to final site receptors after remediation works have been completed.

6 REMEDIAL ACTION PLAN

6.1 REMEDIATION GOAL

The remediation goal is to undertake works which will render the site suitable for the development of a proposed multi-storey complex consisting of two (2) levels of basement car park with commercial and residential use on the ground floor and residential apartments on the above storeys.

The excavation and removal of site soils to depths of approximately five (5) metres below ground level (mbgl) will be required to be undertaken with associated dewatering works.

6.2 DISCUSSION OF THE EXTENT OF THE REMEDIATION REQUIRED

Groundwater is present at the site from depths of approximately 2.0m below the existing ground surface and is noted to contain concentrations of metals (arsenic and zinc) in excess of the NHMRC Australian Drinking Water Guidelines (Ref [7]) and ANZECC 2000 95% Protection Level for marine environments (Ref [8]) and is considered unsuitable for human consumption or use on site.

Additionally, it is noted that adjacent sites may contain potential groundwater impacts that could be drawn to site through the process of dewatering. In particular, RCA is aware of an adjacent site under NSW EPA assessment (Fuchs) that is considered likely to be associated with potential groundwater contamination.

Generally, un-delineated contamination impacts including asbestos materials and elevated concentrations of B(a)P, metals (including lead and zinc) and hydrocarbons were reported in excess of NEPM (Ref [5]) human health and ecological criteria within fill materials across the site.

Upper alluvial sands may contain un-delineated concentrations of contaminants in excess of NEPM (Ref [5]) human health and ecological criteria.

All alluvial sand materials assessed (from 1 to 5m below the existing ground surface) are considered to be acid sulphate soil and potentially acid generating when excavated.

It is understood that all fill materials and the majority of alluvial sands to the depth assessed are required to be removed from the site to enable the construction of the proposed development. It is considered that ASS would continue beyond the depth of assessment (5m) which would require consideration should deeper excavations be required at any stage of the development.

All soil materials to be disposed off site will require assessment in accordance with the NSWEPA Waste Classification Guidelines (Ref [6]) and other applicable legislation described in **Appendix D**.

Un-delineated contamination impacts in the site fill materials and upper alluvial sands, including asbestos materials and concentrations of B(a)P, lead and hydrocarbons in excess of NSWEPA Waste Classification Guidelines (Ref [6]) CT1 GSW and RSW criteria were observed across the site.

Material management strategies are required to manage the excavation, characterisation and off site disposal of this material.

6.3 DISCUSSION OF POSSIBLE REMEDIAL OPTIONS

6.3.1 BASIC REMEDIAL FRAMEWORK SEQUENCE

As the development and remediation constraints of the site are relatively fixed, it is not considered practical to present several remedial options, however each step in the basic remedial framework sequence may be considered in different ways and, where applicable, different options have been discussed with the methodology RCA considers to be the most practical to put forward.

The basic remedial framework sequence considered to be required is presented below:

1. Establish mechanism to prevent groundwater ingress during dewatering and excavation work.
2. Dewatering and disposal of groundwater.
3. Excavation of fill materials.
4. Characterisation and off site disposal of fill materials.
5. Excavation, treatment and classification of alluvial materials.
6. Validation sampling, material tracking, collection of disposal dockets and progressive photographs.
7. Placement of clean backfill following confirmatory testing for suitability.

Some elements of the remedial strategy would require discussion with the nominated principal contractor and suitably qualified specialists on the best approach to achieve the required outcome, such as shoring and sheet piling for excavation works, dewatering requirements for the proposed development, potential for in situ ASS treatments and the possibility of obtaining specific material exemptions from the NSWEPA.

6.3.2 DISCUSSION ON BASIC REMEDIAL FRAMEWORK SEQUENCE OPTIONS

6.3.2.1 ESTABLISH MECHANISM TO PREVENT GROUNDWATER INGRESS DURING DEWATERING AND EXCAVATION WORK

RCA considers that the only feasible way to undertake works which allow for the necessary soil excavation and dewatering works and prevents migration/ingress of groundwater from adjacent areas, would be the erection of a temporary sheet pile wall around the entire site perimeter to be founded within an impermeable clay layer below the alluvial sands. From investigations undertaken in the area RCA anticipates that an impermeable clay layer would likely be encountered at depths of approximately 10 to 12m below the existing surface.

It is noted that this methodology would also be required to shore-up the proposed excavation face. The potential for collapse of alluvial sands is considered to make any other mechanisms to prevent groundwater ingress, such as bentonite cement barrier wall construction or stand-alone groundwater pumping plans, impractical.

Additionally, it is noted that an aggressive groundwater pumping strategy, without isolating the site from the surrounding aquifer through the use of an impermeable sheet pile wall or similar, would have potential to cause groundwater migration from adjacent potentially contaminated sites and may require consultation with the NSWEPA.

A detailed hydrogeological assessment may be required to assist the design and implementation of these works.

6.3.2.2 DEWATERING AND DISPOSAL OF GROUNDWATER

Groundwater was encountered within the natural alluvial sands across the site from depths of approximately two (2) mbgl.

Dewatering of ground water can be undertaken via pumping prior to and/or during excavation works.

The requirements for dewatering of the excavation will require discussion and review of the project details by a dewatering specialist whom can advise on the most appropriate methodology for the project specifics to be adopted at the site.

It is considered that a licence would be required from the NSW Office of Water to undertake the required dewatering of the site.

Any groundwater pumped from site and/or any subsurface seepage and/or accumulated excavation waters will need to be assessed and characterised prior to disposal as determined in consultation with all relevant parties.

There may be potential to apply to Hunter Water Corporation for an application to discharge waters to sewer as Liquid Trade Waste, and this is considered likely to be the most practical and cost effective option based on contaminants assessed.

6.3.2.3 EXCAVATION OF FILL MATERIALS

Fill materials were observed across the site to depths of approximately one (1) m below the existing surface.

All fill materials are to be delineated, excavated, classified and disposed off site. In areas of the site where full final excavation is not required, such as the drive access to the adjacent residential development in the south-eastern portion of the site, all existing fill materials are to be removed, as a minimum.

Fill materials which contain construction and demolition waste and any surface fill materials are to be treated as potentially containing asbestos materials and should be segregated and stockpiled together for appropriate classification.

Any fill materials observed to contain contamination impacts, as identified by visual or olfactory contamination, such as hydrocarbon odour, staining, etc, should be delineated, excavated and stockpiled with like materials. Potential impacts include soils around oil staining in the vicinity of BH12, identified sump and oil water separator, drains and hydrocarbon stained concrete slabs. The approximate location of the oily water separator is shown on **Drawing 1**, **Appendix A**.

Fill materials which are not observed to contain construction and demolition waste or any other obvious contamination impacts should be excavated and stockpiled together.

6.3.2.4 CHARACTERISATION AND OFF SITE DISPOSAL OF FILL MATERIALS

All soil fill materials to be disposed off site will require assessment in accordance with the NSWEPA Waste Classification Guidelines (Ref [6]) and other applicable legislation described in **Appendix D**.

Classification sampling of fill material prior to off site disposal will consist of analysis for TRH, BTEX, PAH and metals (As, Cd, Cr, Cu, Ni, Pb, Zn and Hg) and be undertaken at a rate of one (1) sample per 25m^3 of material assessed with a minimum of three (3) samples per stockpile.

Any fill materials which are not presumed to contain asbestos will be subject to additional asbestos analysis at a rate of one (1) sample per 25m^3 of material assessed in addition to the regular proposed characterisation sampling.

The majority of the fill material encountered on site is expected to be suitable for disposal to a licensed landfill as GSW and/or asbestos impacted special waste under the NSWEPA Waste Classification Guidelines (Ref [6]) CT1 or CT2 criteria based on previous data.

It is noted that there may be potential to reduce hydrocarbon concentrations in impacted materials through the application of landfarming techniques.

It is noted that heavier end hydrocarbon staining as observed in the vicinity of BH12 would not be considered practical for landfarming.

Lighter hydrocarbon fractions (petrol/diesel) noted to potentially be present on the site may be considered more feasible for the application of landfarming techniques, if encountered.

6.3.2.5 *EXCAVATION, TREATMENT AND CLASSIFICATION OF ALLUVIAL MATERIALS*

The majority of alluvial materials are required to be excavated and disposed off site to enable the construction of the proposed development.

When portions of the upper natural alluvial profile are designated to remain in situ then validation sampling along the excavation face should be undertaken to assess the material in accordance with NEPM 2013 (Ref [5]) criteria. Validation results will be compared to NEPM 2013 levels to ensure adequate removal and delineation of potential contaminants has been achieved.

All alluvial sand materials assessed (from 1 to 5 mbgl) are considered to be acid sulfate soils and potentially acid generating when excavated and will need to be managed and treated in accordance with the site acid sulfate soil management plan (ASSMP) prepared by RCA as detailed under separate cover (Ref [9]).

The ASSMP details the recommended treatment option for ASS materials designated for off site disposal and/or on site re-use is neutralisation.

Neutralisation may be achieved via the application of lime, or other such neutralising agent, in a controlled manner at the specified rate to excavated materials.

Alternatively, if site constraints are restrictive to on site stockpile treatment then in situ treatments as noted in the ASSMP may be considered. If in situ ASS treatments are considered viable then a revision to this RAP will be required.

Characterisation sampling following treatment to show that neutralisation has been achieved will consist of analysis for pH, chromium-reducible sulfur (%Scr) and total potential acidity (TPA) levels and be undertaken at a rate of one (1) sample per 50m^3 of material assessed, with a minimum of two (2) samples per stockpile, as specified in the ASSMP (Ref [9]). Additionally, the criteria to show that neutralisation has been achieved are specified in the ASSMP (Ref [9]).

Additionally, all treated alluvial materials to be disposed off site will require assessment in accordance with the NSWEPA Waste Classification Guidelines (Ref [6]) and other applicable legislation described in **Appendix D**.

Waste classification sampling prior to off site disposal will consist of analysis for TRH, BTEX, PAH and metals (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg) and be undertaken at a rate of one (1) sample per 100m^3 of material assessed with a minimum of three (3) samples per stockpile. The reduced sampling density is considered suitable due to the homogeneous nature of the alluvial material.

The majority of the alluvial material encountered on site is expected to be suitable for disposal to a licensed landfill and/or recycling facility as GSW under the NSWEPA Waste Classification Guidelines (Ref [6]) CT1 criteria based on previous data.

It is noted that there may be potential to apply to the NSWEPA for a specific exemption which may enable alternative re-use options for this material and/or allow for neutralisation works to be undertaken off site, however this would require a site which has a licence for accepting ASS material.

6.3.2.6 VALIDATION OF THE SITE

Validation sampling is not considered to be required across the majority of the site as all potentially impacted material will be removed to depths of approximately 5m below the existing surface across the site.

Validation sampling will however, be required where portions of the upper natural alluvial profile are designated to remain in situ (drive access to the adjacent residential property in the south eastern portion of the site) to ensure adequate removal and delineation of any potential contaminants from within the fill materials. The drive access area where it is anticipated alluvial soils will not be removed from site is shown on **Drawing 1**, **Appendix A**.

Any materials designated to remain in situ must be assessed in accordance with NEPM 2013 (Ref [5]) criteria.

Validation sampling for suitability for in situ alluvial sands will consist of analysis for TRH, BTEX, PAH, Metals (As, Cd, Cr, Cu, Ni, Pb, Zn Hg) and asbestos at a rate of one (1) sample per 10 m^2 across the base of the excavation of material assessed. Validation sampling of excavation walls is not considered to be required as the excavation is anticipated to extend to the site boundary.

6.3.2.1 PLACEMENT OF CLEAN BACKFILL

Backfill materials may consist of clean fill brought to site and/or any natural un-impacted alluvial material that has been treated in accordance with the ASSMP. Any materials designated for use as backfill must be assessed in accordance with NEPM 2013 (Ref [5]) criteria.

Validation sampling for on site use/re-use of clean backfill will consist of analysis for TRH, BTEX, PAH, metals (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg), polychlorinated byphenyl (PCB), organochlorine/organophophorous pesticides (OCP/OPP) and asbestos at a rate of one (1) sample per 25m^3 of material assessed with a minimum of three (3) samples from each stockpile of material.

6.4 RATIONALE FOR THE SELECTION OF RECOMMENDED REMEDIAL OPTION

As the development and remediation constraints of the site are relatively fixed it is not considered practical to present several remedial options, however each step in the basic remedial framework sequence may be considered in different ways and where applicable different options have been discussed with the methodology RCA considers to be the most practical put forward, based primarily on assessment of risk and perceived cost.

6.5 PROPOSED VALIDATION OF THE SITE AFTER REMEDIATION

Validation sampling is not considered to be required across the majority of the site as all potentially impacted material will be removed to depths of approximately five (5) mbgl across the site.

Validation sampling will however, be required when portions of the upper natural alluvial profile are designated to remain in situ (drive access in the south eastern portion of the site) to ensure adequate removal and delineation of any potential contaminants from within the fill materials.

Any materials designated to remain in situ must be assessed in accordance with NEPM 2013 (Ref [5]) criteria.

Validation sampling for suitability for in situ alluvial sands will consist of analysis for TRH, BTEX, PAH and metals (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg) at a rate of one (1) sample per 10m^2 of material assessed.

Backfill materials may consist of clean fill brought to site and/or any natural un-impacted alluvial material that has been treated in accordance with the ASSMP. Any materials designated for use as backfill must be assessed in accordance with NEPM 2013 (Ref [5]) criteria.

Validation sampling for on site use/re-use of clean backfill will consist of analysis for TRH, BTEX, PAH, metals (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg), PCB, OCP/OPP and asbestos at a rate of one (1) sample per 25m^3 of material assessed.

Material tracking will be required to be undertaken during the project to ensure materials are managed appropriately and all disposal dockets will be required to be supplied for inclusion in the validation report of the site. Progressive photographs of remediation will be required to be collected for inclusion within the validation report to be prepared at the completion of the remediation works.

6.6 CONTINGENCY PLAN IF THE SELECTED REMEDIAL STRATEGY FAILS

As the remediation strategy chiefly consists of excavation and off site disposal of all groundwater, fill materials and the majority of alluvial materials to depths of approximately five (5) metres, and is strongly tied to the construction strategy, it is not considered that any significant contaminant source will remain after remedial works have been completed.

As such, the remediation plan is not considered to have potential to fail unless project design and construction works are significantly varied, which would require submission of a revised RAP at that time. As such a contingency plan is not considered to be required.

It is noted however, that differing options chosen to facilitate the excavation and disposal of soils and groundwater may indeed have different economic implications which will require consideration.

6.7 INTERIM SITE MANAGEMENT PLAN (BEFORE REMEDIATION)

The current site status is not considered to pose a risk to current site receptors and the development of an interim site management plan is not considered to be required.

6.8 SITE MANAGEMENT PLAN (OPERATION PHASE)

A site management plan will need to be developed by the nominated principal development contractor and/or remediation contractor in consultation with NCC prior to the commencement of any on site works and should, as a minimum provide consideration to the following points raised by RCA.

