REMEDIAL ACTION PLAN

Lot 412 & 413 DP 1063902, Medowie NSW

Prepared for Catholic Diocese of Maitland Newcastle

c/- Webber Architects

Prepared by RCA Australia

RCA ref 13156a-401/1

October 2018

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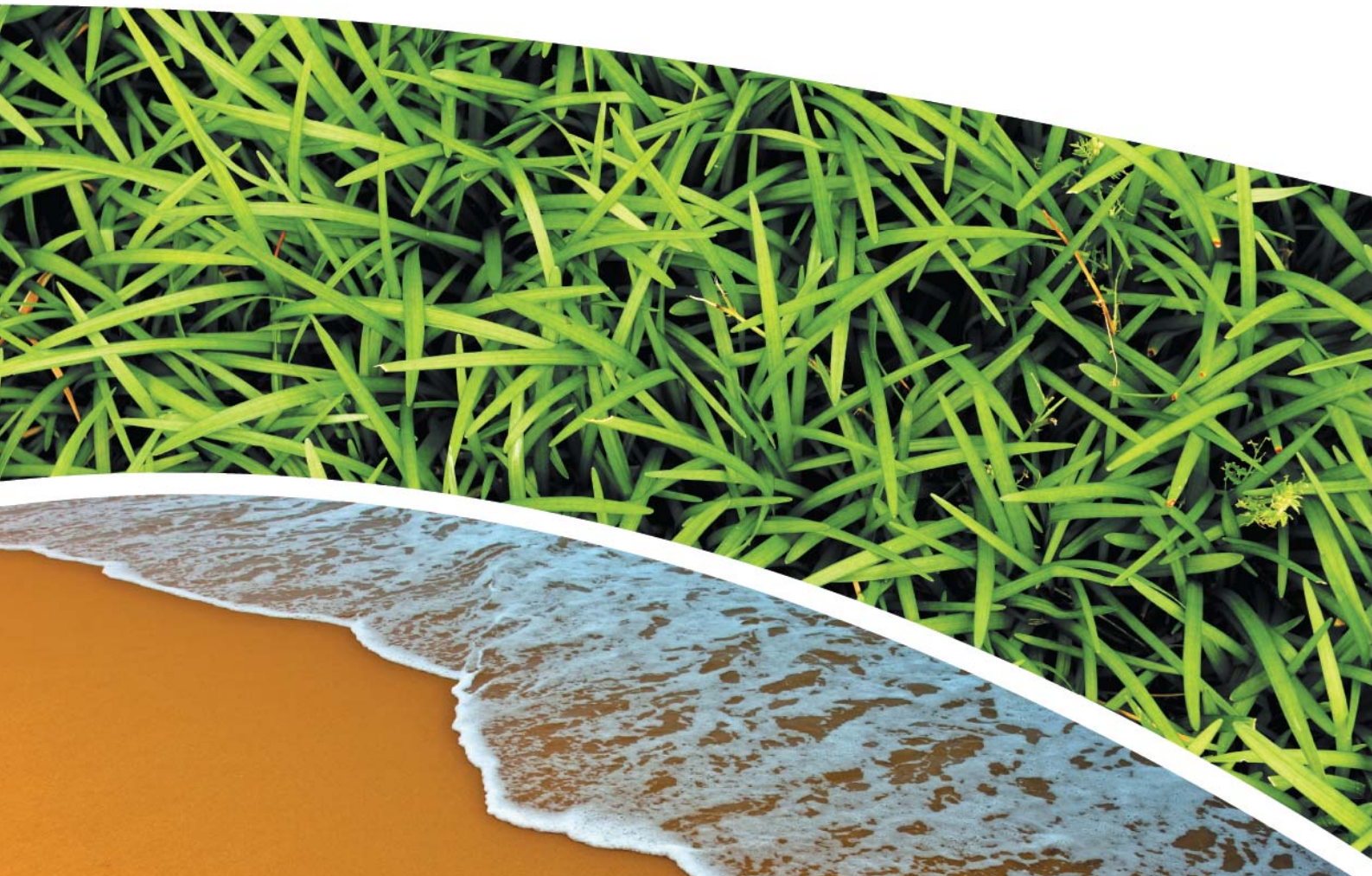

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REMEDIAL ACTION PLAN
LOTS 412 & 413 DP 1063902, MEDOWIE NSW

EXECUTIVE SUMMARY

RCA Australia (RCA) was engaged by Webber Architects on behalf of the Catholic Diocese of Maitland Newcastle to compile a remedial action plan for impacted fill material encountered at Lots 412 and 413 DP1063902, Medowie NSW. Part of the works included further assessment of the two (2) fill mounds located adjacent to a bituminous former go-kart track on the site to fully characterise them and classify as required.

RCA's assessment of the site identified that material within the northern mound was suitable for use, subject to management of potential acid sulfate soil properties, however hydrocarbon contamination was present within the south western mound. The material within the south western mound is impacted with elevated hydrocarbons concentrations, primarily of PAH; carcinogenic PAH (B(a)P equivalent) and benzo(ay)pyrene with benzene and TRH >C_{16}-C_{34} were also elevated in some samples. The soil also indicated limited presence of acid sulfate soil properties. Based on the proposed development of a school providing early learning through to secondary education, the concentrations observed in the southern mound are not considered suitable to remain without further remediation and/or management. Approximately 600m^3 of material is considered to require remediation and/or management.

A review of the available remedial strategies was undertaken, with cap and containment considered to be the most appropriate solution for the site due to logistical, timing and financial aspects of the project.

The proposed cap and containment strategy will comprise the movement of impacted fill material to an area of the site which will be covered with suitable capping material. The material, which is considered to be approximately 600m^3 in volume, will be surveyed and demarcated with a high visibility maker layer directly above the impacted material. The depth of the capping material may vary across the site dependent on the material being used, however this will be documented and surveyed for use in validation and ongoing management of the site.

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1 INTRODUCTION

RCA Australia (RCA) previously conducted an environmental site assessment (ESA, Ref [1]) at 507 Medowie Road and 2 Kingfisher Close, Medowie NSW (Lots 412 and 413 DP 1063902) at the request of Webber Architects who are acting on behalf of the Catholic Schools Office. It is understood that the two (2) Lots are proposed to be used for the development of the proposed Catherine McAuley Catholic College, which is a state significant development (SSD), lodged as SSD 8989. The proposed development comprises a secondary school, primary school, place of worship, early learning centre and future potential for residential use in a northern portion of the site along Kingfisher Close.

The ESA (Ref [1]) concluded that some fill material present on the site was not suitable for the proposed site use and during the site's SSD application the Department of Planning and Environment has therefore requested (Ref [2]) that a remedial action plan (RAP) be prepared for the site.

This report has been prepared following further works which have been undertaken on the fill material to assess and characterise the mounds and allow for an appropriate RAP to be developed for the site. This report represents a partial RAP and has been compiled to facilitate consideration of the preferred remedial strategy based on project constraints.

2 SITE IDENTIFICATION AND DESCRIPTION

The site comprises of two (2) Lots, which are described as 507 Medowie Road, Medowie, NSW, Lot 412 DP 1063902 and 2 Kingfisher Close, Medowie, NSW, Lot 413 DP 1063902.

Additional site details are shown in **Table 1**.