- Groundwater Management -
    - Any groundwater pumped from site and/or any subsurface seepage and/or accumulated excavation waters will need to be assessed and characterised prior to disposal as determined in consultation with the relevant parties (ie, dewatering specialist and Hunter Water Corporation).
- Soil Management -
    - Prevent run-off impacts to/from soil stockpiles by use of appropriate bunding, plastic sheeting base and covers as required.

        - Particular consideration to stockpiled fill materials with obvious contamination impacts, especially hydrocarbon impacts and un-treated potential acid generating alluvial materials.
    - Prevent dust impacts from stockpiles by covering with plastic sheeting, mesh cloth or otherwise, as required.
        - Particular consideration to stockpiled fill materials which contain construction and demolition waste and contain potential asbestos impacts.
    - Prevent dust impacts during excavation works through the application of appropriate dust suppression techniques.
    - Ensure delineation and separation of like materials.
        - Stockpiled materials to be clearly and adequately labelled.
        - Supported by comprehensive material tracking records.
- Surface Water Management -
    - Prevent surface water from entering the proposed excavation works to the extent practical.
    - Prevent run-off impacts to/from soil stockpiles by use of appropriate bunding, plastic sheeting base and covers as required.
- Odour Control investigations to date consider it unlikely that any significant odour issues will be associated with the proposed works.
    - Any landfarming works which may be required would have the potential to generate odours.
    - If odours are generated site works should cease until the odours can be reduced or controlled, with particular consideration to prevailing weather conditions.
- Noise Control -
    - Increased noise levels may result from the use of additional mechanical equipment on the site during the course of the project.
    - All works must comply with DECC 2009 Interim Construction Noise Guideline and "offensive noise" as defined under the Protection of the Environment Operations Act, 1997 is to be avoided.
- Occupation Health and Safety -
    - All work associated with the remediation of the site should conform at a minimum, to the requirements of the NSW Work Health and Safety Act 2011 and associated regulations with particular consideration to:
        - Potential arsenic impacted groundwater.
        - Potential asbestos impacted fills.
        - Potential hydrocarbon, PAH (including B(a)P) and metals (including lead and zinc) contamination in fill materials and upper alluvial materials.
        - Potential acid generating alluvial soils.
        - Safety around excavations, including working at heights.

- Appropriate personal protective equipment (PPE) to be used at the site.

6.9 HOURS OF OPERATION

It is anticipated that hours of work would be stipulated by Newcastle City Council within development approval documentation.

6.10 EMERGENCY AND INCIDENT RESPONSE PLAN

It is considered that an emergency and incident response plan should be incorporated into the SMP which outlines contingencies to prevent potential effects on the surrounding environment and community. Potential issues which may have potential to affect the surrounding environment and community and require contingencies include, but are not limited to the following:

- Excessive noise generation.
- Excessive dust generation.
- Excessive odour generation.
- Excessive traffic to and from the site.
- Compromised structural integrity of the neighbouring properties (requirement for dilapidation surveys).

6.11 IDENTIFICATION OF REGULATORY COMPLIANCE REQUIREMENTS SUCH AS LICENSES AND APPROVALS

RCA has conducted a review of the requirements for licensing of the proposed works under the terms of State Environmental Planning Policy No. 55 (SEPP 55). SEPP 55 provides state wide planning controls for the remediation of contaminated land. Under the provisions of SEPP 55, *"land must not be developed if it is not suitable for a proposed use owing to contamination and must be remediated prior to development".* The site is currently zoned as B4 – Mixed Use Zoning and the proposed land use is as a multi-storey mixed use commercial and residential development.

Under the requirements of SEPP 55, remediation work is classified as either:

- Category 1: remediation work for which development consent is required; or
- Category 2: remediation work not requiring development consent.

Category 1 remediation work, for which development consent is required includes:

- Work which is designated development under Schedule 3 of the Environmental Planning and Assessment (EP&A) Regulation or under a planning instrument.
- Work proposed on land identified as critical habitat under the Threatened Species Conservation Act 1995.
- Works where consideration of s.5A of the EP&A Act indicates that remediation work is likely to have a significant effect on threatened species, populations, ecological communities or their habitats.
- Works proposed in an area or zone identified in a planning instrument as being an area of environmental significance such as scenic areas, wetlands.
- Remediation works requires consent under another SEPP or a regional environmental plan.

The proposed remediation works are considered to fall into Category 2 remediation given that none of the triggers listed in the SEPP 55 apply for the site. This has been supported by review of the information present on the Section 149 Certificate for the site. Category 2 remediation work does not require development consent.

As a requirement of Category 2 remedial works, the remediation contractor should give Newcastle City Council a minimum of 30 days written notice prior to commencement of remedial works as per the SEPP 55.

It is also anticipated that a licence from the NSW Office of water would be required for groundwater interception and dewatering requirements for the site and a trade water approval from Hunter Water Corporation will be required for the disposal of groundwater to sewer.

6.12 KEY PERSONNEL CONTACT DETAILS DURING REMEDIATION

Key site contacts will be required to be developed as part of the SMP prior to works commencing on site.

6.13 COMMUNITY RELATIONS

It is considered that the proposed development will not have a significant impact on the general public during construction works, however there is potential for access issue to apply to the adjacent residential development. It is recommended that a strategy or plan be developed to ensure access is maintained for adjacent residential properties and for the handling of any community complaints with regards to site activities.

6.14 STAGE PROGRESS REPORTING

It is considered that progress reporting should be considered for the remediation works due to several sensitive issues, such as potential impacts to adjacent residential developments, ingress of groundwater, treatment of ASS and disposal of site soils to a suitably licensed facility.

6.15 LONG-TERM MANAGEMENT PLAN

Based on the existing data and understanding of site conditions a Long-term Environmental Management Plan for the site is not considered to be required following implementation of the proposed remediation strategy.

7 CONCLUSION AND RECOMMENDATIONS

RCA has undertaken a Phase 1 and Phase 2 assessment at the site which has identified the following contamination:

- TRH impacts in shallow soils in an area of oil staining in a localised area along the outside of the southern wall of the existing structure.
- Areas of PAH, lead and zinc within the fill material present on the site.
- Asbestos building materials present within the existing structure, banded asbestos fragments in a number of surface soil locations across the site and a fragment of bonded asbestos located at a depth of 0.4m in location BH6.
- Acid sulfate soil present in the underlying natural soil profile extending beyond the required depth of excavation.

- Elevated concentrations of arsenic and zinc in the groundwater of the site.

It has been assumed that the presence of chemical contamination is limited to the fill profile material of the site with the presence of asbestos likely limited to areas of fill where construction and demolition waste are present. It has also been assumed that ASS is present within all underlying natural soil at the site and will require treatment prior to classification for off site disposal.

Uncertainties remain at the site with the data available for site characterisation being limited to the existing sample locations. There remains a significant portion of the site which is not considered to be suitably assessed due to the existing structure, however it is noted that some sample locations were able to be placed within the existing structure to provide an indication of any potential contaminants present.

Given the nature of the development requiring the removal of significant quantities of soil from the site, it is considered that any contamination present at the site would be able to be classified appropriately and removed from the site to a suitably licensed facility. The removal of soil from the site will also include underlying ASS, which is noted to require treatment prior to classification for off site disposal, will require management in order to achieve, as excavation works are proposed to extend below the water table.

The proposed development will also require the off site disposal of groundwater, however without appropriate measures being adopted at the site, the potential drawdown of the groundwater table has potential to cause ingress of contaminated groundwater (if present) from neighbouring properties therefore must be managed during site works.

Following remediation works which are described in this report to remove the contamination present, RCA considers the site would be suitable for the proposed development with regards to the contamination present, however it is noted that there are likely to be other development constraints which do not fall under the jurisdiction of the RAP such as the structural integrity of excavation works, foundation design for the proposed development due to potential mine subsidence and maintenance of access to the neighbouring residential property.

8 LIMITATIONS

This report has been prepared for ADW Johnson on behalf of 22A Park Avenue Pty Ltd in accordance with an agreement with RCA. The services performed by RCA have been conducted in a manner consistent with that generally exercised by members of its profession and consulting practice.

This report has been prepared for the sole use of 22A Park Avenue Pty Ltd and Newcastle City Council. The report may not contain sufficient information for purposes of other uses or for parties other than 22A Park Avenue Pty Ltd and Newcastle City Council. This report shall only be presented in full and may not be used to support objectives other than those stated in the report without written permission from RCA Australia.

The information in this report is considered accurate at the date of issue with regard to the current conditions of the site. Conditions can vary across any site that cannot be explicitly defined by investigation.

Environmental conditions including contaminant concentrations can change in a limited period of time. This should be considered if the report is used following a significant period of time after the date of issue.

Yours faithfully
RCA AUSTRALIA

Craig Handebo
Senior Environmental Engineer

Denton Mauldin
Manager Environmental Services

Matthew Clark
Associate Environmental Scientist

REFERENCES

[1] RCA Australia, *Phase 1 Environmental Site Assessment*, March 2016.

[2] NSW Government, *Newcastle Coalfield Regional Geology Map*.

[3] NSW Government (Department of Natural Resources), *Acid Sulfate Soil Risk Map*, Edition 2 - Newcastle, December 1997.

[4] RCA Australia, *Phase 2 Environmental Site Assessment*, October 2016.

[5] NEPC, *National Environment Protection (Assessment of Site Contamination) Measure*, 1999 as amended 2013.

[6] DECC, *Waste Classification Guidelines*, *Part 1; Classifying Waste*, December 2009.

[7] National Health and Medical Research Council, *Australian Drinking Water Guidelines*, 2011.

[8] ANZECC, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, October 2000.

[9] RCA Australia, *Acid Sulfate Soil Management Plan*, November 2016.

[10] CRC Care, *Technical Report 10, Health screening levels for petroleum in soil and groundwater*, September 2011.

[11] DECC, *Contaminated Sites – Guidelines for the Assessment and Management of Contaminated Groundwater*, March 2007.

GLOSSARY

95%UCL_{ave}	A statistical calculation – 95% Upper Confidence Limit of the arithmetic mean of the data set.
AHD	Australian height datum, based on a mean sea level.
ANZECC	Australian and New Zealand Environmental Conservation Council.
EIL	Ecological investigation level. Relates to soil concentrations which may pose a risk to ecological health.
EMP	Environmental management plan.
ESL	Ecological screening level. Relates to vapour risk from petroleum hydrocarbons which may pose a risk to ecological health.
GIL	Groundwater investigation levels.
HIL	Health investigation level. Relates to soil concentrations which may pose a risk to human health in soil.
Hotspot	A sample, or location, where contaminant concentrations exceed 250% of the appropriate criterion.
HSL	Health screening level. Relates to the vapour risk from petroleum hydrocarbons which may pose a risk to human health in soil. Also relates to exposure to asbestos fibres.
In-Situ	In place, without excavation.

ISL	Investigation screening levels for soil. Comprised of HIL/EIL and HSL/ESL
LEP	Local environment plan. A planning tool for the Local Government.
NEPM	National Environment Protection Measure.
Surfactant	A natural or synthetic chemical that promotes the wetting, solubilisation, and emulsification of various types or organic chemicals.

Chemical Compounds

BTEX	Benzene, toluene, ethylbenzene, xylene.
PAH	Polycyclic aromatic hydrocarbons. Multi-ring compounds found in fuels, oils and creosote. These are also common combustion products.
PCB	Poly chlorinated biphenyls.
Phenol	Carbolic acid (C_6H_5OH). Phenols and substituted phenols are used as anti-microbial agents in high concentrations.
TPH	Total petroleum hydrocarbons.
TRH	Total recoverable hydrocarbons

Appendix A

Drawings

Locality Plan
N.T.S.

LEGEND

- Approximate boundary location
- Potential access issues for adjacent resident
- Approximate borehole location
- Approximate borehole with monitoring well
- Approximate asbestos fragment sample location
- Approximate location of concrete sump and oily water separator

Aerial image taken from Nearmap, November 20 2015

0 10 20 30 40
metres

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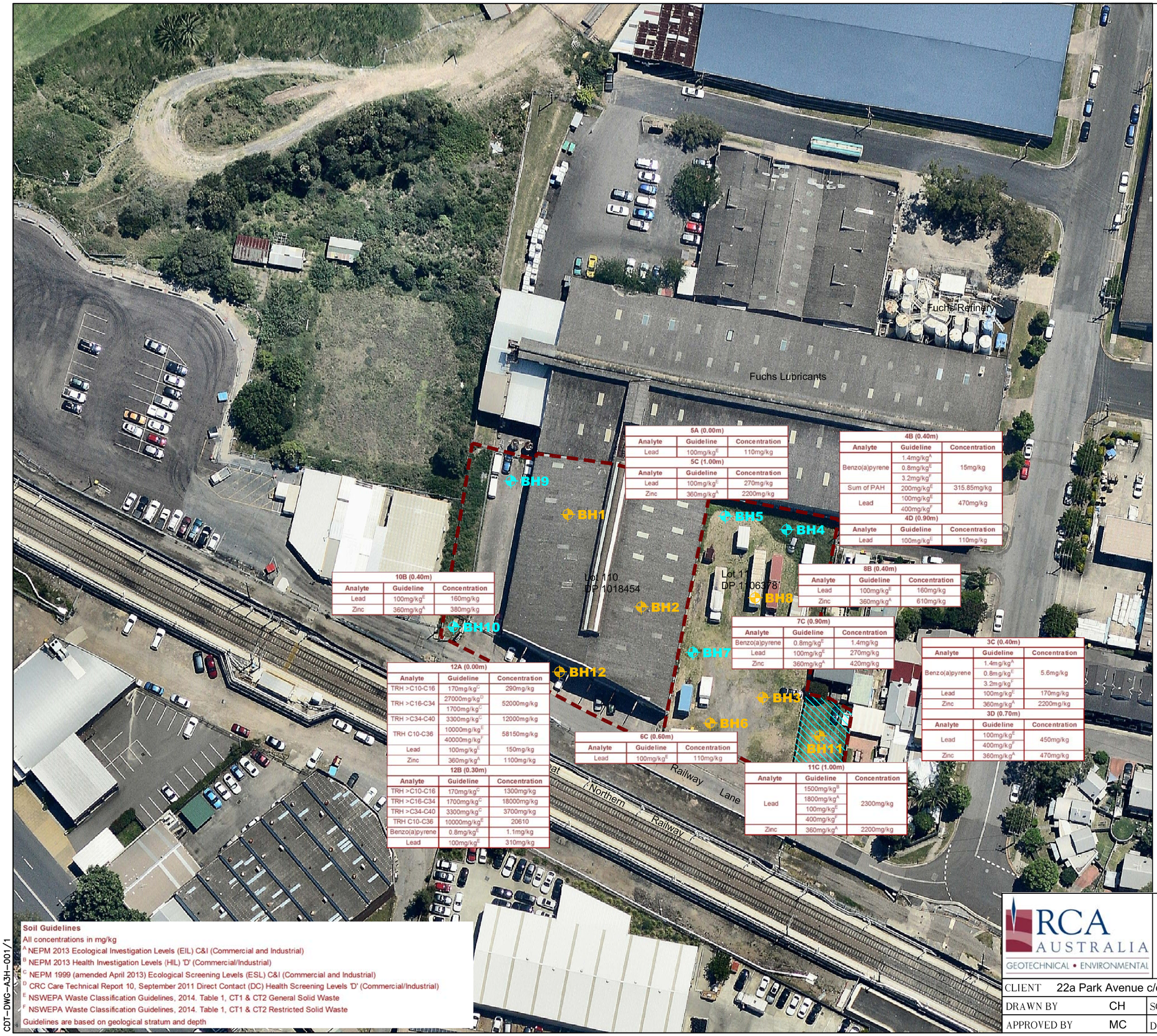
SITE AND SAMPLE LOCATION PLAN
REMEDIAL ACTION PLAN
73 AND 79 RAILWAY LANE
WICKHAM