Table 1 *Site Details*

Current zoning (Ref [3])	 R2 Low density residential and RU2 Rural Landscape
Current use **Proposed use**	Lot 412 DP 1063902 has been previously used for residential use, and consists of one dwelling, large shed, tennis court and bitumen track. This infrastructure is still present, however was vacant during fieldwork undertaken as part of this assessment. Lot 413 DP 1063902 is vacant. Part of the site is proposed to be used as a Catholic College, including early learning through to Year 12. Residential use of a portion of the site is also proposed for a later date. The remainder of the site is understood to remain vacant and undeveloped.
Size of site	Lot 413 DP 1063902 – 10 ha Lot 412 DP 1063902 – 16.83 ha Proposed College Development – 6.7 ha
Land use to the: **North**	Residential housing which falls under R5- Large Lot residential zoning
South	Rural property with grassland, bush and wetlands. A small electrical substation is located within the paddock.
East	An electrical substation and residential house is located directly adjacent to Lot 413 DP 1063902. Medowie Road is directly adjacent to the site. On the other side of the road is residential housing and Pacific Dunes Golf Course.
West	The area is zoned RU2 Rural Landscape, but consists of bushland and possible wetlands.
Nearest sensitive receptor (human health)	Kindy Patch Medowie – Kindergarten and preschool approximately 40m directly east of the site.
Nearest sensitive receptor (environmental)	There is a dam/wetland located in the western portion of the site, whilst a creek/ drainage channel is located in the southern portion of the site. Wetlands are present on the site and directly adjacent to the south, west and northeast of the site (Ref [4]). Grahamstown Dam is located approximately 3.5km west of the site, which is a primary water source for the Newcastle area. A habitat corridor is located along the western boundary of the site as specified within the Medowie Planning Strategy (Ref [5]).

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

3 SITE HISTORY AND BACKGROUND INFORMATION

Previous assessment of the site has been conducted by RCA early in 2018 (Ref [1]) which comprised a combined preliminary and detailed site assessment and was submitted as part of the environmental impact statement (EIS) required for the site's development application.

The preliminary assessment included a historical review of the whole development area and surrounding notifications, local council records, site specific requirements under SSD 8989, published local geology and hydrogeology, nearby registered groundwater bores and historical aerial photographs.

Intrusive works were subsequently conducted at a reduced frequency from the minimum sampling design guideline recommendations (Ref [6]) based on the limited potential for impact based on the historical assessment. Fieldwork conducted on the site included the drilling of twenty three (23) locations for assessment of the soil material and the drilling, installation of, and sampling of three (3) groundwater monitoring wells. These works were conducted to adequately characterise and determine the contamination status of the site. Assessment for potential acid sulfate soils and saline soils was also included within these works.

RCA determined (Ref [1]) that the site has been formerly used for go-karting activities, residential use, and some agricultural use including a small orchard in the southern portion of the Lot 412 DP1063902. Fill mounds were observed on the site within close proximity to the bituminous go-kart track, however the source of the fill material was unknown. Some elevated concentrations of hydrocarbons were encountered within the fill material, and are shown on **Drawing 2**, **Appendix A**. Concentrations indicated that further assessment was required, with a concentration in the south western mound greater than 250% the applied criterion and therefore not considered suitable to remain on the site without further works or management conducted. Leachate analysis under neutral conditions (considered to be representative of rainfall) was undertaken on the two elevated samples; results indicating some concentrations of naphthalene, phenanthrene and anthracene which would be greater than the 99% trigger level for freshwater environments (Ref [7]).

Exceedance of zinc ecological criterion and human health and ecological criteria for total recoverable hydrocarbons were reported in other areas of the site, with the greatest concentration reported 1.18 times above the applicable guideline criteria. These areas were considered to be isolated and due to the results reported, were not considered to affect the suitability of the site for the proposed land use.

The existing dwelling and associated shed structures on the site were audited for the presence of hazardous materials at the time of assessment as they will be demolished as part of the proposed works, with none recorded.

4 PRELIMINARY CONCEPTUAL SITE MODEL

The source of the soil mound is unknown, although was suspected (Ref [1]) to be associated with what is presumed to be a go-kart track immediately adjacent the mound. Based on this and the previous works, RCA considers that the potential contamination arises from:

- The use of material within a go-kart track pavement. Contaminants of concern are considered to be hydrocarbons and metals.
- Source of the material. It is unknown whether the material was imported to site and what the potential sources of contamination at the source site are. Pesticides were not detected in the limited number of samples collected.
- Potential acid sulfate soils. No assessment of the potential acid sulfate soils was undertaken on the soil mound during the previous works (Ref [1]). It is not considered likely that the soil would be acid sulfate soil however it is considered prudent that this be considered prior to determining the fate of the material.

Results of the previous assessment are included in **Appendix B**.

5 SAMPLING AND ANALYTICAL QUALTIY PLAN

No formal sampling and analytical quality plan (SAQP) was developed for this assessment. The scope of work has been based on the previous assessment (Ref [1]) which considered the fill mounds were not suitable for the proposed use. The previous assessment was undertaken over the whole of the proposed development footprint and therefore only limited assessment of the fill mounds was covered. The additional works included within this report were to provide a detailed evaluation of the fill mounds to allow for an appropriate remedial strategy to be employed. The following details the basis for the scope.

Table 2 *Data Quality Objectives of the Site Investigation*

Data Quality Objective	Description
Step 1- State the Problem	Assessment of the site as part of the development process of the proposed Catherine McAuley Catholic College previously identified elevated concentrations within fill mounds present on the site that were not considered suitable for the proposed use (Ref [1]). Further assessment was to be undertaken as part of the RAP due to previous scope of works only providing limited detail regarding the fill mounds. The further works were intended to offer more detail in regards to the fill material present, including presence of anthropogenic materials, and sufficient characterisation of the material. It was considered that this information would enable consideration of which remedial strategy/ies are most appropriate for the site.
Step 2- Identify the Goal and Decisions	Based on the limited assessment previously undertaken, potential contaminants of concern are considered to primarily be hydrocarbons. However due to the variable nature of uncontrolled importation of fill; metals and pesticides (OCP and OPP) have also been included as part of the assessment. The key uncertainties that the investigation was to address were: • Were the results of the previous assessment representative of the fill mounds as a whole? • How much of the material is not considered suitable for use on the site? • Is there presence of anthropogenic materials not previously identified? • What is the source of the elevated hydrocarbon concentrations; is this related to the presence of asphalt? • Is any of the fill mound material considered suitable for the proposed use and therefore not required to be subject to remedial measures?

Data Quality Objective	Description
Step 3- Identify the Inputs to the decisions	Previous assessment information (Ref [1]); including historical information, sampling and results relevant to the fill mounds. Field observations. Analytical data for the collected samples. Appropriate field methods. Appropriate laboratory analysis methods. Guidelines for assessing risk to human health and the environment from contaminated soil under residential site use due to the proposed sensitive use as a school that will have children from early learning through to the end of secondary education. Due to the limited scope of fieldwork, site specific EIL were not to be generated and therefore the most conservative of the guideline criteria in the ASC NEPM (Ref [8]) were to be used for comparison. Material will be also assessed against the NSW EPA Waste Classification Guidelines (Ref [9]) to allow for determination of off-site disposal suitability as part of the possible remedial strategies detailed further in this report. The ASSMAC (Ref [10]) document is considered the most appropriate guidance for potential acid sulfate soils. RCA have utilised the coarse material criteria, which are the same for projects regardless of the amount of tonnes disturbed. These are the most conservative of the available criteria and is considered consistent with previous observations (Ref [1]) of the material within the mounds. Full details of the relevant guidelines are included in **Appendix C**.
Step 4- Define the Boundaries of the investigation	The extent of the assessment was defined by the fill mounds which are easily identifiable on the site. They were situated bordering the presumed former go-kart track present on the central portion of Lot 412 DP1063902. **Drawing 1**, **Appendix A** presents the approximate extent of the fill mounds. The vertical extent was defined by the depth of fill. Topography adjacent to the fill mounds allowed for some visual correlation to the depth of fill because limited to no fill material were observed around these mounds. Groundwater was not considered to require assessment as this is a targeted investigation and groundwater assessment has been undertaken previously (Ref [1]). No limiting practical constraints that could have interfered with sampling were identified. The financial constraint had been defined in accordance with the agreement between RCA, Webber Architects and the Catholic Schools Office. RCA understood that there were considerable time constraints with project completion to maintain the development program as detailed by Webber Architects.

Data Quality Objective	Description
Step 5- Develop the Decision Rules	Data Quality Indicators of accuracy, precision, completeness, representativeness and comparability were to be used for the project. Specific criteria are detailed below. Data Quality Indicators: *Accuracy* • Determined internally with surrogates, laboratory control samples (LCS), matrix spikes, method blanks. • Criteria include 70 to 130% recovery for surrogates, LCS and spikes. Blank results were to be less than the practical quantification limit (PQL). *Precision* • Determined internally with laboratory duplicates and externally with intra-laboratory duplicates. • Criteria required the relative percentage difference (RPD) of all duplicates to be less than 30%. If RPD over 30% were encountered, discussion on the non-conformance and the significance on the data was to be provided. *Completeness* The percentage of completed data points, taking in account consideration of other DQI was to be 95%. *Representativeness* Whether there had been sufficient sampling by appropriate methodology with relevant analysis to determine that the assessment was representative of the site conditions. *Comparability* • All samples collected during this sampling programme were to be obtained by adequately trained RCA personnel using consistent sampling methodologies throughout the project. • All samples must have been received by the laboratory cool and appropriately preserved for the requested analysis with sufficient time for testing within the specified holding time. • All laboratory analyses was to be conducted by NATA accredited methodologies that comply with the international standard methods referred to in the ASC NEPM (Ref [8]) guidelines. • Comparable analytes such as TRH C_6-C_{10} and BTEX, PAH and TRH $C_{>10}$-C_{40}, and metals should have shown some concurrence between analytical results and to identified field observations.

Data Quality Objective	Description
Step 6- Acceptable Limits on Decision Rules	In the event that data was received which was not in accordance with the DQI, the useability of data was to be determined after consideration of: • Closeness of the result to the guideline concentrations. • Specific contaminant of concern (eg, response to carcinogens may have been more conservative). • The area of site in question and the potential lateral and vertical extent of questionable information. • Whether the uncertainty can be effectively managed by site management controls. The significance of the non-conformance would have determined if rectification was required. Refer to the Quality Assurance and Control Assessment for the project, **Appendix D**.

Data Quality Objective	Description
Step 7- Optimisation of the Design of the Collection of Data	The derived scope of work was to have comprised the collection of sixty (60) samples from the northern fill mound and twenty four (24) from the south western mound to characterise the fill material and allow for adequate classification. The total number of samples is in accordance with the recommended frequency of 1/25m^3 as recommended by the EPA Victoria for the characterisation of stockpiles (Ref [11]) which is endorsed by the ASC NEPM (Ref [8]) for stockpiles which have estimated volumes of 1,400m^3 and 600m^3 respectively. The number of samples to be collected were considered to be sufficient to allow for some variability in the material. Samples were to be collected from three (3) different depths within northern and south western mounds respectively on a systematic grid sampling pattern (Ref [11]). Sampling depths were to be collected from approximately 0.3mbgs, 1.0mbgs and 1.5-2.0mbgs. Soil samples were to be collected directly from the excavator bucket. This method of sampling was chosen due to the presumed absence of volatile compounds based on the previous sampling and to provide for full inspection of the soil mound. Soil samples were screened with a photoionisation detector (PID) for the presence of volatile compounds and to assist in the sample selection process. Should impact have been identified, additional sampling may have been collected. 50% of the samples collected were to be analysed. All selected soil samples, forty two (42) in total, were to be analysed for metals and hydrocarbons, whilst twenty one (21) were to be further assessed for the presence of pesticides (OCP and OPP). All samples collected were screened for acid sulfate potential due to the unknown source of the material and previous investigation indicated potential for ASS on parts of the site. From the screening results, an allowance for ten (10) samples were included for complete chromium reducible sulfur (CRS) analysis. Soil samples were to be stored in the field in a chilled container on ice. All samples were to be sent to the laboratory under Chain of Custody (COC) documentation. ALS and Eurofins Mgt were to be used as the analysing laboratory for all analyses due to their NATA accreditation and experience with potentially contaminated materials; these laboratories are also consistent with the previous assessment undertaken.

6 FIELDWORK

An environmental scientist experienced in the handling of potentially contaminated soil undertook the fieldwork on 5 and 6 September 2018. The scope of work included:

- A site inspection.
- The collection of seventy nine (79) soil samples from twenty eight (28) test pit locations on the fill mounds, as presented on **Drawing 2**, **Appendix A**:
    - Twenty (20) test pits were located on the northern mound, in which sixty (60) samples were collected from depths between 0.3mbgs and 1.9mbgs.
    - Eight (8) test pits were located on the south western mound, in which nineteen (19) samples were collected from depths between 0.3 and 1.3mbgs. This is slightly less than the number specified within the DQO identified in **Section 5**. Natural material was encountered at a depth shallower than expected and therefore the 1.3-1.5m sample was not collected in TP28. This is not considered to impact characterisation of the fill mound as the number of samples analysed did not change.
    - Samples were collected from using an excavator. Sampling depths were predetermined to allow for a systematic 3-D grid to be employed as specified within the VIC EPA guidelines for sampling stockpiles (Ref [11]).
    - All samples were screened at the time of collection with a PID, the results of which are shown on the logs provided in **Appendix E**.
- Logging of test pits including description of samples for texture, colour, odour, moisture content.
- Re-instatement of all excavations.
- Analysis of forty two (42) soil samples for chemical analytes; in which thirty (30) were from the northern mound and twelve (12) were from the south western mound. Samples were analysed for total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylenes (BTEX), polycyclic aromatic hydrocarbons (PAH), metals (arsenic, cadmium, chromium, copper, lead, nickel, zinc, mercury).
    - Twenty one (21) samples were additionally analysed for organochloride and organophosphorous pesticides (OCP, OPP).
- All samples collected were screened for acid sulfate potential.
    - Ten (10) were additionally sent for CRS based on the screening results.

No gross contamination issues were identified within the mounds during fieldwork.

The northern mound material was generally more homogenous, consisting of sandy clay with gravels. Anthropogenic material consisting of glass, concrete, geo fabric, rebar was observed within the material. PID readings of all samples in this mound reported low concentrations (<10ppm), indicating minimal vapour concentrations within the encountered soil.

The smaller, south western mound reported higher PID concentrations, with the greatest reading 64.6ppm at 1.0mbgs in TP23. No visual or olfactory signs of impact were observed to correlate with this result. Anthropogenic material was also encountered within this mound; however the material varied from the northern mound and included asphalt, concrete, terracotta pipe and plastic. The material within this mound was more heterogeneous than the northern mound, with material comprising of sands, sandy clays, and clayey sands.

7 QUALITY ASSURANCE/QUALITY CONTROL

RCA has assessed the quality assurance and control in **Appendix D** and found it to be acceptable for the purpose of site assessment.

8 RESULTS

Soil results have been compared to the relevant criteria, with samples segregated into the northern and south western mounds for the purposes of characterisation. The following section presents a summary.

8.1 NORTHERN MOUND

All samples were screened for potential ASS and results are presented in **Table 3** below. Twenty three (23) of the samples met one or more of the triggers for possible presence of (potential) acid sulfate soil.

Table 3 *Acid Sulfate Screening Results – Northern Mound*

Sample (Trigger)	Initial pH (<4)	pH after oxidisation (<4)	pH drop (>1)	Reaction Rate (>2)
TP1/0.3	5.71	4.33	**1.38**	2
TP1/1	5.99	4.60	**1.39**	2
TP1/1.5	6.46	4.67	**1.79**	2
TP2/0.3	5.22	4.15	**1.07**	2
TP2/1	5.39	4.09	**1.30**	2
TP2/1.5	**3.28**	4.24	-0.96	2
TP3/0.3	4.98	4.10	0.88	2
TP3/1	4.76	**3.51**	**1.25**	2
TP3/1.7	4.81	**3.73**	1.08	2
TP4/0.3	5.93	**2.94**	**2.99**	2
TP4/1	4.88	4.04	0.84	2
TP4/1.8	4.82	**3.82**	1.00	1
TP5/0.3	5.33	4.37	0.96	2
TP5/1	5.04	4.10	0.94	1
TP5/1.6	6.31	5.50	0.81	**4**
TP6/0.3	5.61	4.46	**1.15**	2
TP6/1	5.77	4.60	**1.17**	2
TP6/1.5	5.43	4.64	0.79	**3**
TP7/0.3	5.20	4.50	0.70	2
TP7/1	5.55	4.54	**1.01**	**3**
TP7/1.6	5.58	4.23	**1.35**	2
TP8/0.3	5.05	4.21	0.84	2
TP8/1	4.39	4.30	0.09	2
TP8/1.7	5.34	4.19	**1.15**	2
TP9/0.3	5.11	4.08	**1.03**	1
TP9/1	5.13	4.00	**1.13**	2
TP9/1.5	5.02	4.14	0.88	2