CLIENT	22a Park Avenue c/o ADW Johnson			RCA Ref	12101b-301/1
DRAWN BY	CH	SCALE	1 : 800 (A3)	DRAWING No 1	REV 0
APPROVED BY	MC	DATE	18/11/2016	OFFICE	NEWCASTLE

CDT-DWG-A3H-001/1



5A (0.00m)		
Analyte	Guideline	Concentration
Lead	100mg/kg[E]	110mg/kg
5C (1.00m)		
Analyte	Guideline	Concentration
Lead	100mg/kg[E]	270mg/kg
Zinc	360mg/kg[A]	2200mg/kg

4B (0.40m)		
Analyte	Guideline	Concentration
Benzo(a)pyrene	1.4mg/kg[A]	15mg/kg
	0.8mg/kg[E]	
	3.2mg/kg[F]	
Sum of PAH	200mg/kg[E]	315.85mg/kg
Lead	100mg/kg[E]	470mg/kg
	400mg/kg[F]	
4D (0.90m)		
Analyte	Guideline	Concentration
Lead	100mg/kg[E]	110mg/kg

10B (0.40m)		
Analyte	Guideline	Concentration
Lead	100mg/kg[E]	160mg/kg
Zinc	360mg/kg[A]	380mg/kg

8B (0.40m)		
Analyte	Guideline	Concentration
Lead	100mg/kg[E]	160mg/kg
Zinc	360mg/kg[A]	610mg/kg

7C (0.90m)		
Analyte	Guideline	Concentration
Benzo(a)pyrene	0.8mg/kg[E]	1.4mg/kg
Lead	100mg/kg[E]	270mg/kg
Zinc	360mg/kg[A]	420mg/kg

3C (0.40m)		
Analyte	Guideline	Concentration
Benzo(a)pyrene	1.4mg/kg[A]	5.6mg/kg
	0.8mg/kg[E]	
	3.2mg/kg[F]	
Lead	100mg/kg[E]	170mg/kg
Zinc	360mg/kg[A]	2200mg/kg
3D (0.70m)		
Analyte	Guideline	Concentration
Lead	100mg/kg[E]	450mg/kg
	400mg/kg[F]	
Zinc	360mg/kg[A]	470mg/kg

12A (0.00m)		
Analyte	Guideline	Concentration
TRH >C10-C16	170mg/kg[C]	290mg/kg
TRH >C16-C34	27000mg/kg[D]	52000mg/kg
	1700mg/kg[C]	
TRH >C34-C40	3300mg/kg[C]	12000mg/kg
TRH C10-C36	10000mg/kg[E]	58150mg/kg
	40000mg/kg[F]	
Lead	100mg/kg[E]	150mg/kg
Zinc	360mg/kg[A]	1100mg/kg
12B (0.30m)		
Analyte	Guideline	Concentration
TRH >C10-C16	170mg/kg[C]	1300mg/kg
TRH >C16-C34	1700mg/kg[C]	18000mg/kg
TRH >C34-C40	3300mg/kg[C]	3700mg/kg
TRH C10-C36	10000mg/kg[E]	20610
Benzo(a)pyrene	0.8mg/kg[E]	1.1mg/kg
Lead	100mg/kg[E]	310mg/kg

6C (0.60m)		
Analyte	Guideline	Concentration
Lead	100mg/kg[E]	110mg/kg

11C (1.00m)		
Analyte	Guideline	Concentration
Lead	1500mg/kg[B]	2300mg/kg
	1800mg/kg[A]	
	100mg/kg[E]	
	400mg/kg[F]	
Zinc	360mg/kg[A]	2200mg/kg

Soil Guidelines

All concentrations in mg/kg

[A] NEPM 2013 Ecological Investigation Levels (EIL) C&I (Commercial and Industrial)

[B] NEPM 2013 Health Investigation Levels (HIL) 'D' (Commercial/Industrial)

[C] NEPM 1999 (amended April 2013) Ecological Screening Levels (ESL) C&I (Commercial and Industrial)

[D] CRC Care Technical Report 10, September 2011 Direct Contact (DC) Health Screening Levels 'D' (Commercial/Industrial)

[E] NSWEPA Waste Classification Guidelines, 2014. Table 1, CT1 & CT2 General Solid Waste

[F] NSWEPA Waste Classification Guidelines, 2014. Table 1, CT1 & CT2 Restricted Solid Waste

Guidelines are based on geological stratum and depth

LEGEND

- Approximate boundary location
- Potential access issues for adjacent resident
- Approximate borehole location
- Approximate borehole with monitoring well

Aerial image taken from Nearmap, November 20 2015

0 10 20 30 40
metres

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SOIL GUIDELINE EXCEEDENCES REMEDIAL ACTION PLAN 73 AND 79 RAILWAY LANE WICKHAM

CLIENT	22a Park Avenue c/o ADW Johnson			RCA Ref	12101b-301/1
DRAWN BY	CH	SCALE	1 : 800 (A3)	DRAWING No 2	REV 0
APPROVED BY	MC	DATE	18/11/2016	OFFICE	NEWCASTLE

CDT-DWG-A3H-001/1

LEGEND

- Approximate boundary location
- Potential access issues for adjacent resident
- Approximate borehole with monitoring well
- Area observed to contain installed groundwater monitoring wells

Aerial image taken from Nearmap, November 20 2015

0 10 20 30 40
metres

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GROUNDWATER GUIDELINE EXCEEDENCES REMEDIAL ACTION PLAN 73 AND 79 RAILWAY LANE WICKHAM

CLIENT	22a Park Avenue c/o ADW Johnson			RCA Ref	12101b-301/1
DRAWN BY	CH	SCALE	1 : 800 (A3)	DRAWING No 3	REV 0
APPROVED BY	MC	DATE	18/11/2016	OFFICE	NEWCASTLE

CDT-DWG-A3H-001/1

Appendix B

Summary of Previous Results

Sample Identification	PQL	Guideline [A]							1B	2A	2B	2D	3A	3B	3C	3D	4B	4D
Sample Depth (m) [B]		HSL 'D'				ESL C&I	Non-sensitive ML	DC D	0.30	0.15	0.30	1.80	0.00	0.20	0.40	0.70	0.40	0.90
Date		SAND 0-<1m	SAND 1-<2m	SAND 2-<4m	SAND >4m	Coarse	Coarse		15/9/16	15/9/16	15/9/16	15/9/16	15/9/16	15/9/16	15/9/16	15/9/16	15/9/16	15/9/16
Sample Profile									FILL; Clayey Sand and Gravel (C&D waste including brick fragments), dark brown.	FILL; Construction Sand, pale brown/yellow.	FILL; Clayey Sand and Gravel (C&D waste including brick fragments, slag), dark brown.	Sandy Clayey SILT; some organics, dark brown.	FILL; Sandy Gravel, orange brown.	FILL; Silty Sandy Gravel (C&D waste including brick fragments), grey/brown.	FILL; Silty Sandy Gravel (C&D waste including brick fragments), grey/brown.	FILL; Silty Sandy Clay/Clayey Sand with some Gravel and potential coal/ash products, black.	FILL; Clayey Silty Sand with some Gravel (C&D waste including brick fragments), dark brown.	Silty SAND, pale grey/brown.
Dominant Stratum [C]									Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand
Laboratory Report Reference									516561	516561	516561	516561	516561	516561	516561	516561	516561	516561
Laboratory Sample Reference									S16-Se19185	S16-Se19186	S16-Se19297	S16-Se19298	S16-Se19187	S16-Se19188	S16-Se19189	S16-Se19190	S16-Se19192	S16-Se19193
Sample Purpose									Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation
Sample collected by									CH	CH	CH	CH	CH	CH	CH	CH	CH	CH
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)																		
Benzene	0.1	3	3	3	3	75		430	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	0.1	NL	NL	NL	NL	135		99000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	0.1	NL	NL	NL	NL	165		27000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
meta- and para-Xylene	0.2								<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
ortho-Xylene	0.1								<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Xylenes	0.3	230	NL	NL	NL	180		81000	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Polycyclic Aromatic Hydrocarbons (PAH)																		
Naphthalene	0.5	NL	NL	NL	NL	370		11000	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.5	<0.5
Total Recoverable Hydrocarbons (TRH)																		
TRH C_6-C_{10}	20						700	26000	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
TRH >C_{10}-C_{16}	50					170	1000	20000	<50	<50	<50	<50	<50	<50	<50	160	170	<50
TRH >C_{16}-C_{34}	100					1700	3500	27000	<100	<100	<100	200	170	<100	240	790	1100	110
TRH >C_{34}-C_{40}	100					3300	10000	38000	<100	<100	<100	<100	250	<100	<100	170	120	<100
F1	20	260	370	630	NL	215			<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
F2	50	NL	NL	NL	NL				<50	<50	<50	<50	<50	<50	<50	159.75	166.5	<50

All results are in units of mg/kg.

Blank Cell indicates no criterion available

PQL = Practical Quantitation Limit. Where PQL is for a summation, PQL of all components is summed and may be different from that presented by laboratory

F1 = TRH C_6-C_{10} minus BTEX. F1 PQL deemed equal TRH C_6-C_{10}.

F2 = TRH >C_{10}-C_{16} minus naphthalene. F2 PQL deemed = TRH >C_{10}-C_{16}.

[A] NEPM 1999 (amended April 2013) Vapour Based Health Screening Levels (HSL)'D' (Commercial/Industrial)

[A] NEPM 1999 (amended April 2013) Ecological Screening Levels (ESL) C&I (Commercial and Industrial)

[A] NEPM 1999 (amended April 2013) Management Limits (ML) Non-Sensitive Sites (Commercial and Industrial)

[A] CRC Care Technical Report 10, September 2011 Direct Contact (DC) Health Screening Levels 'D' (Commercial/Industrial)

[B] Start of sample, generally over a 0.1m interval, refer to logs for further details

[C] Note that this is a generalisation for the purpose of comparing to the HSL criteria. Where two strata equally represented, most conservative criterion used

NL designates 'Not Limiting' indicating that the pore water concentration required to constitute a vapour risk is higher than the solubility capacity for that compound based on a petroleum mixture. Vapour is therefore not a risk for this compound.

Results for TRH have been compared to TPH guidelines.

Presented ESL for naphthalene is an Ecological Investigation Level

For the purpose of the Tier 1 ESL/EIL assessment, all background concentrations are assumed to be zero

ESL for TRH >C_{16}-C_{34} and >C_{34}-C_{40} are low reliability

Results shown in **BOLD** are in excess of the vapour based HSL

Results shown in shading are >250% of the vapour based HSL

Results shown in underline are in excess of the ESL

Results shown in *italics* are in excess of the management limit

Results shown in patterned cells are in excess of the direct contact HSL

Where summation required (Xylene, F1, F2) calculation includes components reported as non detected as 1/2 PQL.

Sample Identification	PQL	Guideline [A]							4E	4F	5A	5C	5D	5G	6A	6C	6E	7B	7C
Sample Depth (m) [B]		HSL 'D'				ESL C&I	Non-sensitive ML	DC D	2.00	3.00	0.00	1.00	1.40	4.40	0.00	0.60	1.50	0.40	0.90
Date		SAND 0-<1m	SAND 1-<2m	SAND 2-<4m	SAND >4m	Coarse	Coarse		15/9/16	15/9/16	15/9/16	15/9/16	15/9/16	15/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16
Sample Profile									Silty SAND, pale grey/brown.	Silty SAND, pale grey/brown.	FILL; Sandy Silty Clay with some gravel and organics/ rootlets, grey and orange brown.	Silty SAND, pale grey/brown.	Silty SAND, pale grey/brown.	Silty SAND, pale grey/brown.	FILL; Silty Sand and Gravel (C&D waste including brick fragments and fibre cement fragments), brown.	FILL; Silty Sand, brown.	Silty SAND, pale grey/brown.	FILL; Silty Sand and some Gravel (C&D waste including brick fragments), d/brown.	FILL; Silty Sand and some Gravel (C&D waste including brick fragments and potential coal/ash products), d/brown.
Dominant Stratum [C]									Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand
Laboratory Report Reference									516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561
Laboratory Sample Reference									S16-Se19194	S16-Se19195	S16-Se19196	S16-Se19197	S16-Se19198	S16-Se19199	S16-Se19200	S16-Se19202	S16-Se19203	S16-Se19205	S16-Se19206
Sample Purpose									Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation
Sample collected by									CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)																			
Benzene	0.1	3	3	3	3	75		430	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	0.1	NL	NL	NL	NL	135		99000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	0.1	NL	NL	NL	NL	165		27000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
meta- and para-Xylene	0.2								<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
ortho-Xylene	0.1								<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Xylenes	0.3	230	NL	NL	NL	180		81000	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Polycyclic Aromatic Hydrocarbons (PAH)																			
Naphthalene	0.5	NL	NL	NL	NL	370		11000	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Recoverable Hydrocarbons (TRH)																			
TRH C_6-C_{10}	20						700	26000	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
TRH >C_{10}-C_{16}	50					170	1000	20000	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	60
TRH >C_{16}-C_{34}	100					1700	3500	27000	<100	<100	120	180	<100	<100	<100	<100	100	<100	390
TRH >C_{34}-C_{40}	100					3300	10000	38000	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
F1	20	260	370	630	NL	215			<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
F2	50	NL	NL	NL	NL				<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	59.75

All results are in units of mg/kg.
Blank Cell indicates no criterion available
PQL = Practical Quantitation Limit. Where PQL is for a summation, PQL of all components is summed and may be different from that pres
F1 = TRH C_6-C_{10} minus BTEX. F1 PQL deemed equal TRH C_6-C_{10}.
F2 = TRH >C_{10}-C_{16} minus naphthalene. F2 PQL deemed = TRH >C_{10}-C_{16}.
[A] NEPM 1999 (amended April 2013) Vapour Based Health Screening Levels (HSL)'D' (Commercial/Industrial)
[A] NEPM 1999 (amended April 2013) Ecological Screening Levels (ESL) C&I (Commercial and Industrial)
[A] NEPM 1999 (amended April 2013) Management Limits (ML) Non-Sensitive Sites (Commercial and Industrial)
[A] CRC Care Technical Report 10, September 2011 Direct Contact (DC) Health Screening Levels 'D' (Commercial/Industrial)
[B] Start of sample, generally over a 0.1m interval, refer to logs for further details
[C] Note that this is a generalisation for the purpose of comparing to the HSL criteria. Where two strata equally represented, most conservati
NL designates 'Not Limiting' indicating that the pore water concentration required to constitute a vapour risk is higher than the solubility cap
Results for TRH have been compared to TPH guidelines.
Presented ESL for naphthalene is an Ecological Investigation Level
For the purpose of the Tier 1 ESL/EIL assessment, all background concentrations are assumed to be zero
ESL for TRH >C_{16}-C_{34} and >C_{34}-C_{40} are low reliability
Results shown in **BOLD** are in excess of the vapour based HSL
Results shown in shading are >250% of the vapour based HSL
Results shown in underline are in excess of the ESL
Results shown in *italics* are in excess of the management limit
Results shown in patterned cells are in excess of the direct contact HSL
Where summation required (Xylene, F1, F2) calculation includes components reported as non detected as 1/2 PQL.

Sample Identification	PQL	Guideline [A]							7E	7D	8A	8B	8C	8D	9A	9B	9C	9D	9F
Sample Depth (m) [B]		HSL 'D'				ESL C&I	Non-sensitive ML	DC D	2.40	1.50	0.00	0.40	1.00	2.40	0.10	0.50	1.00	1.40	3.00
Date		SAND 0-<1m	SAND 1-<2m	SAND 2-<4m	SAND >4m	Coarse	Coarse		16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16
Sample Profile									Silty SAND, pale grey/brown.	Silty SAND, pale grey/brown.	FILL; Silty Sand and some Gravel (C&D waste including brick fragments and potential coal/ash products), d/brown.	FILL; Silty Sand and some Gravel (C&D waste including brick fragments and potential coal/ash products), d/brown.	Silty SAND, pale grey/brown.	Silty SAND, pale grey/brown.	FILL; Clayey Sandy Gravel (Roadbase), brown.	FILL; Clayey Gravelly Sand with some Gravel (C&D waste including brick fragments, malleable sheet metal/metal pipe material) and some organics, brown.	FILL; Gravelly Silty Sand with potential trace of coal, dark brown.	Sandy Clayey SILT; dark brown/brown.	Silty SAND, pale grey/brown.
Dominant Stratum [C]									Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand
Laboratory Report Reference									516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561
Laboratory Sample Reference									S16-Se19207	S16-Se19208	S16-Se19209	S16-Se19210	S16-Se19211	S16-Se19212	S16-Se19213	S16-Se19214	S16-Se19215	S16-Se19216	S16-Se19217
Sample Purpose									Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation
Sample collected by									CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)																			
Benzene	0.1	3	3	3	3	75		430	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	0.1	NL	NL	NL	NL	135		99000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	0.1	NL	NL	NL	NL	165		27000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
meta- and para-Xylene	0.2								<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
ortho-Xylene	0.1								<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Xylenes	0.3	230	NL	NL	NL	180		81000	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Polycyclic Aromatic Hydrocarbons (PAH)																			
Naphthalene	0.5	NL	NL	NL	NL	370		11000	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.6	<0.5	<0.5	<0.5	<0.5
Total Recoverable Hydrocarbons (TRH)																			
TRH C_6-C_{10}	20						700	26000	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
TRH >C_{10}-C_{16}	50					170	1000	20000	<50	<50	62	<50	<50	<50	95	<50	<50	<50	<50
TRH >C_{16}-C_{34}	100					1700	3500	27000	<100	120	260	130	<100	<100	1500	530	<100	<100	<100
TRH >C_{34}-C_{40}	100					3300	10000	38000	<100	<100	<100	<100	<100	<100	200	<100	<100	<100	<100
F1	20	260	370	630	NL	215			<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
F2	50	NL	NL	NL	NL				<50	<50	61.75	<50	<50	<50	93.4	<50	<50	<50	<50

All results are in units of mg/kg.
Blank Cell indicates no criterion available
PQL = Practical Quantitation Limit. Where PQL is for a summation, PQL of all components is summed and may be different from that pres
F1 = TRH C_6-C_{10} minus BTEX. F1 PQL deemed equal TRH C_6-C_{10}.
F2 = TRH >C_{10}-C_{16} minus naphthalene. F2 PQL deemed = TRH >C_{10}-C_{16}.
[A] NEPM 1999 (amended April 2013) Vapour Based Health Screening Levels (HSL)'D' (Commercial/Industrial)
[A] NEPM 1999 (amended April 2013) Ecological Screening Levels (ESL) C&I (Commercial and Industrial)
[A] NEPM 1999 (amended April 2013) Management Limits (ML) Non-Sensitive Sites (Commercial and Industrial)
[A] CRC Care Technical Report 10, September 2011 Direct Contact (DC) Health Screening Levels 'D' (Commercial/Industrial)
[B] Start of sample, generally over a 0.1m interval, refer to logs for further details
[C] Note that this is a generalisation for the purpose of comparing to the HSL criteria. Where two strata equally represented, most conservati
NL designates 'Not Limiting' indicating that the pore water concentration required to constitute a vapour risk is higher than the solubility cap
Results for TRH have been compared to TPH guidelines.
Presented ESL for naphthalene is an Ecological Investigation Level
For the purpose of the Tier 1 ESL/EIL assessment, all background concentrations are assumed to be zero
ESL for TRH >C_{16}-C_{34} and >C_{34}-C_{40} are low reliability
Results shown in **BOLD** are in excess of the vapour based HSL
Results shown in shading are >250% of the vapour based HSL
Results shown in underline are in excess of the ESL
Results shown in *italics* are in excess of the management limit
Results shown in patterned cells are in excess of the direct contact HSL
Where summation required (Xylene, F1, F2) calculation includes components reported as non detected as 1/2 PQL.

Sample Identification	PQL	Guideline [A]							10A	10B	10D	11A	11B	11C	12A	12B
Sample Depth (m) [B]		HSL 'D'				ESL C&I	Non-sensitive ML	DC D	0.00	0.40	1.90	0.00	0.50	1.00	0.00	0.30
Date		SAND 0-<1m	SAND 1-<2m	SAND 2-<4m	SAND >4m	Coarse	Coarse		16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16
Sample Profile									FILL; Silty Clayey Sand with some Gravel, brown.	Silty SAND, grey.	Silty SAND, pale brown.	FILL; Silty Sandy Gravel (C&D waste including brick fragments), orange brown.	FILL; Silty Sand (Construction), pale brown.	FILL; Gravelly Clayey Sand, dark brown.	FILL; Silty Sand and Gravel (C&D waste including brick fragments and metal), Significant oil/hydrocarbon stained with strong odour, dark brown.	FILL; Clayey Sand with some gravel (C&D waste including brick fragments), dark brown.
Dominant Stratum [C]									Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand
Laboratory Report Reference									516561	516561	516561	516561	516561	516561	516561	516561
Laboratory Sample Reference									S16-Se19218	S16-Se19219	S16-Se19220	S16-Se19221	S16-Se19222	S16-Se19223	S16-Se19224	S16-Se19225
Sample Purpose									Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation
Sample collected by									CH	CH	CH	CH	CH	CH	CH	CH
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)																
Benzene	0.1	3	3	3	3	75		430	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	0.1	NL	NL	NL	NL	135		99000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	0.1	NL	NL	NL	NL	165		27000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
meta- and para-Xylene	0.2								<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
ortho-Xylene	0.1								<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Xylenes	0.3	230	NL	NL	NL	180		81000	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Polycyclic Aromatic Hydrocarbons (PAH)																
Naphthalene	0.5	NL	NL	NL	NL	370		11000	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Recoverable Hydrocarbons (TRH)																
TRH C_6-C_{10}	20						700	26000	<20	<20	<20	<20	<20	<20	<20	<20
TRH >C_{10}-C_{16}	50					170	1000	20000	<50	<50	<50	<50	<50	68	290	*1300*
TRH >C_{16}-C_{34}	100					1700	3500	27000	220	<100	<100	110	<100	370	*52000*	*18000*
TRH >C_{34}-C_{40}	100					3300	10000	38000	<100	<100	<100	<100	<100	<100	*12000*	3700
F1	20	260	370	630	NL	215			<20	<20	<20	<20	<20	<20	<20	<20
F2	50	NL	NL	NL	NL				<50	<50	<50	<50	<50	67.75	289.75	1299.75

All results are in units of mg/kg.
Blank Cell indicates no criterion available
PQL = Practical Quantitation Limit. Where PQL is for a summation, PQL of all components is summed and may be different from that pres
F1 = TRH C_6-C_{10} minus BTEX. F1 PQL deemed equal TRH C_6-C_{10}.
F2 = TRH >C_{10}-C_{16} minus naphthalene. F2 PQL deemed = TRH >C_{10}-C_{16}.
[A] NEPM 1999 (amended April 2013) Vapour Based Health Screening Levels (HSL)'D' (Commercial/Industrial)
[A] NEPM 1999 (amended April 2013) Ecological Screening Levels (ESL) C&I (Commercial and Industrial)
[A] NEPM 1999 (amended April 2013) Management Limits (ML) Non-Sensitive Sites (Commercial and Industrial)
[A] CRC Care Technical Report 10, September 2011 Direct Contact (DC) Health Screening Levels 'D' (Commercial/Industrial)
[B] Start of sample, generally over a 0.1m interval, refer to logs for further details
[C] Note that this is a generalisation for the purpose of comparing to the HSL criteria. Where two strata equally represented, most conservati
NL designates 'Not Limiting' indicating that the pore water concentration required to constitute a vapour risk is higher than the solubility cap
Results for TRH have been compared to TPH guidelines.
Presented ESL for naphthalene is an Ecological Investigation Level
For the purpose of the Tier 1 ESL/EIL assessment, all background concentrations are assumed to be zero
ESL for TRH >C_{16}-C_{34} and >C_{34}-C_{40} are low reliability
Results shown in **BOLD** are in excess of the vapour based HSL
Results shown in shading are >250% of the vapour based HSL
Results shown in underline are in excess of the ESL
Results shown in *italics* are in excess of the management limit
Results shown in patterned cells are in excess of the direct contact HSL
Where summation required (Xylene, F1, F2) calculation includes components reported as non detected as 1/2 PQL.

Sample Identification	PQL	Guideline [A]		1B	2A	2B	2D	3A	3B	3C	3D	4A	4B
Sample Depth (m) [B]		HIL 'D'	EIL C&I	0.30	0.15	0.30	1.80	0.00	0.20	0.40	0.70	0.00	0.40
Date				15/9/16	15/9/16	15/9/16	15/9/16	15/9/16	15/9/16	15/9/16	15/9/16	15/9/16	15/9/16
Sample Profile				FILL; Clayey Sand and Gravel (C&D waste including brick fragments), dark brown.	FILL; Construction Sand, pale brown/yellow.	FILL; Clayey Sand and Gravel (C&D waste including brick fragments, slag), dark brown.	Sandy Clayey SILT; some organics, dark brown.	FILL; Sandy Gravel, orange brown.	FILL; Silty Sandy Gravel (C&D waste including brick fragments), grey/brown.	FILL; Silty Sandy Gravel (C&D waste including brick fragments), grey/brown.	FILL; Silty Sandy Clay/Clayey Sand with some Gravel and potential coal/ash products, black.	FILL; Sandy Silty Clay with some gravel and organics, grey.	FILL; Clayey Silty Sand with some Gravel (C&D waste including brick fragments), dark brown.
Laboratory Report Reference				516561	516561	516561	516561	516561	516561	516561	516561	516561	516561
Laboratory Sample Reference				S16-Se19185	S16-Se19186	S16-Se19297	S16-Se19298	S16-Se19187	S16-Se19188	S16-Se19189	S16-Se19190	S16-Se19191	S16-Se19192
Sample Purpose				Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation
Sample collected by				CH	CH	CH	CH	CH	CH	CH	CH	CH	CH
Polycyclic Aromatic Hydrocarbons (PAH)													
Acenaphthene	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	8.5
Acenaphthylene	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	<0.5
Anthracene	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.4	<0.5	--	21
Benz(a)anthracene	0.5			<0.5	<0.5	<0.5	<0.5	0.8	0.5	5.7	1.7	--	19
Benzo(a) pyrene	0.5		1.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	5.6	0.7	--	15
Benzo(b)&(j)fluoranthene	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.4	0.5	--	12
Benzo(g,h,i)perylene	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.6	<0.5	--	7.3
Benzo(k)fluoranthene	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.8	0.6	--	13
Chrysene	0.5			<0.5	<0.5	<0.5	<0.5	0.6	<0.5	5.3	1	--	20
Dibenz(a,h)anthracene	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.1	<0.5	--	3.5
Fluoranthene	0.5			<0.5	<0.5	<0.5	<0.5	1.3	1.1	16	1.6	--	58
Fluorene	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	9
Indeno(1,2,3-c,d)pyrene	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.6	<0.5	--	7.3
Naphthalene	0.5		370	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	14
Phenanthrene	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	0.5	7.6	1.5	--	63
Pyrene	0.5			<0.5	<0.5	<0.5	<0.5	1.2	0.9	15	1.6	--	45
Carcinogenic PAH (B(a)P equivalent)	1.21	40		0.605	0.605	0.605	0.605	0.6635	0.63	8.439	1.2675	--	23.903
Sum of reported PAH	8	4000		4	4	4	4	6.9	6	73.1	11.2	--	315.85
Metals													
Arsenic	2	3000	160	2.3	<2	4.2	8	<2	<2	<2	2.1	--	<2
Cadmium	0.4	900		<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	--	<0.4
Chromium	5	3600	310	<5	<5	<5	8.6	8.7	6.7	7.1	8.9	--	9.6
Copper	5	240000	400	10	<5	6.4	37	56	7.8	15	67	--	120
Mercury	0.05	730		0.07	<0.05	<0.05	0.07	<0.05	<0.05	<0.05	0.54	--	0.18
Lead	5	1500	1800	15	<5	5.2	39	47	23	170	450	--	470
Nickel	5	6000	55	<5	<5	<5	9.5	6.6	<5	5.6	15	--	10
Zinc	5	400000	360	17	<5	25	110	68	25	150	470	--	360
Polychlorinated Biphenyls (PCB)													
Aroclor 1016	0.5			--	<0.5	--	--	<0.5	--	--	--	<0.5	--
Aroclor 1221	0.1			--	<0.1	--	--	<0.1	--	--	--	<0.1	--
Aroclor 1232	0.5			--	<0.5	--	--	<0.5	--	--	--	<0.5	--
Aroclor 1242	0.5			--	<0.5	--	--	<0.5	--	--	--	<0.5	--
Aroclor 1248	0.5			--	<0.5	--	--	<0.5	--	--	--	<0.5	--
Aroclor 1254	0.5			--	<0.5	--	--	<0.5	--	--	--	<0.5	--
Aroclor 1260	0.5			--	<0.5	--	--	<0.5	--	--	--	<0.5	--
Total PCB	3.1	50		--	1.55	--	--	1.55	--	--	--	1.55	--
Asbestos													
Detected Asbestos Weight Sample weight				--	Nil detected 74g	--	--	--	Nil detected 75g	--	--	Nil detected 67g	--

All results are in units of mg/kg, except for asbestos.