Sample (Trigger)	Initial pH (<4)	pH after oxidisation (<4)	pH drop (>1)	Reaction Rate (>2)
TP10/0.3	5.04	4.34	0.70	2
TP10/1	5.38	4.11	**1.27**	2
TP10/1.9	5.14	4.07	**1.07**	2
TP11/0.3	5.08	4.20	0.88	2
TP11/1	4.94	4.15	0.79	2
TP11/1.5	5.24	4.36	0.88	1
TP12/0.3	5.26	4.37	0.89	2
TP12/1	4.92	4.07	0.85	2
TP12/1.7	4.91	4.00	0.91	2
TP13/0.3	5.21	4.35	0.86	2
TP13/1	5.28	4.35	0.93	2
TP13/1.7	4.76	4.56	0.20	2
TP14/0.3	4.63	4.23	0.40	2
TP14/1	4.64	4.19	0.45	2
TP14/1.6	4.78	4.26	0.52	2
TP15/0.3	4.85	4.43	0.42	2
TP15/1	5.19	4.60	0.59	2
TP15/1.5	5.39	4.56	0.83	2
TP16/0.3	5.41	4.51	0.90	2
TP16/1	4.80	4.10	0.70	2
TP16/1.6	5.11	4.32	0.79	2
TP17/0.3	5.24	4.67	0.57	2
TP17/1	5.02	4.40	0.62	2
TP17/1.8	5.30	4.22	**1.08**	2
TP18/0.3	5.32	4.28	**1.04**	2
TP18/1	5.06	4.18	0.88	2
TP18/1.5	4.90	4.04	0.86	2
TP19/0.3	5.17	4.38	0.79	2
TP19/1	5.15	4.18	0.97	2
TP19/1.7	5.10	4.25	0.85	2
TP20/0.3	5.46	4.76	0.70	2
TP20/1	5.21	4.45	0.76	2
TP20/1.5	5.34	4.71	0.63	2

Bold identifies where pH value less than 4, pH drop of greater than 1 pH unit, and reaction rate >2.

Based on the screening results, five (5) samples from the northern mound were sent to an external laboratory for chromium reducible sulphur (CRS) testing to determine the potential for acid sulfate soils and the neutralising capacity. Results are shown in **Table 4** below.

Table 4 *Acid Sulfate Soil Analysis – Northern Mound*

	TP1 (1.5m)	TP3 (1.0m)	TP4 (0.3m)	TP8 (1.7m)	TP18 (0.3m)
pH	4.9	4.8	5.1	5.9	4.7
Chromium Reducible Sulphur (% S) **Guideline (Ref [10]) 0.03**	0.007	0.005	<0.005	0.012	<0.005
Acidity - Chromium Reducible Sulphur (mole H^+/t) **Guideline (Ref [10]) 18**	<10	<10	<10	<10	<10
Sulfidic - Acid Neutralising Capacity (% pyrite S)	--	--	--	--	--
Liming Rate (kg $CaCO_3$/t)	2	3	1	1	2

Bold indicates those in excess of the guideline (Ref [10]).

Based on the results, none of the samples are considered to be acid sulfate soils. Sample TP2 (1.5m) is considered to be likely actual acid sulfate soil based on the initial pH however was identified to have sufficient buffering capacity within the sample to neutralise the generated acid during the testing process.

Chemical results are compared to the guidelines in **Appendix F**. In summary, samples from the northern mound exhibited:

- BTEX concentrations below laboratory quantification in all of the samples analysed and are therefore concentrations are considered to be below the relevant criteria.
- TRH concentrations below laboratory quantification in any of the samples analysed and are therefore concentrations are considered to be below the relevant criteria.
- PAH concentrations below laboratory quantification in any of the samples analysed and are therefore concentrations are considered to be below the relevant criteria.
- Concentrations of metals below quantification or at low concentrations well below the applied guideline criteria for residential site use.
- OCP and OPP concentrations below laboratory quantification in any of the fifteen (15) samples analysed and therefore concentrations are considered to be below the relevant criteria.

Laboratory report sheets from both the screening and CRS analysis are provided in **Appendix D**.

8.2 SOUTH WESTERN MOUND

All samples were screened for potential ASS and results are presented in **Table 5** below. Twenty three (23) of the samples met one or more of the triggers for possible presence of (potential) acid sulfate soil.

Table 5 *Acid Sulfate Screening Results – South Western Mound*

Sample (Trigger)	Initial pH (<4)	pH after oxidisation (<4)	pH drop (>1)	Reaction Rate (>2)
TP21/0.3	5.10	**3.55**	**1.55**	2
TP21/0.6	4.85	**3.00**	**1.85**	2
TP22/0.3	4.24	**3.26**	0.98	2
TP22/1	4.79	**3.74**	**1.05**	2
TP23/0.3	5.04	**3.89**	**1.15**	2
TP23/1	4.78	**3.76**	**1.02**	1
TP24/0.3	4.72	**3.78**	0.94	1
TP24/1	6.33	6.02	0.31	**3**
TP25/0.3	7.25	6.48	0.77	**3**
TP25/1	7.68	6.68	1.00	**4**
TP25/1.2	7.59	6.24	**1.35**	**4**
TP26/0.3	5.63	4.02	**1.61**	1
TP26/1	7.62	7.43	0.19	**4**
TP26/1.2	7.87	7.72	0.15	**4**
TP27/0.3	7.73	6.53	**1.20**	**3**
TP27/1	8.08	7.16	0.92	**4**
TP27/1.1	7.90	7.13	0.77	**4**
TP28/0.3	8.02	7.53	0.49	2
TP28/1	8.15	7.41	0.74	2

Bold identifies where pH value less than 4, pH drop of greater than 1 pH unit, and reaction rate >2.

Based on the screening results, five (5) samples from the south western mound were sent to an external laboratory for chromium reducible sulphur (CRS) testing to determine the potential for acid sulfate soils and the neutralising capacity. Results are shown in **Table 6** below.

Table 6 *Acid Sulfate Soil Analysis – South Western Mound*

	TP21 (0.6m)	**TP22 (1.0m)**	**TP23 (0.3m)**	**TP25 (1.2m)**	**TP26 (0.3m)**
pH	4.7	4.9	5.1	9.2	4.5
Chromium Reducible Sulphur (% S) **Guideline (Ref [10]) 0.03**	0.007	0.005	<0.005	**0.094**	0.015
Acidity - Chromium Reducible Sulphur (mole H^+/t) **Guideline (Ref [10]) 18**	<10	<10	<10	**59**	<10
Sulfidic - Acid Neutralising Capacity (% pyrite S)	--	--	--	4.65	
Liming Rate (kg $CaCO_3$/t)	3	2	1	<1*	6

Bold indicates those in excess of the guideline (Ref [10]).
***** Recommended liming rate is 4 without the ANC being taken into account.

Based on the results, none of the samples are considered to be acid sulfate soils with the exception of TP25 (1.2m) which is potential acid sulfate soil, however was identified to have sufficient buffering capacity within the sample to neutralise the generated acid during the testing process.