Blank Cell indicates no criterion available

PQL = Practical Quantitation Limit. Where PQL is for a summation, PQL of all components is summed and may be different from that presented by laboratory

[A] NEPM 1999 (amended April 2013) Health Investigation Levels (HIL) 'D' (Commercial/Industrial)

[A] NEPM 1999 (amended April 2013) Ecological Investigation Levels (EIL)C&I (Commercial and Industrial)

[B] Start of sample, generally over a 0.1m interval, refer to logs for further details

The Carcinogenic PAH value is calculated by multiplying the concentration of each of the 8 carcinogenic PAH compounds by its B(a)P toxic equivalence factor and summing these products.

HIL for Chromium are for Chromium VI

Presented ecological value for benzo(a)pyrene is a low reliability Ecological Screening Level

For the purpose of the Tier 1 ESL/EIL assessment, all background concentrations are assumed to be zero

EIL for Naphthalene are for fresh (<2years) Naphthalene

EIL for Arsenic are for aged (>2years) Arsenic

EIL for Chromium are the added contaminant limit for aged (>2years) Chromium III in soils of 1% clay, the most conservative of the criteria.

EIL for Copper are the added contaminant limit for aged (>2years) Copper in soils of pH 6.5.

EIL for Lead are the added contaminant limit for aged (>2years) Lead.

EIL for Nickel are the added contaminant limit for aged (>2years) Nickel in soils of 5% CEC the most conservative of the criteria.

EIL for Zinc are the added contaminant limit for aged (>2years) Zinc in soils of 5% CEC and pH of 6.5, the most conservative of the criteria at pH 6.5.

EIL for DDT are for fresh (<2years) DDT

PCB analysis includes non-Dioxin like and Dioxin-like compounds compared to a guideline of non-Dioxin like PCB

Results shown in **BOLD** are in excess of the HIL

Results shown in shading are >250% of the HIL

Results shown in underline are in excess of EIL

Where summation required (PAH, OCP, PCB) calculation includes components reported as non detected as 1/2 PQL.

* Duplicate sample concentrations used following QA assessment

**Labtoratory duplicate sample concentration used following internal QA review

4D	4E	4F	5A	5C	5D	5G	6A	6B	6C	6E	7A	7B	7C	7E
0.90	2.00	3.00	0.00	1.00	1.40	4.40	0.00	0.40	0.60	1.50	0.00	0.40	0.90	2.40
15/9/16	15/9/16	15/9/16	15/9/16	15/9/16	15/9/16	15/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16
Silty SAND, pale grey/brown.	Silty SAND, pale grey/brown.	Silty SAND, pale grey/brown.	FILL; Sandy Silty Clay with some gravel and organics/ rootlets, grey and orange brown.	Silty SAND, pale grey/brown.	Silty SAND, pale grey/brown.	Silty SAND, pale grey/brown.	FILL; Silty Sand and Gravel (C&D waste including brick fragments and fibre cement fragments), brown.	FILL; Silty Sand and Gravel (C&D waste including brick fragments and fibre cement fragments), brown.	FILL; Silty Sand, brown.	Silty SAND, pale grey/brown.	FILL; Silty Sand and some Gravel (C&D waste including brick fragments), d/brown.	FILL; Silty Sand and some Gravel (C&D waste including brick fragments), d/brown.	FILL; Silty Sand and some Gravel (C&D waste including brick fragments and potential coal/ash products), d/brown.	Silty SAND, pale grey/brown.
516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561
S16-Se19193	S16-Se19194	S16-Se19195	S16-Se19196	S16-Se19197	S16-Se19198	S16-Se19199	S16-Se19200	S16-Se19201	S16-Se19202	S16-Se19203	S16-Se19204	S16-Se19205	S16-Se19206	S16-Se19207
Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation
CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	<0.5	<0.5	--	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	<0.5	<0.5	--	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	<0.5	<0.5	--	<0.5	0.7	<0.5
0.8	<0.5	<0.5	0.6	0.6	<0.5	<0.5	<0.5	--	<0.5	<0.5	--	<0.5	2.7	<0.5
<0.5	<0.5	<0.5	0.7	<0.5	<0.5	<0.5	<0.5	--	<0.5	<0.5	--	<0.5	1.4	<0.5
<0.5	<0.5	<0.5	0.7	<0.5	<0.5	<0.5	<0.5	--	<0.5	<0.5	--	<0.5	1.3	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	<0.5	<0.5	--	<0.5	1	<0.5
<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	--	<0.5	<0.5	--	<0.5	1.1	<0.5
0.6	<0.5	<0.5	0.7	<0.5	<0.5	<0.5	<0.5	--	<0.5	<0.5	--	<0.5	1.8	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	<0.5	<0.5	--	<0.5	<0.5	<0.5
1.2	<0.5	<0.5	1.6	0.8	<0.5	<0.5	<0.5	--	<0.5	<0.5	--	<0.5	3.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	<0.5	<0.5	--	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	<0.5	<0.5	--	<0.5	1	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	<0.5	<0.5	--	<0.5	<0.5	<0.5
0.6	<0.5	<0.5	0.7	0.6	<0.5	<0.5	<0.5	--	<0.5	<0.5	--	<0.5	2.1	<0.5
1	<0.5	<0.5	1.5	0.7	<0.5	<0.5	<0.5	--	<0.5	<0.5	--	<0.5	3	<0.5
0.6635	0.605	0.605	1.1745	0.64	0.605	0.605	0.605	--	0.605	0.605	--	0.605	2.288	0.605
6.95	4	4	9.1	5.7	4	4	4	--	4	4	--	4	20.85	4
<2	2.3	<2	<2	5.2	<2	3.9	2.3	--	<2	<2	--	3.9	4.4	2.8
<0.4	<0.4	<0.4	<0.4	2	<0.4	<0.4	<0.4	--	<0.4	<0.4	--	2.2	0.9	<0.4
<5	<5	<5	7.3	5.3	<5	<5	<5	--	<5	<5	--	<5	7.8	<5
19	<5	<5	37	74	20	<5	12	--	<5	<5	--	75	130	<5
0.06	<0.05	<0.05	0.09	0.25	<0.05	<0.05	<0.05	--	<0.05	<0.05	--	<0.05	0.22	<0.05
110	<5	7.5	110	270	16	<5	13	--	110	<5	--	87	270	<5
<5	<5	<5	12	13	<5	<5	<5	--	<5	<5	--	<5	12	<5
120	9.8	25	120	2200	110	150	110	--	69	5.4	--	300	420	32
--	--	--	<0.5	--	--	--	<0.5	--	--	--	<0.5	--	--	--
--	--	--	<0.1	--	--	--	<0.1	--	--	--	<0.1	--	--	--
--	--	--	<0.5	--	--	--	<0.5	--	--	--	<0.5	--	--	--
--	--	--	<0.5	--	--	--	<0.5	--	--	--	<0.5	--	--	--
--	--	--	<0.5	--	--	--	<0.5	--	--	--	<0.5	--	--	--
--	--	--	<0.5	--	--	--	<0.5	--	--	--	<0.5	--	--	--
--	--	--	<0.5	--	--	--	<0.5	--	--	--	<0.5	--	--	--
--	--	--	1.55	--	--	--	1.55	--	--	--	1.55	--	--	--
--	--	--	Nil detected 68g	--	--	--	Nil detected 73g	Chrysotile 0.4560g 76g	--	--	Nil detected 78g	--	--	--

All results are in units of mg/kg, except for asbestos.
Blank Cell indicates no criterion available
PQL = Practical Quantitation Limit. Where PQL is for a summation, PQL of all components is summed and may be different from that presented by laboratory
[A] NEPM 1999 (amended April 2013) Health Investigation Levels (HIL) 'D' (Commercial/Industrial)
[A] NEPM 1999 (amended April 2013) Ecological Investigation Levels (EIL)C&I (Commercial and Industrial)
[B] Start of sample, generally over a 0.1m interval, refer to logs for further details
The Carcinogenic PAH value is calculated by multiplying the concentration of each of the 8 carcinogenic PAH compounds by its B(a)P toxic equivalence factor and summing these products.
HIL for Chromium are for Chromium VI
Presented ecological value for benzo(a)pyrene is a low reliability Ecological Screening Level
For the purpose of the Tier 1 ESL/EIL assessment, all background concentrations are assumed to be zero
EIL for Naphthalene are for fresh (<2years) Naphthalene
EIL for Arsenic are for aged (>2years) Arsenic
EIL for Chromium are the added contaminant limit for aged (>2years) Chromium III in soils of 1% clay, the most conservative of the criteria.
EIL for Copper are the added contaminant limit for aged (>2years) Copper in soils of pH 6.5.
EIL for Lead are the added contaminant limit for aged (>2years) Lead.
EIL for Nickel are the added contaminant limit for aged (>2years) Nickel in soils of 5% CEC the most conservative of the criteria.
EIL for Zinc are the added contaminant limit for aged (>2years) Zinc in soils of 5% CEC and pH of 6.5, the most conservative of the criteria at pH 6.5.
EIL for DDT are for fresh (<2years) DDT
PCB analysis includes non-Dioxin like and Dioxin-like compounds compared to a guideline of non-Dioxin like PCB
Results shown in **BOLD** are in excess of the HIL
Results shown in shading are >250% of the HIL
Results shown in underline are in excess of EIL
Where summation required (PAH, OCP, PCB) calculation includes components reported as non detected as 1/2 PQL.
* Duplicate sample concentrations used following QA assessment
**Labtoratory duplicate sample concentration used following internal QA review

7D	8A	8B	8C	8D	9A	9B	9C	9D	9F	10A	10B	10D	11A	11B
1.50	0.00	0.40	1.00	2.40	0.10	0.50	1.00	1.40	3.00	0.00	0.40	1.90	0.00	0.50
16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16
Silty SAND, pale grey/brown.	FILL; Silty Sand and some Gravel (C&D waste including brick fragments and potential coal/ash products), d/brown.	FILL; Silty Sand and some Gravel (C&D waste including brick fragments and potential coal/ash products), d/brown.	Silty SAND, pale grey/brown.	Silty SAND, pale grey/brown.	FILL; Clayey Sandy Gravel (Roadbase), brown.	FILL; Clayey Gravelly Sand with some Gravel (C&D waste including brick fragments, malleable sheet metal/metal pipe material) and some organics, brown.	FILL; Gravelly Silty Sand with potential trace of coal, dark brown.	Sandy Clayey SILT; dark brown/brown.	Silty SAND, pale grey/brown.	FILL; Silty Clayey Sand with some Gravel, brown.	Silty SAND, grey.	Silty SAND, pale brown.	FILL; Silty Sandy Gravel (C&D waste including brick fragments), orange brown.	FILL; Silty Sand (Construction), pale brown.
516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561
S16-Se19208	S16-Se19209	S16-Se19210	S16-Se19211	S16-Se19212	S16-Se19213	S16-Se19214	S16-Se19215	S16-Se19216	S16-Se19217	S16-Se19218	S16-Se19219	S16-Se19220	S16-Se19221	S16-Se19222
Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation
CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
0.605	0.605	0.605	0.605	0.605	0.605	0.605	0.605	0.605	0.605	0.605	0.605	0.605	0.605	0.605
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
<2	3.5	4.1	<2	<2	2.2	25	11	15	3.7	3	5.4	<2	7.7	2.3
<0.4	1.6	1.2	0.9	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.4	<0.4	<0.4	0.7	<0.4
<5	13	13	<5	<5	<5	<5	6.5	7.3	<5	47	7.7	<5	12	<5
13	30	66	15	<5	<5	16	44	5.6	<5	33	53	<5	52	<5
<0.05	<0.05	0.79	0.05	<0.05	<0.05	0.08	0.17	<0.05	<0.05	<0.05	0.08	<0.05	0.06	<0.05
52**	73	160	17	<5	7.2	43	82	11	<5	44	160	<5	83	<5
<5	<5	12	<5	<5	<5	<5	<5	<5	<5	35	8.2	<5	9.7	<5
100	240	610	230	150	30	270	75	20	22	280	380	<5	170	10
--	<0.5	--	--	--	<0.5	--	--	--	--	<0.5	--	--	<0.5	--
--	<0.1	--	--	--	<0.1	--	--	--	--	<0.1	--	--	<0.1	--
--	<0.5	--	--	--	<0.5	--	--	--	--	<0.5	--	--	<0.5	--
--	<0.5	--	--	--	<0.5	--	--	--	--	<0.5	--	--	<0.5	--
--	<0.5	--	--	--	<0.5	--	--	--	--	<0.5	--	--	<0.5	--
--	<0.5	--	--	--	<0.5	--	--	--	--	<0.5	--	--	<0.5	--
--	<0.5	--	--	--	<0.5	--	--	--	--	<0.5	--	--	<0.5	--
--	1.55	--	--	--	1.55	--	--	--	--	1.55	--	--	1.55	--
--	--	Nil detected 69g	--	--	--	Nil detected 76g	--	--	--	Nil detected 78g	--	--	--	--

All results are in units of mg/kg, except for asbestos.
Blank Cell indicates no criterion available
PQL = Practical Quantitation Limit. Where PQL is for a summation, PQL of all components is summed and may be different from that presented by laboratory
[A] NEPM 1999 (amended April 2013) Health Investigation Levels (HIL) 'D' (Commercial/Industrial)
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HIL for Chromium are for Chromium VI
Presented ecological value for benzo(a)pyrene is a low reliability Ecological Screening Level
For the purpose of the Tier 1 ESL/EIL assessment, all background concentrations are assumed to be zero
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EIL for Chromium are the added contaminant limit for aged (>2years) Chromium III in soils of 1% clay, the most conservative of the criteria.
EIL for Copper are the added contaminant limit for aged (>2years) Copper in soils of pH 6.5.
EIL for Lead are the added contaminant limit for aged (>2years) Lead.
EIL for Nickel are the added contaminant limit for aged (>2years) Nickel in soils of 5% CEC the most conservative of the criteria.
EIL for Zinc are the added contaminant limit for aged (>2years) Zinc in soils of 5% CEC and pH of 6.5, the most conservative of the criteria at pH 6.5.
EIL for DDT are for fresh (<2years) DDT
PCB analysis includes non-Dioxin like and Dioxin-like compounds compared to a guideline of non-Dioxin like PCB
Results shown in **BOLD** are in excess of the HIL
Results shown in shading are >250% of the HIL
Results shown in underline are in excess of EIL
Where summation required (PAH, OCP, PCB) calculation includes components reported as non detected as 1/2 PQL.
* Duplicate sample concentrations used following QA assessment
**Labtoratory duplicate sample concentration used following internal QA review