Chemical results are compared to the guidelines in **Appendix F**. In summary, samples from the south western mound exhibited:

- BTEX concentrations below laboratory quantification or at low concentrations below the guideline criterion with the exception of:
    - TP26 (1.2m) and TP27 (0.3m) which reported concentrations of benzene of 0.8mg/kg and 1.3mg.kg respectively. Both concentrations are in excess of the human health based criterion, with TP27 (0.3m) reporting concentrations over 250% of the guideline criterion.
- TRH concentrations were below laboratory quantification or at low concentrations below the guideline criteria with the exception of:
    - TP28 (1.0m) which reported a concentration of TRH fraction >C_{16}-C_{34} 1.36 times the guideline criterion.
- PAH concentrations were below laboratory quantification or at low concentrations below the guideline criteria with the exception of:
    - Benzo(a)pyrene concentrations in excess of ecological criterion in TP25 (0.3m), TP25 (1.2m), TP26 (1.2m), TP27 (0.3m) and TP28 (1.0m) by up to 12.4 times.
    - Carcinogenic PAH (B(a)P equivalent) concentrations in excess of the human health criterion in TP25 (0.3m), TP25 (1.2m), TP26 (1.2m), TP27 (0.3m) and TP28 (1.0m) by between 1.06 and 4.12 times.

- Metals concentrations below quantification or at low concentrations well below the applied guideline criteria for residential site use.
- OCP and OPP concentrations below laboratory quantification in any of the six (6) samples analysed and therefore concentrations are considered below the relevant criteria.

Laboratory report sheets from both the screening and CRS analysis are provided in **Appendix D**.

Soil results in excess of the relevant ecological and human health criteria are shown on **Drawing 2**, **Appendix A**.

9 SITE CONTAMINATION CHARACTERISATION

Test pitting was conducted within both of the two (2) fill mounds situated on the proposed Catherine McAuley Catholic College site. Assessment was conducted to allow for full characterisation of the material following limited previous assessment (Ref [1]) which recommended further works to be undertaken to determine suitability of the material.

The number of test pits and systematic 3-D grid employed across the mounds was based on the requirements stipulated in the VIC EPA stockpile sampling guidelines (Ref [11]) which is endorsed in the ASC NEPM (Ref [8]). The number of samples collected in each mound was in accordance with the 1:25m^3 sampling frequency for stockpile sampling (Ref [11]). Not all samples collected were sent for laboratory analysis and due to the concentrations in TP25 (1.2), TP27 (0.3) and TP28 (1.0) being >250% criterion the 95% UCL for the south western mound couldn't be calculated in accordance with the guidelines (Ref [11]). This stockpile would require further sampling in order to be considered fully assessed in accordance with the guidelines (Ref [11]). The northern fill mound is considered to have been fully assessed.

Based on the encountered materials within the mounds, RCA considers that the fill mounds should be assessed separately as they exhibited different characteristics.

The northern mound was found to be fairly homogenous in nature, with some anthropogenic material encountered. Assessment for potential contaminants indicates that the northern mound has not been impacted and would be considered suitable for use across the site as all analytes were below the applied guideline criteria for both human health and ecological communities under the sensitive receptor for residential site use. Anthropogenic material encountered within the material should be removed prior to placement of the material depending on the potential aesthetic impacts.

The indication of acid sulfate soil should be taken into account when using the material from the northern mound. While buffering capacity was identified during the testing process, this capacity may not be activated when the material is moved for the intended use. As such it is recommended that the material be considered to have acid sulfate soil properties and 6kg calcium carbonate be incorporated (i.e. thoroughly mixed with appropriate methodology for the strata) into each tonne of soil when material is being re-used on site.

Greater heterogeneity was encountered within the smaller fill mound located to the south western portion of the go-kart track. Anthropogenic material was predominantly concrete and asphalt, with terracotta pipe and plastic also observed. Characterisation of this material correlates with the results of the limited assessment previously undertaken (Ref [1]) in which BH17 reported elevated concentrations of hydrocarbons, predominantly PAH and heavier fractions of TRH (C_{16}-C_{40}). Further to elevated PAH and TRH, benzene concentrations were reported in two (2) samples of which one is at hotspot concentration (>250% the applied criterion). Elevated concentrations of hydrocarbons were observed at all depths of the fill mound but only in the northern portion of the mound; TP21-TP24 reports concentrations compliant with the applied guideline criteria and hydrocarbons concentrations were below the laboratory PQL. Comparison against the test pits logs indicates that the elevated concentrations of hydrocarbons generally correlates with the presence of asphalt in the fill material. One sample indicated the presence of acid sulfate soil and it is uncertain whether the buffering capacity identified during the testing process would be activated when the material is processed for remediation. As such it is recommended that the material be considered to have acid sulfate soil properties and 6kg calcium carbonate be incorporated (i.e. thoroughly mixed with appropriate methodology for the strata) into each tonne of soil when material is being re-used on site.

Due to the presence of the hydrocarbons it is considered that further remediation and/or management of the south western fill mound material is required in order for the material to be considered suitable for the proposed use as a school for early learning through to secondary education. The volume of material within this mound is considered to be approximately 600m^3, with the following section providing details of the remedial strategies available.

From the information reviewed remediation at the site would be considered to be Category 2 in accordance with SEPP 55 (Ref [12]). RCA does not consider that the impact of the site requires notification to the NSW EPA under the Contaminated Lands Management Act 1997.

10 REMEDIAL ACTION PLAN

Environmental assessment relating to the south western fill mound situated on the site, undertaken by RCA, has determined that the material is not suitable to remain on the site without remediation or management of the material.

This section provides detail of the options and recommendations available based on the impacted material that is not currently considered suitable for the proposed land use.

10.1 REMEDIATION GOAL

The plans provided to RCA, included as **Appendix G**, indicate that the site is proposed to be used for a Catholic College with attending children ranging from early learning through to secondary school level. The master plan includes an allocation for residential development along the northern boundary of Lot 413 DP1063902.

The goal of remediation is to render the site suitable for the proposed development of a school which includes sensitive receptors.

10.2 EXTENT OF THE REMEDIATION REQUIRED

The extent of remediation of the site is considered to be limited to a fill mound that is located to the south western portion of a bituminous track that is considered to have been used for go-karting activities. The fill mound is up to 1.5m in height and has an approximate volume of 600m^3. Elevated concentrations of hydrocarbons, predominantly benzo(a)pyrene, carcinogenic PAH and benzene have been identified within three (3) test pits dug in September 2018 and one (1) drill hole bored in February 2018 that are all located in the northern portion of the mound. Three (3) test pits were located on the southern portion of this mound which reported concentrations below laboratory PQL and the applied site guideline.

Due to the variation within the material, RCA consider that the entirety of the stockpile needs to be remediated, however note that material to the south of TP24 may be suitable for use on site. Further sampling in accordance with the allowance of the guidelines (Ref [11]) would be required to confirm the suitability of the material.

10.3 DISCUSSION OF POSSIBLE REMEDIAL OPTIONS

10.3.1 NO ACTION

The no action approach assumed an acceptable risk to receptors from the identified soil contamination and is generally not considered to be a suitable remedial strategy. Based on the proposed development of the site including sensitive receptors, this strategy is not considered to be a suitable option. Under current condition and management the site is not considered to pose a significant threat to human health or ecological communities.

10.3.2 IN-SITU TREATMENT

In-situ treatment of carcinogenic PAH (B(a)P equivalent) in soil generally has complications relating to the certainty of achieving the remedial goals. The main options to consider would be as follows:

Bioremediation

Enhanced bioremediation would involve the application soil micro-organisms to breakdown the B(a)P present to reduce the contaminant concentrations and associated toxicity. This would have no impact on the potential acid sulfate soil properties.

This strategy is generally not considered suitable because B(a)P tends to be recalcitrant to microbial degradation (Ref [13]) and therefore is not considered to be a suitable remedial strategy.

Soil Flushing

Soil flushing involves the application of a solvent to mobilise the contaminant. To address the primary contaminant a hydrophobic, non-ionic surfactant or hydrophobic solvent would have to be used. It is reported (Ref [13]) that soil flushing can cause spreading of contaminants, performance can be difficult to predict and requires management of contaminated flushing solution. This would have no impact on the potential acid sulfate soil properties.

The use of in-situ soil flushing will address soil in the saturated zone but will have limited effect on soils in the vadose zone (above the groundwater table) and therefore the technology is not considered suitable for the mounded material.

Stabilisation/Sorption

Stabilisation/sorption would involve the introduction of a reagent to bind with the contaminant, thus reducing the mobility of the contaminant. Stabilisation/sorption is generally used to reduce the leaching potential of contaminants to make material more acceptable for disposal to landfill rather than removal of the contaminant. The method would potentially address the carcinogenic PAH component however would have to have a secondary neutralisation step for the potential acid sulfate soil properties.