11C	12A	12B	AB1	AB2	AB3
1.00	0.00	0.30	Surface	Surface	Surface
16/9/16	16/9/16	16/9/16	16/9/16	16/9/16	16/9/16
FILL; Gravelly Clayey Sand, dark brown.	FILL; Silty Sand and Gravel (C&D waste including brick fragments and metal), Significant oil/hydrocarbon stained with strong odour, dark brown.	FILL; Clayey Sand with some gravel (C&D waste including brick fragments), dark brown.	Fragment of Bonded Cement Sheeting	Fragment of Bonded Cement Sheeting	Fragment of Bonded Cement Sheeting
516561	516561	516561	516562	516563	516564
S16-Se19223	S16-Se19224	S16-Se19225	S16-Se19294	S16-Se19295	S16-Se19296
Investigation	Investigation	Investigation	Investigation	Investigation	Investigation
CH	CH	CH	CH	CH	CH
<0.5	<0.5	<0.5	--	--	--
<0.5	<0.5	<0.5	--	--	--
<0.5	<0.5	<0.5	--	--	--
<0.5	<0.5	1.9	--	--	--
<0.5	<0.5	1.1	--	--	--
<0.5	<0.5	1.3	--	--	--
<0.5	<0.5	1.9	--	--	--
<0.5	<0.5	1.1	--	--	--
<0.5	<0.5	1.6	--	--	--
<0.5	<0.5	<0.5	--	--	--
<0.5	<0.5	2.8	--	--	--
<0.5	<0.5	<0.5	--	--	--
<0.5	<0.5	1.9	--	--	--
<0.5	<0.5	0.8	--	--	--
<0.5	<0.5	0.7	--	--	--
<0.5	<0.5	3.7	--	--	--
0.605	0.605	2.005	--	--	--
4	4	20.05	--	--	--
16	7.2	7.1	--	--	--
3.7	3	0.9	--	--	--
19	39	16	--	--	--
300	80	80	--	--	--
0.88	0.07	0.07	--	--	--
2300	150	310	--	--	--
32	18	6.4	--	--	--
2200	1100	250	--	--	--
--	<0.5	--	--	--	--
--	<0.1	--	--	--	--
--	<0.5	--	--	--	--
--	<0.5	--	--	--	--
--	<0.5	--	--	--	--
--	<0.5	--	--	--	--
--	<0.5	--	--	--	--
--	1.55	--	--	--	--
--	--	--	Chrysotile and amosite detected	Chrysotile and amosite detected	Chrysotile and amosite detected

All results are in units of mg/kg, except for asbestos.
Blank Cell indicates no criterion available
PQL = Practical Quantitation Limit. Where PQL is for a summation, PQL of all components is summed and may be different from that presented by laboratory
[A] NEPM 1999 (amended April 2013) Health Investigation Levels (HIL) 'D' (Commercial/Industrial)
[A] NEPM 1999 (amended April 2013) Ecological Investigation Levels (EIL)C&I (Commercial and Industrial)
[B] Start of sample, generally over a 0.1m interval, refer to logs for further details
The Carcinogenic PAH value is calculated by multiplying the concentration of each of the 8 carcinogenic PAH compounds by its B(a)P toxic equivalence factor and summing these pro
HIL for Chromium are for Chromium VI
Presented ecological value for benzo(a)pyrene is a low reliability Ecological Screening Level
For the purpose of the Tier 1 ESL/EIL assessment, all background concentrations are assumed to be zero
EIL for Naphthalene are for fresh (<2years) Naphthalene
EIL for Arsenic are for aged (>2years) Arsenic
EIL for Chromium are the added contaminant limit for aged (>2years) Chromium III in soils of 1% clay, the most conservative of the criteria.
EIL for Copper are the added contaminant limit for aged (>2years) Copper in soils of pH 6.5.
EIL for Lead are the added contaminant limit for aged (>2years) Lead.
EIL for Nickel are the added contaminant limit for aged (>2years) Nickel in soils of 5% CEC the most conservative of the criteria.
EIL for Zinc are the added contaminant limit for aged (>2years) Zinc in soils of 5% CEC and pH of 6.5, the most conservative of the criteria at pH 6.5.
EIL for DDT are for fresh (<2years) DDT
PCB analysis includes non-Dioxin like and Dioxin-like compounds compared to a guideline of non-Dioxin like PCB
Results shown in **BOLD** are in excess of the HIL
Results shown in shading are >250% of the HIL
Results shown in underline are in excess of EIL
Where summation required (PAH, OCP, PCB) calculation includes components reported as non detected as 1/2 PQL.
* Duplicate sample concentrations used following QA assessment
**Labtoratory duplicate sample concentration used following internal QA review

TIER 1 - Total Concentrations WITHOUT Leaching Test

Analyte	PQL	Total Concentration [A]		Samples														
		General Solid	Restricted Solid	1B	2A	2B	2D	3A	3B	3C	3D	4A	4B	4D	4E	4F	5A	5C	5D
Sample Profile				FILL; Clayey Sand and Gravel (C&D waste including brick fragments), dark brown.	FILL; Construction Sand, pale brown/yellow.	FILL; Clayey Sand and Gravel (C&D waste including brick fragments, slag), dark brown.	Sandy Clayey SILT; some organics, dark brown.	FILL; Sandy Gravel, orange brown.	FILL; Silty Sandy Gravel (C&D waste including brick fragments), grey/brown.	FILL; Silty Sandy Gravel (C&D waste including brick fragments), grey/brown.	FILL; Silty Sandy Clay/Clayey Sand with some Gravel and potential coal/ash products, black.	FILL; Sandy Silty Clay with some gravel and organics, grey.	FILL; Clayey Silty Sand with some Gravel (C&D waste including brick fragments), dark brown.	Silty SAND, pale grey/brown.	Silty SAND, pale grey/brown.	Silty SAND, pale grey/brown.	FILL; Sandy Silty Clay with some gravel and organics/ rootlets, grey and orange brown.	Silty SAND, pale grey/brown.	Silty SAND, pale grey/brown.
Sample Fate				Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu
Laboratory Report Reference				516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561
Laboratory Sample Reference				S16-Se19185	S16-Se19186	S16-Se19297	S16-Se19298	S16-Se19187	S16-Se19188	S16-Se19189	S16-Se19190	S16-Se19191	S16-Se19192	S16-Se19193	S16-Se19194	S16-Se19195	S16-Se19196	S16-Se19197	S16-Se19198
Sample Purpose				Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation
Sample collected by				CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)																			
Benzene	0.1	10	40	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	--	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	0.1	288	1152	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	--	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	0.1	600	2400	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	--	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Xylene	0.3	1000	4000	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	--	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Total Recoverable Hydrocarbons (TRH)																			
TRH C_6-C_9	20	650	2600	<20	<20	<20	<20	<20	<20	<20	<20	--	<20	<20	<20	<20	<20	<20	<20
TRH C_{10}-C_{36}	120	10000	40000	60	60	60	261	253	140	298	1040	--	1354	120	60	60	157	241	60
Polycyclic Aromatic Hydrocarbons (PAH)																			
Benzo(a) pyrene	0.5	0.8	3.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**5.6**	0.7	--	**15**	<0.5	<0.5	<0.5	0.7	<0.5	<0.5
Sum of Reported PAH	8	200	800	4	4	4	4	6.9	6	73.1	11.2	--	**315.85**	6.95	4	4	9.1	5.7	4
Metals																			
Arsenic	2	100	400	2.3	<2	4.2	8	<2	<2	<2	2.1	--	<2	<2	2.3	<2	<2	5.2	<2
Cadmium	0.4	20	80	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	--	<0.4	<0.4	<0.4	<0.4	<0.4	2	<0.4
Chromium	5	100	400	<5	<5	<5	8.6	8.7	6.7	7.1	8.9	--	9.6	<5	<5	<5	7.3	5.3	<5
Copper	5			10	<5	6.4	37	56	7.8	15	67	--	120	19	<5	<5	37	74	20
Mercury	0.05	4	16	0.07	<0.05	<0.05	0.07	<0.05	<0.05	<0.05	0.54	--	0.18	0.06	<0.05	<0.05	0.09	0.25	<0.05
Lead	5	100	400	15	<5	5.2	39	47	23	**170**	**450**	--	**470**	**110**	<5	7.5	**110**	**270**	16
Nickel	5	40	160	<5	<5	<5	9.5	6.6	<5	5.6	15	--	10	<5	<5	<5	12	13	<5
Zinc	5			17	<5	25	110	68	25	150	470	--	360	120	9.8	25	120	2200	110
Final Sample Classification				General Solid Waste	General Solid Waste	General Solid Waste	General Solid Waste	General Solid Waste	General Solid Waste	**Hazardous Waste**	**Hazardous Waste**	General Solid Waste	**Hazardous Waste**	**Restricted Solid Waste**	General Solid Waste	General Solid Waste	**Restricted Solid Waste**	**Restricted Solid Waste**	General Solid Waste

All total results are in units of mg/kg. All leachable results are in units of mg/L

PQL = Practical Quantitation Limit.

[A] NSWEPA Waste Classification Guidelines, 2014. Table 1, CT1 & CT2

Blank Cell indicates no criterion available

Results for TRH have been compared to TPH guidelines.

Guidelines reported for Chromium are for Chromium VI

Results shown in ***BOLD*** are in excess of the General Solid Waste criteria

Results shown in ***shading*** are in excess of the Restricted Solid Waste criteria

Where summation required (Xylene, TRH, PAH) calculation includes components reported as non detected as 1/2 PQL.

* Duplicate sample concentrations used following QA assessment

TIER 1 - Total Concentrations WITHOUT Leaching Tes

Analyte	PQL	Total Concentration [A]		Samples														
		General Solid	Restricted Solid	5G	6A	6B	6C	6E	7A	7B	7C	7E	7D	8A	8B	8C	8D	9A	9B
Sample Profile				Silty SAND, pale grey/brown.	FILL; Silty Sand and Gravel (C&D waste including brick fragments and fibre cement fragments), brown.	FILL; Silty Sand and Gravel (C&D waste including brick fragments and fibre cement fragments), brown.	FILL; Silty Sand, brown.	Silty SAND, pale grey/brown.	FILL; Silty Sand and some Gravel (C&D waste including brick fragments), d/brown.	FILL; Silty Sand and some Gravel (C&D waste including brick fragments), d/brown.	FILL; Silty Sand and some Gravel (C&D waste including brick fragments and potential coal/ash products), d/brown.	Silty SAND, pale grey/brown.	Silty SAND, pale grey/brown.	FILL; Silty Sand and some Gravel (C&D waste including brick fragments and potential coal/ash products), d/brown.	FILL; Silty Sand and some Gravel (C&D waste including brick fragments and potential coal/ash products), d/brown.	Silty SAND, pale grey/brown.	Silty SAND, pale grey/brown.	FILL; Clayey Sandy Gravel (Roadbase), brown.	FILL; Clayey Gravelly Sand with some Gravel (C&D waste including brick fragments, malleable sheet metal/metal pipe material) and some organics, brown.
Sample Fate				Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu
Laboratory Report Reference				516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561
Laboratory Sample Reference				S16-Se19199	S16-Se19200	S16-Se19201	S16-Se19202	S16-Se19203	S16-Se19204	S16-Se19205	S16-Se19206	S16-Se19207	S16-Se19208	S16-Se19209	S16-Se19210	S16-Se19211	S16-Se19212	S16-Se19213	S16-Se19214
Sample Purpose				Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation
Sample collected by				CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)																			
Benzene	0.1	10	40	<0.1	<0.1	--	<0.1	<0.1	--	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	0.1	288	1152	<0.1	<0.1	--	<0.1	<0.1	--	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	0.1	600	2400	<0.1	<0.1	--	<0.1	<0.1	--	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Xylene	0.3	1000	4000	0.15	0.15	--	0.15	0.15	--	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Total Recoverable Hydrocarbons (TRH)																			
TRH C_6-C_9	20	650	2600	<20	<20	--	<20	<20	--	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
TRH C_{10}-C_{36}	120	10000	40000	60	124	--	60	119	--	126	480	60	154	363	187	60	60	1712	595
Polycyclic Aromatic Hydrocarbons (PAH)																			
Benzo(a) pyrene	0.5	0.8	3.2	<0.5	<0.5	--	<0.5	<0.5	--	<0.5	**1.4**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sum of Reported PAH	8	200	800	4	4	--	4	4	--	4	20.85	4	4	4	4	4	4	4	4
Metals																			
Arsenic	2	100	400	3.9	2.3	--	<2	<2	--	3.9	4.4	2.8	<2	3.5	4.1	<2	<2	2.2	25
Cadmium	0.4	20	80	<0.4	<0.4	--	<0.4	<0.4	--	2.2	0.9	<0.4	<0.4	1.6	1.2	0.9	<0.4	<0.4	<0.4
Chromium	5	100	400	<5	<5	--	<5	<5	--	<5	7.8	<5	<5	13	13	<5	<5	<5	<5
Copper	5			<5	12	--	<5	<5	--	75	130	<5	13	30	66	15	<5	<5	16
Mercury	0.05	4	16	<0.05	<0.05	--	<0.05	<0.05	--	<0.05	0.22	<0.05	<0.05	<0.05	0.79	0.05	<0.05	<0.05	0.08
Lead	5	100	400	<5	13	--	**110**	<5	--	87	**270**	<5	52**	73	**160**	17	<5	7.2	43
Nickel	5	40	160	<5	<5	--	<5	<5	--	<5	12	<5	<5	<5	12	<5	<5	<5	<5
Zinc	5			150	110	--	69	5.4	--	300	420	32*	100	240	610	230	150	30	270
Final Sample Classification				General Solid Waste	General Solid Waste	*Special Waste*	**Restricted Solid Waste**	General Solid Waste	General Solid Waste	General Solid Waste	**Restricted Solid Waste**	General Solid Waste	General Solid Waste	General Solid Waste	**Restricted Solid Waste**	General Solid Waste	General Solid Waste	General Solid Waste	General Solid Waste

All total results are in units of mg/kg. All leachable results are in units of mg/L

PQL = Practical Quantitation Limit.

[A] NSWEPA Waste Classification Guidelines, 2014. Table 1, CT1 & CT2

Blank Cell indicates no criterion available

Results for TRH have been compared to TPH guidelines.

Guidelines reported for Chromium are for Chromium VI

Results shown in ***BOLD*** are in excess of the General Solid Waste criteria

Results shown in ***shading*** are in excess of the Restricted Solid Waste criteria

Where summation required (Xylene, TRH, PAH) calculation includes components reported as non detected as 1/2 PQL.