A bench-scale study would provide additional information about the use of this technology on PAH. The technology is retained for further consideration however based on the small volume of impacted material it is considered that this option may not be viable.

10.3.3 EX SITU TREATMENT

Land Farming

Land farming would comprise the spreading of the material in a maximum layer of 0.5m and aeration to promote the biological degradation of contaminants. Neutralisation of the potential acid sulfate soil properties could be undertaken at the same time.

Land farming can significantly reduce lower molecular weight PAH, however is generally not considered effective for semi-volatile contaminants of which carcinogenic PAH (B(a)P equivalent) is considered to be. This method would be considered suitable for the elevated benzene identified in TP26 and TP27 only.

Soil Washing

Soil washing would require the excavation and physical washing of soils which in this case would require enhancement using surfactants or solvents. The waste fluid following the process would likely have high concentrations of PAH which would require a licensed waste contractor to dispose of. Acid runoff may also be generated.

This strategy may have limited success due to potential for contaminant binding within the clayey and gravel matrix and will produce waste fluid that will need appropriate management and disposal.

Stabilisation/Sorption

Stabilisation/sorption would involve the introduction of a reagent to bind with the contaminant, thus reducing the mobility of the contaminant. Stabilisation/sorption is generally used to reduce the leaching potential of contaminants to make material more acceptable for disposal to landfill rather than removal of the contaminant. The process may be able to be adjusted to address the potential acid sulfate soil properties.

The method may potentially address the carcinogenic PAH component however a bench-scale study would be required to provide additional information about the use of this technology on PAH but the technology is retained for further consideration although the small volume of impacted material may determine that this may not be viable.

Thermal Desorption

Thermal desorption involves the excavation of impacted soil and passing it through a thermal desorption plant which heats the waste to remove water and organic contaminants. This process may oxidise the material and secondary treatment of potential acid sulfate soil effects may be required.

This method is generally more suitable for larger projects due to the high cost of mobilising a treatment plant to the site and as the volume of material impacted is 600m^3 it is considered that this option will not be viable for the site.

10.3.4 CONTAINMENT

Cap and Contain

Containment of contamination on site is achieved through the application of compacted soil, asphalt or concrete over impacted areas to cut the pathway between source of contaminant and the receptor. This strategy requires ongoing management of the site through a long-term environmental management plan or protocol (LEMP) to ensure the remediation undertaken is maintained and protection of receptors (human and the environment) continues and therefore some continued investment may be required. This strategy is viable for all contaminants identified however may have to be supplemented with neutralisation of potential acid sulfate soil properties and is subject to geotechnical suitability of the material for the proposed use.

The plans of the proposed development (**Appendix G**) indicate that a significant portion of the site is covered with building slabs or roadways and therefore suitable containment areas are available.

Costs associated with these works will comprise the over-excavation of material from beneath building slabs and roadways to make a void, movement of the mound to beneath the buildings and roadways, compaction of the material in accordance with geotechnical requirements, placement of a marker layer around the material to delineate its position, survey of the position of the material and verification of the removal of the mound. As the material is within a mound, RCA considers that validation would comprise visual verification that the mound had been removed from site. Depending on the placement depth of material, validation samples may be required to confirm neutralisation of potential acid sulfate soil properties.

An environmental management plan / strategy would be required to identify the presence of the mound material such that if any works are required in the area of emplacement that appropriate controls can be put in place for the protection of human health and the environment.

10.3.5 REMOVAL

Off Site Re-use

While no specific assessment has been undertaken, it is RCA opinion that the material does not appear to meet any of the Resource Recovery requirements (Ref [14]) for ‘excavated natural materials’, ‘excavated public road material’, ‘reclaimed asphalt pavement’ or ‘recovered aggregate’. A specific exemption for the use of the material may be granted by the NSW EPA based on the sampling undertaken and may allow the material to be beneficially used.

Costs for the specific exemption application are minimal and require personnel time to undertake the application. However additional sampling may be requested by the NSW EPA due to the wide variation in the results, although RCA note that the previous (Ref [1]) testing results included distilled water leaching of contaminated samples. It is considered likely that the acid sulfate soil properties will require treatment prior to any use and may invalidate the option.

Off Site Disposal

Removal with off site disposal would involve the excavation of impacted soil material and off site disposal to a suitably licensed facility. RCA does not consider that the material can be pre-classified as 'asphalt waste' in accordance with the guidelines (Ref [9]) due to the soil and other deleterious material and as such that material has to be classified based on the chemical concentrations. An assessment has been provided in **Appendix H** and identified that the material is currently Hazardous Waste in accordance with the NSW EPA Waste Classification Guidelines (Ref [8]), however further leachate assessment could revise the classification to General Solid Waste. The acid sulfate potential of the material would have to be addressed, subject to the requirements of the licensed waste disposal contractor.

Costs associated with these works would comprise the excavation and transport of the material to a licensed waste facility, disposal costs (in the order of $400/tonne for hazardous waste however subject to commercial agreement with licensed contractor) and verification that material has been removed and received at the appropriately licensed waste facility.

Following verification, no further or ongoing management would be necessary.

10.4 RATIONALE FOR THE SELECTION OF RECOMMENDED REMEDIAL OPTION

Based on a review of the suitable available strategies and based on the client's non-technical constraints, capping and containment has been determined to be most suitable. This option has been chosen due to:

- The limited extent of contamination which is restricted to the stockpiled fill material within the south western mound and estimated as approximately 600m^3.
- The suitability of this remedial option to address all contaminants present in all areas impacted.
- There is minimal environmental burden (i.e., no off site transportation required, and limited required on site) and the use of additional resources (landfill space, imported fills) is reduced compared to other options.
- The compatibility of the proposed development to the remediation strategy:
    - Significant portions of the site are proposed to be covered with hard stand materials from the construction of the school buildings and roads/pavement areas (refer to the plans provided in **Appendix G**). This will reduce the risk to site inhabitants and users whilst also limiting the potential for surface contamination to migrate in surface waters across and off the site providing that the material is considered suitable based on the required geotechnical properties.
- Acid sulfate soil properties identified within the material preventing the suitability for offsite re-use.
- Financial reasons based on the hazardous waste classification of the material under Tier 1 of the NSW EPA guidelines (Ref [9]).

10.5 REMEDIAL STRATEGY PROCESS

RCA considers that the remedial strategy will involve:

- Decision of the preferred location for the fill mound emplacement area as determined by the development design, geotechnical properties and any other constraints.
- Appointment of the earthworks contractor to implement the proposed strategy within the proposed overall development.
- Inclusion of the remedial strategy into the site management plan/ construction documentation and programme to ensure that all workers are aware of controls required to protect human health and the environment during works relating to the impacted material and subsequent capping works. Details of the requirements to be included are provided in **Section 10.9**.
- Distinct physical identification of the proposed emplacement area.
- Excavation of the south western fill mound and treatment for acid sulfate soil properties and geotechnical deficiencies, as necessitated.
- Emplacement of the south western fill mound material in the designated containment area.
- Placement of a geotextile material on the surface of the site to act as a marker layer between the site users and the potentially contaminated material.
    - This layer should be highly visible, either in the colour of the geotextile material, or else with the use of a secondary material on top of the geotextile.
    - The type of geotextile will be defined in the construction documentation based on the operational requirements such as difficulty in placement and trafficability. Different materials may be used in different areas as long as the material is highly visible, durable and will present a physical barrier[1] to potential future excavations.
    - A photographic log of the material and its placement will be maintained for use in the validation report and final LEMP. If differing materials/colours are used across the site, these need to be recorded.
- Survey of the emplacement area following the completion of works to provide detail on the final potentially contaminated surface.
- Installation of the chosen capping layer.
- Survey of the site to confirm design depths of capping have been achieved if material is being placed under a road or covered with clean fill (e.g. in an area of open space). Additional works to be undertaken where required.
- Compilation of a validation report which details the works undertaken and verifies it has been conducted to the required specifications to allow the site to be considered suitable for the proposed sensitive land use.
- Compilation of a LEMP which ensures the remediation undertaken is maintained, continued protection of the receptors (human and the environment) and that all personnel undertaking work at the site are aware of and implement procedures required. The requirements of the LEMP are discussed in **Section 10.15**.

[1] The geotextile does not have to prevent excavations, however it has to be such that anyone undertaking excavations will be aware of it upon encountering.

10.5.1 POTENTIAL CAPPING MATERIALS

Appropriate site capping would be considered to consist of any or a combination of the following:

- Concrete hardstand or building slab.
- Asphalt.
- Permanent paving.
- Compacted road-base of a minimum 100mm thickness.
- Any other engineered equivalent hardstand material.
- Placement of 500mm certified clean material, with some allowance for the top 100mm to be suitable for growing grass media. The presence of grass cover is considered suitable to minimise the potential for erosion of placed soil material.

A high visibility marker layer is considered to be required for any of these which could be penetrated without consent and prior approval from the Catholic Diocese of Maitland Newcastle or Catholic Schools Office.

10.6 PROPOSED VALIDATION TESTING

Validation of the remediation works is proposed to include survey of the emplacement area following the importation of the fill mound material and installation of the marker layer and visual inspection to confirm appropriate capping has been adequately placed across the emplacement area. If the chosen capping material consisting of clean fill material, the top of this material will also require survey to confirm that the cap is of suitable thickness.

The visual inspections at the site will be undertaken by a suitably qualified and experienced environmental consultant with a photographic log recorded. No validation sampling is considered to be required for the remediation works.

Survey records must be reported for the marker layer and top of capping material placed in areas where asphalt or concrete are not present.

At the completion of remediation a validation report is to be prepared in accordance with the NSW EPA *Guidelines for Consultants Reporting on Contaminated Sites* (Ref [14]). The validation report would confirm, or otherwise substantiate, the correct implementation of the remedial strategy and compliance with the construction documentation.

10.6.1 IMPORTED MATERIAL

Imported fill material shall be sourced from a certified source and documentation is to be provided for inclusion with the validation report. All material imported for the purpose of fill is to be certified as virgin excavated natural material (VENM), excavated natural material (ENM) or, under another resource recovery order, to the satisfaction of the environmental professional (Ref [15]). The following controls are stipulated prior to importation of materials to the site:

- Certification reports are to be reviewed for adequacy by an environmental professional prior to material being imported to site.
- Material is to be tracked from source to site and material is to be inspected upon its arrival to ensure that it matches the certification.

- Materials certified without sampling (such as VENM) may require confirmation sampling depending on the source, with analysis to be advised dependent on the type of material and as necessary based on the source. Materials imported to the site under a resource recovery order certification and documentation will not require additional testing is not a requirement.
- Material must be inspected by the project manager, or appropriate delegate, prior to acceptance at site to ensure the material matches the certification documents.
- Any stockpiles of material must be controlled to preserve the integrity of the certification prior to use.

Any material suspected to be potentially contaminated (based on visual inspection) or otherwise not in accordance with the certification description should be rejected and returned to the supplier.

10.7 REMEDIAL CONTINGENCY PLAN

The overall remedial strategy is considered to be robust and whilst it does not appear that a potential failure exists, the following potential issues could arise:

- The material is not considered to have the required geotechnical properties required for the desired emplacement area.
    - The material could be assessed for use in alternative areas, e.g. required properties for road design may vary significantly from a multi-storey building.
    - If the material is considered unsuitable for use under any hardstand areas of the site, the following could be employed:
        - Material may be used on areas of open space as long as a suitable high visibility marker layer and a minimum of 500mm clean and verified capping layer is installed.
    - Amelioration measures to treat the geotechnical properties.
- Failure to maintain the site in accordance with the required EMP the following contingency protocol is recommended:
    - Undertake maintenance as required, to restore the break in source/receptor pathway; or
    - Undertake detailed site specific risk assessment of the identified contamination; or
    - Undertake removal of material from the area of issue to a licensed landfill followed by validation of removal.
- Groundwater levels encountered during works within ground disturbance levels.
    - Should groundwater be encountered during works, there may need to be alterations to minimise the impact to groundwater. Alternatively the water could be stored and tested to allow for evaluation of the suitability of re-use, dewatering or appropriate disposal.

10.8 INTERIM SITE MANAGEMENT PLAN

The site is vacant and RCA has determined that the current vegetation coverage manages the potential risk to human or ecological health. As such, no interim site management plan is considered necessary.

10.9 REQUIREMENTS TO BE INCLUDED WITHIN CONSTRUCTION DOCUMENTATION

The construction documentation must identify the process, procedures and protocols associated with undertaking the remedial works in accordance with this RAP. The process may differ from that described in this RAP as long as the overall design of the remedial strategy is not compromised. Specific consideration of the following is to be included:

- Induction of personnel and register of inductions to be kept.
- Areas where impacted material is required to be excavated and the management and placement of that material.
- Identification of type and/or depth of capping across the site prior to works commencing.
- Identification of a marker/identifying layer (eg, highly visible and/or geotextile) to be used across the site and rationale for selection of type(s) if required dependent on the capping material employed.
- Material control such as certification of imported fill.
- Sediment and erosion control such as silt fencing.
- Surface water control such as interim contouring and redirection of upgradient overland flow.
- Noise control such as the management of work hours especially in relation to sensitive receptors.
- Dust control such as the use of water sprays or suppressants.
- WHS management plans for all activities, including those from external contractors. The plan must include processes for the event that unexpected finds of contamination are encountered.
- Contingency planning for response, management and reparation for incidents in relation to the above management plans.
- Remedial schedule.
- Hours of operation.
- Personnel contact details.
- Complaint management process.

10.10 REMEDIATION SCHEDULE

A remediation schedule can be defined at a later stage and undertaken in conjunction with the proposed development.

10.11 HOURS OF OPERATION

The hours of operation for site activities would be in accordance with the development approval and as specified in the construction documents.

10.12 IDENTIFICATION OF REGULATORY COMPLIANCE REQUIREMENTS

All work is required to be undertaken in accordance with any licences and approvals that apply to the site. The scope of remediation is not considered to require any specific approval beyond development approval.

10.13 CONTACT PERSONS

The responsible personnel for the project has not been finalised at this stage. These will be finalised prior to the commencement of work at the site and specified within the construction documents and forwarded to the relevant regulatory authorities.

10.14 COMMUNITY RELATIONS PLAN

It is envisaged that the community will be provided information about the project; however no specific information regarding the contamination is considered to require disclosure. Contact details of relevant site personnel will be included with any information provided.

10.15 LONG-TERM MANAGEMENT

A long-term environmental management plan or strategy (LEMP) will be required for the site. This plan will then be included in the legal documents associated with the site and will be managed by the McAuley Catholic College and the Catholic Diocese of Maitland Newcastle. The details and stipulations of the LEMP will be dependent on capping materials used, however will include, but not necessarily be limited to:

- Description of the contamination status of the site below the surface including survey plan of the locations.
- Precautions and control measures that have been put in place during the development to ensure the safety of the workers and visitors to the site and how they work.
- Obligations of the occupier in regards to those precautions and control measures, including maintenance of capping, prohibitions and approval requirements.
- Potential effects, including any legal implications, of non-compliance with the detailed obligations.

There must be a method to provide notification of restrictions to the site to future owners and occupiers.

If services are located within or directly adjacent to the emplacement area the relevant authorities, eg, Telstra, Hunter Water and Energy Australia, should be informed of and/or provided with the LEMP and the requirement to adhere to the management plan during any future works.

11 CONCLUSIONS

This report has presented the findings of further works conducted at 507 Medowie Road and 2 Kingfisher Close, Medowie NSW.

RCA were engaged by Webber Architects on behalf of the Catholic Diocese of Maitland Newcastle to conduct a detailed intrusive assessment of fill mounds located on the central portion of the site. Previous assessment (Ref [1]) had identified hydrocarbon concentrations in excess of criteria considered suitable for the proposed use of the site as a school and potential residential use. Fieldwork included test pitting operations and sampling of the material encountered for assessment of suitability for use on site and waste classification for removal off site.