* Duplicate sample concentrations used following QA assessment

TIER 1 - Total Concentrations WITHOUT Leaching Tes

Analyte	PQL	Total Concentration [A]		Samples										
		General Solid	Restricted Solid	9C	9D	9F	10A	10B	10D	11A	11B	11C	12A	12B
Sample Profile				FILL; Gravelly Silty Sand with potential trace of coal, dark brown.	Sandy Clayey SILT; dark brown/brown.	Silty SAND, pale grey/brown.	FILL; Silty Clayey Sand with some Gravel, brown.	Silty SAND, grey.	Silty SAND, pale brown.	FILL; Silty Sandy Gravel (C&D waste including brick fragments), orange brown.	FILL; Silty Sand (Construction), pale brown.	FILL; Gravelly Clayey Sand, dark brown.	FILL; Silty Sand and Gravel (C&D waste including brick fragments and metal), Significant oil/hydrocarbon stained with strong odour, dark brown.	FILL; Clayey Sand with some gravel (C&D waste including brick fragments), dark brown.
Sample Fate				Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu	Insitu
Laboratory Report Reference				516561	516561	516561	516561	516561	516561	516561	516561	516561	516561	516561
Laboratory Sample Reference				S16-Se19215	S16-Se19216	S16-Se19217	S16-Se19218	S16-Se19219	S16-Se19220	S16-Se19221	S16-Se19222	S16-Se19223	S16-Se19224	S16-Se19225
Sample Purpose				Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation
Sample collected by				CH	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)														
Benzene	0.1	10	40	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	0.1	288	1152	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	0.1	600	2400	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Xylene	0.3	1000	4000	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Total Recoverable Hydrocarbons (TRH)														
TRH C_6-C_9	20	650	2600	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
TRH C_{10}-C_{36}	120	10000	40000	60	60	60	272	60	60	137	60	494	**58150**	**20610**
Polycyclic Aromatic Hydrocarbons (PAH)														
Benzo(a) pyrene	0.5	0.8	3.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**1.1**
Sum of Reported PAH	8	200	800	4	4	4	4	4	4	4	4	4	4	20.05
Metals														
Arsenic	2	100	400	11	15	3.7	3	5.4	<2	7.7	2.3	16	7.2	7.1
Cadmium	0.4	20	80	<0.4	<0.4	<0.4	0.4	<0.4	<0.4	0.7	<0.4	3.7	3	0.9
Chromium	5	100	400	6.5	7.3	<5	47	7.7	<5	12	<5	19	39	16
Copper	5			44	5.6	<5	33	53	<5	52	<5	300	80	80
Mercury	0.05	4	16	0.17	<0.05	<0.05	<0.05	0.08	<0.05	0.06	<0.05	0.88	0.07	0.07
Lead	5	100	400	82	11	<5	44	**160**	<5	83	<5	**2300**	**150**	**310**
Nickel	5	40	160	<5	<5	<5	35	8.2	<5	9.7	<5	32	18	6.4
Zinc	5			75	20	22	280	380	<5	170	10	2200	1100	250
Final Sample Classification				General Solid Waste	General Solid Waste	General Solid Waste	**Restricted Solid Waste**	**Restricted Solid Waste**	General Solid Waste	General Solid Waste	General Solid Waste	**Hazardous Waste**	**Hazardous Waste**	**Restricted Solid Waste**

All total results are in units of mg/kg. All leachable results are in units of mg/L

PQL = Practical Quantitation Limit.

[A] NSWEPA Waste Classification Guidelines, 2014. Table 1, CT1 & CT2

Blank Cell indicates no criterion available

Results for TRH have been compared to TPH guidelines.

Guidelines reported for Chromium are for Chromium VI

Results shown in ***BOLD*** are in excess of the General Solid Waste criteria

Results shown in ***shading*** are in excess of the Restricted Solid Waste criteria

Where summation required (Xylene, TRH, PAH) calculation includes components reported as non detected as 1/2 PQL.

* Duplicate sample concentrations used following QA assessment

Sample Identification	PQL	Human Health (Vapour Based) Guideline [A]		BH4	BH5	BH7	BH9	BH10
Sample Depth (m) [B]		HSL 'D'		2.55	2.61	2.56	2.00	3.28
Date		SAND 2-<4m	SAND 4-<8m	19/9/16	19/9/16	19/9/16	19/9/16	19/9/16
Sample Description				Brown, slightly turbid, no odour	Brown, slightly turbid, no odour	Brown, turbid, no odour	Brown, turbid, no odour	Brown, slightly turbid, no odour
Dominant Stratum [C]				Sand	Sand	Sand	Sand	Sand
Laboratory Report Reference				516561	516561	516561	516561	516561
Laboratory Sample Reference				S16-Se19232	S16-Se19233	S16-Se19234	S16-Se19235	S16-Se19236
Sample Purpose				Investigation	Investigation	Investigation	Investigation	Investigation
Sample collected by				CH	CH	CH	CH	CH
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)								
Benzene	0.001	5	5	<0.001	<0.001	<0.001	<0.001	<0.001
Toluene	0.001	NL	NL	<0.001	<0.001	<0.001	<0.001	<0.001
Ethylbenzene	0.001	NL	NL	<0.001	<0.001	<0.001	<0.001	<0.001
meta- and para-Xylene	0.002			<0.002	<0.002	<0.002	<0.002	<0.002
ortho-Xylene	0.001			<0.001	<0.001	<0.001	<0.001	<0.001
Total Xylenes	0.003	NL	NL	0.0015	0.0015	0.0015	0.0015	0.0015
Polycyclic Aromatic Hydrocarbons (PAH)								
Naphthalene	0.01	NL	NL	<0.01	<0.01	<0.01	<0.01	<0.01
Total Recoverable Hydrocarbons (TRH)								
TRH C_6-C_{10}	0.02			<0.02	<0.02	<0.02	<0.02	<0.02
TRH >C_{10}-C_{16}	0.05			<0.05	<0.05	<0.05	<0.05	<0.05
TRH >C_{16}-C_{34}	0.1			<0.1	<0.1	<0.1	<0.1	<0.1
TRH >C_{34}-C_{40}	0.1			<0.1	<0.1	<0.1	<0.1	<0.1
F1	0.02	6	6	<0.02	<0.02	<0.02	<0.02	<0.02
F2	0.05	NL	NL	<0.05	<0.05	<0.05	<0.05	<0.05

All results are in units of mg/L

Blank Cell indicates no criterion available

PQL = Practical Quantitation Limit. Where PQL is for a summation, PQL of all components is summed and may be different from that presented by laboratory

F1 = TRH C_6-C_{10} minus BTEX. F1 PQL deemed equal TRH C_6-C_{10}.

F2= TRH>C_{10}-C_{16} minus naphthalene. F2 PQL deemed = TRH >C_{10}-C_{16}.

[A] NEPM 2013 Vapour Based Health Screening Level (HSL) 'D' (Commercial/Industrial)

[B] Sample depths presented are as encountered during sampling

[C] Note that this is a generalisation for the purpose of comparing to the HSL criteria. Where two strata equally represented, most conservative criterion used

NL designates 'Not Limiting' indicating that the pore water concentration required to constitute a vapour risk is higher than the solubility capacity for that compound based on a petroleum mixture. Vapour is therefore not a risk for this compound.

Results for TRH have been compared to TPH guidelines.

Results shown in shading are in excess of the HSL

Where summation required (Xylene, F1, F2) calculation includes components reported as non detected as 1/2 PQL.

Sample Identification	PQL	Aquatic Ecosystem Guideline [A]	Human Health (Ingestion) Guideline [B]	BH4	BH5	BH7	BH9	BH10
Sample Depth (m) [C]		95% Marine		2.55	2.61	2.56	2.00	3.28
Date				19/9/16	19/9/16	19/9/16	19/9/16	19/9/16
Sample Description				Brown, slightly turbid, no odour	Brown, slightly turbid, no odour	Brown, turbid, no odour	Brown, turbid, no odour	Brown, slightly turbid, no odour
Laboratory Report Reference				516561	516561	516561	516561	516561
Laboratory Sample Reference				S16-Se19232	S16-Se19233	S16-Se19234	S16-Se19235	S16-Se19236
Sample Purpose				Investigation	Investigation	Investigation	Investigation	Investigation
Sample collected by				CH	CH	CH	CH	CH
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)								
Benzene	0.001	0.7	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Toluene	0.001	*0.18*	0.8	<0.001	<0.001	<0.001	<0.001	<0.001
Ethylbenzene	0.001	*0.005*	0.3	<0.001	<0.001	<0.001	<0.001	<0.001
meta- and para-Xylene	0.002	*0.275*		<0.002	<0.002	<0.002	<0.002	<0.002
ortho-Xylene	0.001	*0.35*		<0.001	<0.001	<0.001	<0.001	<0.001
Total Xylenes	0.003		0.6	0.0015	0.0015	0.0015	0.0015	0.0015
Total Recoverable Hydrocarbons (TRH)								
TRH C_6-C_{10}	0.02			<0.02	<0.02	<0.02	<0.02	<0.02
TRH >C_{10}-C_{16}	0.05			<0.05	<0.05	<0.05	<0.05	<0.05
TRH >C_{16}-C_{34}	0.1			<0.1	<0.1	<0.1	<0.1	<0.1
TRH >C_{34}-C_{40}	0.1			<0.1	<0.1	<0.1	<0.1	<0.1
TRH C_6-C_{40}	0.27	*0.007*		0.135	0.135	0.135	0.135	0.135
Polycyclic Aromatic Hydrocarbons (PAH)								
Acenaphthene	0.001			<0.001	<0.001	<0.001	<0.001	<0.001
Acenaphthylene	0.001			<0.001	<0.001	<0.001	<0.001	<0.001
Anthracene[D]	0.001	*0.0004*		<0.001	<0.001	<0.001	<0.001	<0.001
Benz(a)anthracene	0.001			<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(a) pyrene[D]	0.001	*0.0002*	0.00001	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(b)&(j)fluoranthene	0.001			<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(g,h,i)perylene	0.001			<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(k)fluoranthene	0.001			<0.001	<0.001	<0.001	<0.001	<0.001
Chrysene	0.001			<0.001	<0.001	<0.001	<0.001	<0.001
Dibenz(a,h)anthracene	0.001			<0.001	<0.001	<0.001	<0.001	<0.001
Fluoranthene[D]	0.001	*0.0014*		<0.001	<0.001	<0.001	<0.001	<0.001
Fluorene	0.001			<0.001	<0.001	<0.001	<0.001	<0.001
Indeno(1,2,3-c,d)pyrene	0.001			<0.001	<0.001	<0.001	<0.001	<0.001
Naphthalene	0.001	0.07		<0.001	<0.001	<0.001	<0.001	<0.001
Phenanthrene[D]	0.001	*0.002*		<0.001	<0.001	<0.001	<0.001	<0.001
Pyrene	0.001			<0.001	<0.001	<0.001	<0.001	<0.001
Sum of reported PAH	0.016			0.008	0.008	0.008	0.008	0.008
Metals								
Arsenic	0.001	*0.0023*	0.01	**0.029**	**0.034**	**0.015**	**0.031**	**0.007**
Cadmium	0.0001	0.0055	0.002	<0.0001	0.0003	<0.0001	<0.0001	<0.0001
Chromium	0.001	0.0044	0.05	<0.001	<0.001	<0.001	0.002	<0.001
Copper	0.001	0.0013	2	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	0.001	0.0044	0.01	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury[D]	0.0001	0.0004	0.001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001
Nickel	0.001	0.07		0.004	0.009	<0.001	0.001	<0.001
Zinc	0.005	0.015		**0.79**	**43**	**0.006**	**0.017**	**0.015**

All results are in units of mg/L

Blank Cell indicates no criterion available

PQL = Practical Quantitation Limit. Where PQL is for a summation, PQL of all components is summed and may be different from that presented by laboratory

[A] ANZECC 2000 % Protection Level for Receiving Water Type

[B] NHMRC Australian Drinking Water Guidelines, 2011

[C] Sample depths presented are as encountered during sampling

[D] Bioaccummulative Compounds

ANZECC guidelines in *italics* are low level reliability guidelines

ANZECC arsenic guideline based on As (III) for marine, the lowest of presented guidelines.

NHMRC arsenic guidelines are based on total arsenic

ANZECC and NHMRC guidelines for chromium are based on Cr (VI)

Total Phenolics guideline based on Phenol

ANZECC guidelines for mercury are based on inorganic mercury.

NHMRC guidelines for mercury are based on total mercury.

NHMRC guidelines for total cyanide are based on cyanogen chloride (as cyanide).

Results for TRH have been compared to TPH guidelines.

Results shown in **BOLD** are in excess of the aquatic ecosystems guidelines

Results shown in underline are in excess of the human health (ingestion) guideline

Where summation required (Xylene,TRH,PAH) calculation includes components reported as non detected as 1/2 PQL.

Appendix C

Exposure Scenarios

Table 5-B
Residential with minimal soil access

Summary of Exposure Pathways	Abbreviations	Units	Parameters	
			Adult	Child
Body weight	BW_A or BW_C	kg	70	15
Exposure duration	ED_A or ED_C	years	29	6
Exposure frequency	EF	days	365	365
Soil/dust ingestion rate[1]	IR_{SA} or IR_{SC}	mg/day	12.5 [3]	25 [3]
Soil/dust to skin adherence factor	AF	$mg/cm^2/day$	0.5	0.5
Skin surface area	SA_A or SA_C	cm^2	20 000	6100
Fraction of skin exposed	F_s	%	31.5	44.3
Dermal absorption factor	DAF	%	Chemical specific values applied	
Time spent indoors on site each day	ET_i	hours	20	20
Time spent outdoors on site each day	ET_o	hours	1	1
Home-grown fraction of vegetables consumed	F_{HG}	%	0	0
Vegetable & fruit consumption rate	C_y (veg and fruit)	g/day	-	-
Averaging time for carcinogens ('lifetime')	AT_{NT}	years	70	70
Dust lung retention factor	RF	%	37.5	37.5

Soil ingestion rates for children are based on a child aged 2-3 years where normal hand-to-mouth activity is assumed and does not account for pica behaviour.

Soil ingestion rates for the HIL B scenario are based on the assumption that a quarter of the HIL A soil/dust ingestion occurs.

Table 5-D
Commercial/Industrial premises

Summary of Exposure Pathways	Abbreviations	Units	Parameters
			Adult
Body weight	BW_A or BW_C	kg	70
Exposure duration	ED_A or ED_C	years	30
Exposure frequency	EF	days	240
Soil/dust ingestion rate[1]	IR_{SA} or IR_{SC}	mg/day	25 [5]
Soil/dust to skin adherence factor	AF	$mg/cm^2/day$	0.5
Skin surface area	SA_A or SA_C	cm^2	20 000
Fraction of skin exposed	F_s	%	19
Dermal absorption factor	DAF	%	Chemical specific values applied
Time spent indoors on site each day	ET_i	hours	8
Time spent outdoors on site each day	ET_o	hours	1
Home-grown fraction of vegetables consumed	F_{HG}	%	0
Vegetable & fruit consumption rate	C_v (veg and fruit)	g/day	-
Averaging time for carcinogens ('lifetime')	AT_{NT}	years	70
Dust lung retention factor	RF	%	37.5

Soil ingestion rates for children are based on a child aged 2-3 years where normal hand-to-mouth activity is assumed and does not account for pica behaviour.

Soil ingestion rates for the HIL D scenario are based on the default soil/dust ingestion rates, corrected for an 8 hr/day daily exposure duration (50% of total waking hours)

Appendix D

Site Guidelines Explanation

1 SITE INVESTIGATION AND SCREENING LEVELS

1.1 NEPM – NATIONAL ENVIRONMENT PROTECTION (ASSESSMENT OF SITE CONTAMINATION) MEASURE 2013

1.1.1 SOIL

The investigation and screening levels (ISL) utilised for the assessment of the soil on site were sourced from the National Environment Protection Measure (NEPM) for the Assessment of Site Contamination (Ref [5]). These ISL are not derived as acceptance criteria for contamination at a site, but as levels above which specific consideration of risk, based on the site use and potential exposure, is required. If a risk is determined as present, then remediation and/or management must be undertaken.

Assessment ISL are based on:

- Human Health -

  Intentionally conservative health investigation levels (HIL) have been derived for four (4) generic land use settings.

  - HIL 'A' - Residential with garden/accessible soil (home grown produce <10% fruit and vegetable intake (no poultry). This category includes children's daycare 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 flats.
  - HIL 'C' - Public open space such as parks, playgrounds, playing fields (eg, ovals) secondary schools and footpaths. It does not include undeveloped public open space (such as urban bush land and reserves).
  - HIL 'D' - Commercial/industrial such as shops, offices, factories and industrial sites.

  Refer to **Appendix C** for a copy of the exposure scenarios for the derivation of the above land use settings.

  Health screening levels (HSL) have been determined for risks associated from vapour intrusion from petroleum[1] compound contamination for the same land use settings. These HSL are additionally based on the fraction of compound, the soil texture and the depth of the encountered soil.

  Direct hydrocarbon contact criteria are not provided in the NEPM, however these are provided in CRC Care Technical Report 10 (Ref [10]) which is the source document for the HSL.

  HSL have also been determined for asbestos containing materials. The HSL for bonded asbestos containing material is based on the land use settings detailed above, however the following HSL also apply:

  - Total of Fibrous asbestos and asbestos fines – less than 0.001%.

[1] Laboratory analysis of hydrocarbons is being reported as total recoverable hydrocarbons (TRH). This testing method includes all forms of hydrocarbons, not just petroleum hydrocarbons and therefore can be considered a conservative measure against the chosen TPH criteria. Further laboratory analysis using a silica gel clean up (TRH_{sg}) is considered to enable a better identification of the extent of petroleum based contamination.

- No visible asbestos in surface soil – or where an area is likely to be disturbed during any proposed works.

- Ecological Health -

  These levels are considered to apply to soil within two (2) metres of the surface, the root zone and habitation zone of many species.

  Ecological investigation levels (EIL) have been determined for arsenic, copper, chromium III, DDT, naphthalene, nickel, lead and zinc in soil based on species sensitivity model and for three (3) generic land use settings:

  - Areas of ecological significance – for areas where the primary intention is for the conservation and protection of the natural environment. Protection level of 99%.
  - Urban residential areas and public open space – broadly equivalent to the HIL 'A', HIL 'B' and HIL 'C' land use settings. Protection level of 80%.
  - Commercial and industrial land uses – considered to be broadly equivalent to HIL 'D' land use setting. Protection level of 60%.

  Methodology for the derivation of EIL for other contaminants is available in the NEPM and requires additional soil character data.

  Ecological screening levels (ESL) have been determined for petroleum compound contamination. Due to limitations in the data only moderate reliability ESL have been determined for fractions $<C_{16}$, applied generically in fine and coarse grained soils. ESL for petroleum fractions $> C_{16}$, BTEX and naphthalene are consider low reliability.

- Aesthetics -

  Aesthetic considerations operate separately to the HIL/HSL and EIL/ESL assessment. Issues to be considered include:

  - Highly malodorous soils or extracted groundwater (eg, strong residual petroleum hydrocarbon odours, hydrogen sulphide in soil or extracted groundwater, organosulfur compounds).
  - Hydrocarbon sheen on surface water.
  - Discoloured chemical deposits or soil staining with chemical waste other than of a very minor nature.
  - Large monolithic deposits of otherwise low-risk material, eg, gypsum as powder or plasterboard, cement kiln dust.
  - Presence of putrescible refuse including material that may generate hazardous levels of methane such as a deep-fill profile of green waste or large quantities of timber waste.
  - Soils containing residue from animal burial (eg, former abattoir sites).

  Site assessment requires consideration of the quantity, type and distribution of foreign material or odours in relation to the specific land use and its sensitivity. For example, higher expectations for soil quality would apply to residential properties with gardens compared with industrial settings.

Tier 1 assessment comprises the comparison of the soil data with the HIL/HSL and EIL/ESL. In the event that some concentrations are in excess of the relevant criteria, the summary statistics of the data set may be utilised for assessment purpose. Consideration of a range of statistics is recommended; at a minimum the 95%UCL_{ave} should be compared to the relevant criteria as long as:

- No single value exceeds 250% of the relevant criterion.
- The standard deviation of the results for each analyte is less than 50% of the relevant criterion.

In addition to appropriate consideration and application of the HSL and ESL, there are a number of policy considerations which reflect the nature and properties of petroleum hydrocarbons:

- Formation of observable light non-aqueous phase liquids (LNAPL).
- Fire and explosive hazards.
- Effects on buried infrastructure eg, penetration of, or damage to, in-ground services by hydrocarbons.

The NEPM has therefore provided management limits, the application of which will require consideration of site-specific factors such as the depth of building basements and services and depth to groundwater, to determine the maximum depth to which the limits should apply. The management limits may have less relevance at operating industrial sites (including mine sites) which have no or limited sensitive receptors in the area of potential impact. When the management limits are exceeded, further site-specific assessment and management may enable any identified risk to be addressed.

The presence of site hydrocarbon contamination at the levels of the management limits does not imply that there is no need for administrative notification or controls in accordance with jurisdiction requirements.

The following figure has been taken from the NEPM to illustrate the assessment methodology in regards to petroleum contamination.

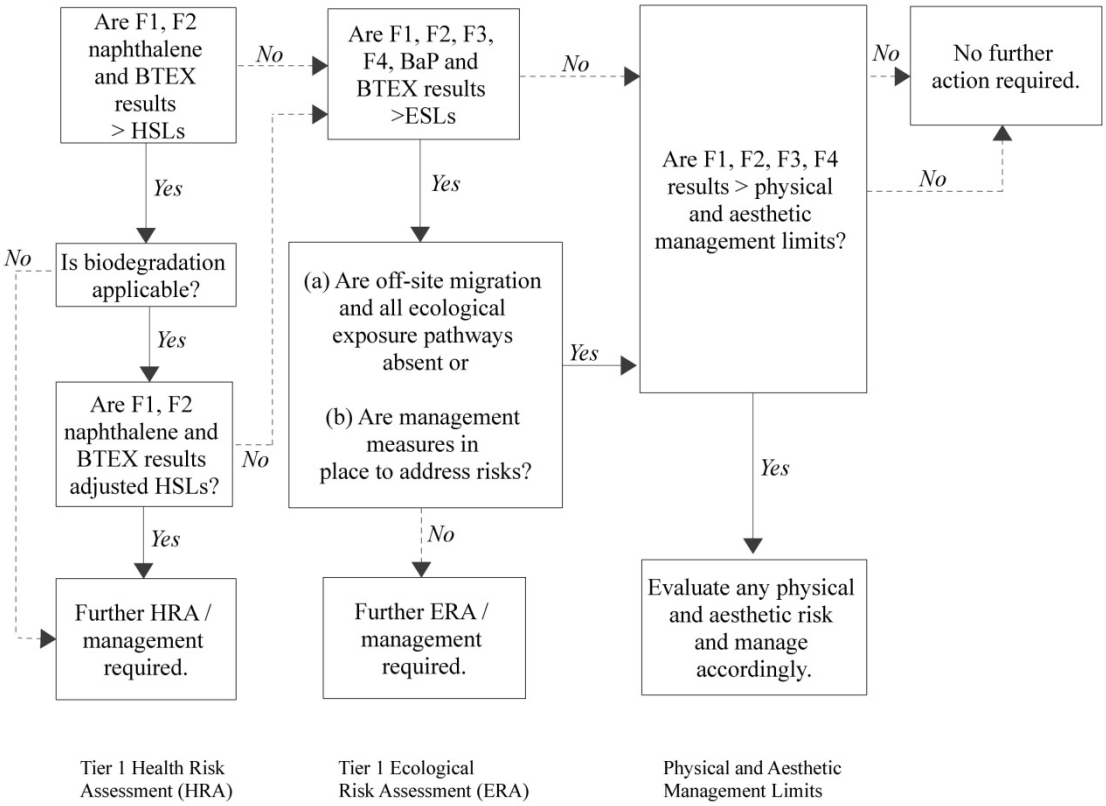

Figure 1 *Flowchart for the Tier 1 human and ecological risk assessment of petroleum hydrocarbon contamination – application of HSL and ESL and consideration of management limits*

1.1.2 WATER

Schedule B6 of the NEPM provides generic groundwater investigation levels (GIL) which are defined as 'the concentration of a contaminant in groundwater above which further investigation is required'. Selected GIL are tabulated in Table 1C of Schedule B1 and are sourced from the:

- Australian water quality guidelines for fresh and marine water (AWQG) (ANZECC and ARMCANZ 2000).
- Australian drinking water guidelines (ADWG) (NHMRC and NRMMC 2011).
- Guidelines for managing risk in recreational water (GMRRW) (NHMRC 2008).

The GIL are designed to avoid unacceptable impact to exposed populations or ecosystems under a range of circumstances. The aquatic ecosystem protection GIL presented in Table 1C of Schedule B1 are applicable to 'slightly - moderately disturbed' ecosystems. The AWQG should be consulted, refer Section 7.3, for additional values for protection of disturbed ecosystems and pristine ecosystems.

Schedule B1 of the NEPM provides generic health screening levels (HSL) for groundwater, for protection of human health from petroleum hydrocarbon vapours, based on the following land use scenarios as detailed in Section 7.1.1:

- HSL 'A' - Residential with garden/accessible soil (home grown produce <10% fruit and vegetable intake (no poultry). This category includes children's daycare centres, preschools and primary schools.

- HSL ‘B’- Residential with minimal opportunities for soil access includes dwellings with fully and permanently paved yard space such as high rise buildings and flats.
- HSL ‘C’ - Public open space such as parks, playgrounds, playing fields (eg, ovals) secondary schools and footpaths. It does not include undeveloped public open space (such as urban bush land and reserves).
- HSL ‘D’ - Commercial/industrial such as shops, offices, factories and industrial sites.

1.2 NSW EPA 2014, WASTE CLASSIFICATION GUIDELINES

The waste classification guidelines (Ref [6]) are designed to ensure waste streams are managed appropriately and in accordance with the Protection of the Environment Operations Act 1997 (the POEO Act) and its associated regulations. The guidelines classify waste into groups which pose similar risks to the environment and human health; and facilitate their management and appropriate disposal.

Six waste classes are used:

- Special waste:
  - Clinical or related waste, asbestos waste, waste tyres.
- Liquid waste:
  - As defined by angle of repose, temperature at which it is free flowing and physical composition.
- Hazardous waste.
- Restricted solid waste.
- General solid waste (putrescible).
- General solid waste (non-putrescible).

Classification begins with determination of whether the waste is ‘special waste’. If not determination of whether material is classified as liquid waste is then required. Material which is not liquid waste, or is special waste due to asbestos content, must be compared to pre-classification definitions. Without pre-classification, the potential for hazardous characteristics (such as explosives, gases, flammable materials, oxidising, toxic and corrosive substances) must be established. If material cannot be classified as hazardous, assessment by chemical analysis must be undertaken. Without assessment, material must be managed as if hazardous waste.

Chemical classification is two tiered. The first set of criteria is based on total contaminant concentrations, whereas the second set of criteria is based on a leachable (TCLP) concentration and a total contaminant concentration. The total concentrations criteria are generally higher in conjunction with TCLP testing than if it was not undertaken.

1.3 DECC 2007, GUIDELINES FOR THE ASSESSMENT AND MANAGEMENT OF GROUNDWATER CONTAMINATION

These groundwater quality guidelines have been introduced by the NSW DECC (Ref [11]) and recommend that ANZECC (Ref [8]) investigation levels be adopted as groundwater investigation levels (GIL) for aquatic ecosystems and NHMRC and NMMC (Ref [7]) for drinking water GIL.

ANZECC 2000 are complex guidelines that consider not only the level of protection (eg, 99% or 95%) but also the state of the receiving water (eg, moderately disturbed). For the protection of aquatic ecosystems the DECC recommend the use of 95% protection for all analytes with the exception of carcinogenic analytes for which the 99% protection value should be used. The following comments are additionally made:

- Where the existing generic GIL is below the naturally occurring background concentration of a particular contaminant, the background concentration becomes the default GIL.
- Where PQL are greater than the recommended GIL the PQL is adopted as the GIL. Where background concentrations are proven to be greater than the GIL, the background concentration is adopted as the GIL.
- Where there is insufficient data for the derivation of marine water criteria it is allowable to use fresh water criteria (Section 8.3.4.5, pg 8.3-36, (Ref [8])).

The NHMRC and NMMC 2011 document provides a framework for drinking water quality management and assessment. The framework provided in this document has been adopted for the evaluation of contaminants in groundwater where groundwater can be, or is being, extracted and used for drinking water purpose.

RCA notes that the NEPM (Ref [11]) endorses the guidelines for use as GIL.

1.4 ACID SULFATE SOILS

Estuarine sediments of coastal NSW from the Holocene geological age contain iron pyrite, the main constituent of acid sulfate soils. The Holocene sediment is found below and up to 5m Australian Height Datum (AHD) typically in coastal and floodplain areas. The sediment can be divided into classes based on its oxidised state. If the pyritic material above the water table is being oxidised and has a pH <4.0 it is called actual acid sulfate soil (AASS). If the pyrite material is below the water table and has not been oxidised, it is termed potential acid sulfate soil (PASS) and generally has a pH of >4.0. The pH has the potential to become much lower when the soil is exposed to oxygen. Sediment, which, after the addition of hydrogen peroxide, has a pH <2.5 strongly indicates the presence of ASS (Ref [9]).

The ASSMAC Guidelines outline an Action Criteria based on Acid Sulfate Soil analysis. These are based on three broad texture categories, and can be seen in **Table 1**.

Table 1 *Acid Sulfate Soils Action Criteria for Different Texture (Ref [9])*

Type of Material		**Action Criteria if 1 to 1000 Tonnes of material is Disturbed**		**Action Criteria > 1000 Tonnes of material is Disturbed**	
Soil Texture	Approx. Clay Content (%)	Equivalent Sulfur (%S)	Equivalent Acidity (mol H^+/tonne)	Equivalent Sulfur (%S)	Equivalent Acidity (mol H^+/tonne)
Coarse (silty sand to sands)	≤5	0.03	18	0.03	18
Medium (sandy loam-light clay)	5-40	0.06	36	0.03	18
Fine (medium to heavy clays and silty clays)	≥40	0.1	62	0.03	18