Contamination was not identified within the northern mound with the exception of limited indications of acid sulfate soil properties which will require management during use at the site.

Hydrocarbon contamination was identified within the south western fill mound, approximately 600m^3 in volume, and the material within the south western mound is considered unsuitable for the proposed sensitive site use without remediation/management. Acid sulfate soil properties were also identified within this material that will require management.

A review of the available remedial strategies was undertaken with cap and containment considered to be the most appropriate for the proposed development due to logistical, timing and financial attributes in relation to the project.

The remedial solution includes moving material stockpiled in the south western mound, as identified in **Appendix A**, treatment of acid sulfate soil properties, installation of a high visibility marker layer and survey, installation of capping layer (clean material or hardstand). It is considered that as the development includes large areas of buildings and road; hardstand capping would be the preferred option; however this may be reliant on geotechnical constraints of the fill material. Dependent on the capping material used, the depth of the capping material may vary; however regardless of the capping material used, this will be documented and surveyed for use in validation and ongoing management of the site.

Following the completion of works a validation report and LEMP will be compiled, with the area in which the fill material has been used to be under ongoing management and monitoring as stipulated in the LEMP.

12 LIMITATIONS

This report has been prepared for Catholic Diocese of Maitland Newcastle in accordance with an agreement with RCA Australia (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 Catholic Diocese of Maitland Newcastle, Webber Architects and for compilation of the EIS. The report may not contain sufficient information for purposes of other uses or for parties other than Catholic Diocese of Maitland Newcastle, Webber Architects and for compilation of the EIS. 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

Katy Shaw
Senior Environmental Scientist

Fiona Brooker
Environmental Services Manager

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[3] Port Stephens Council, Local Environment Plan 2013 under the Environmental Planning and Assessment Act 1979, Land Zoning Map – Sheet LZN_004C, published December 2014.

[4] Port Stephens Council, Local Environment Plan 2013 under the Environmental Planning and Assessment Act 1979, Wetlands Map – Sheet WET_004, published October 2013.

[5] Port Stephens Council, Medowie Planning Strategy, 13 December 2016.

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GLOSSARY

ASC NEPM	National Environment Protection (Assessment of Site Contamination) Measure.
Bioremediation	The process by which living organisms act to degrade or transform hazardous organic contaminants.
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.
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.
In-Situ	In place, without excavation.

Interlaboratory	A sample sent to two different laboratories for comparative analysis.
Intralaboratory	A sample split into two and sent blind to the sample laboratory for comparative analysis.
ISL	Investigation screening levels for soil. Comprised of HIL/EIL and HSL/ESL
kg	kilogram, 1000 gram.
Leachate	Fluid that has passed through a soil stratum, possibly collects contaminants.
LEP	Local environment plan. A planning tool for the Local Government.
Methanogen	Bacteria that anaerobically oxidise hydrogen to methane and water using carbon dioxide as the electron acceptor. These occur in anaerobic mud, ponds and sewage sludge.
mg	milligram, 1/1000 gram.
NEPC	National Environment Protection Council.
NSW EPA	NSW Environment Protection Authority – formerly a component of DECC, DECCW, OEH but made a separate entity in 2011 to regulates the contaminated land industry.
Pathogen	An organism capable of causing disease.
PID	Photoionisation detector. Measures volatile gases in air or emanating from soil or water.
PPE	Personal Protective Equipment.
PQL	Practical Quantitation Limit.
QA	Quality Assurance.
QC	Quality Control.
RPD	Relative Percentage Difference.
Surfactant	A natural or synthetic chemical that promotes the wetting, solubilisation, and emulsification of various types or organic chemicals.
TCLP	Toxicity characteristic leaching procedure. An analysis designed to mimic the transfer of contaminants from soil into water. Undertaken in acidic environment and used to determine impact in landfill conditions.
Vadose Zone	Unsaturated zone of soil above the groundwater, extending from the bottom of the capillary fringe all the way to the soil surface.
VENM	Virgin excavated natural material.

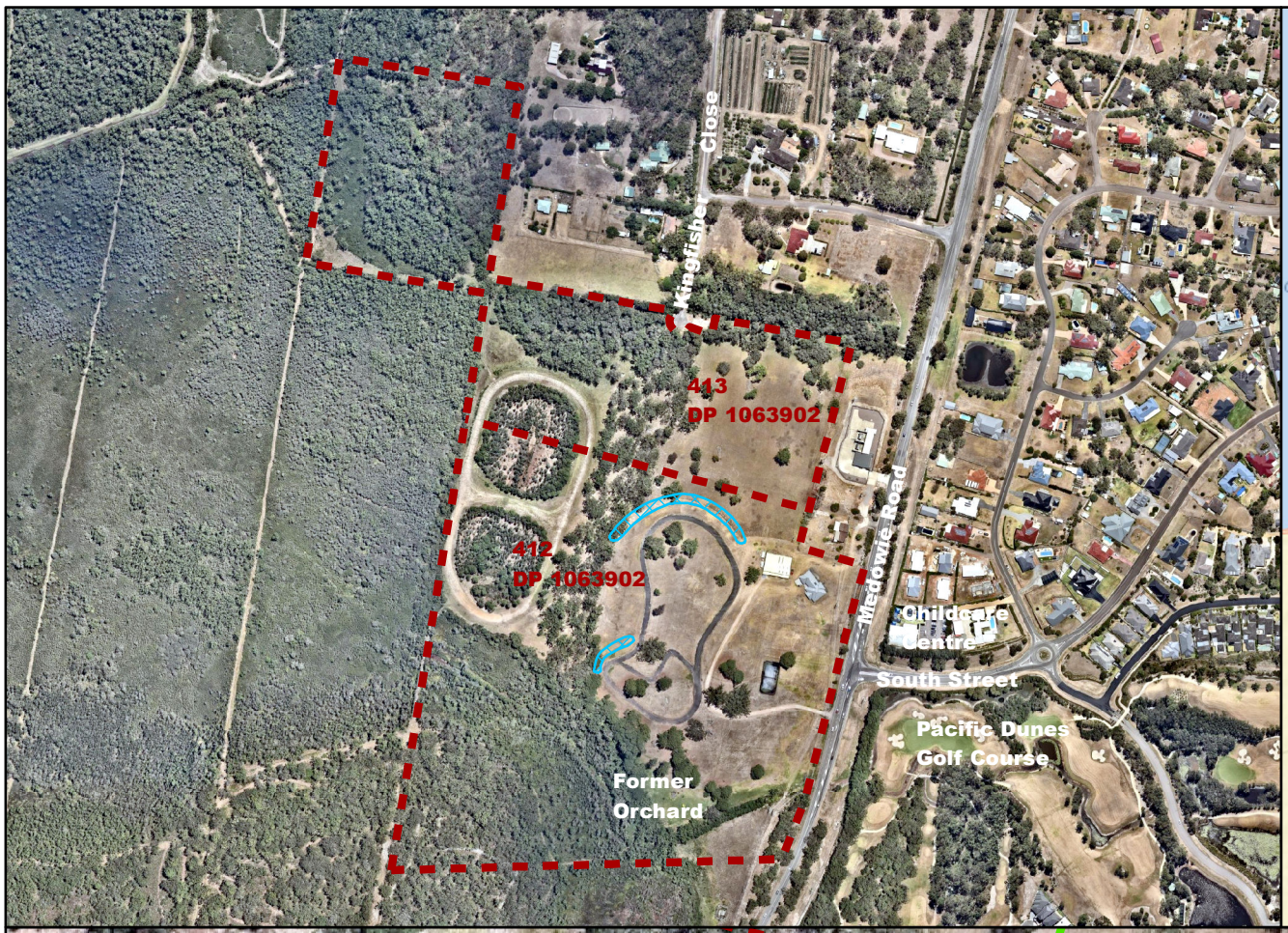
<u>Chemical Compounds</u>

BTEX	Benzene, toluene, ethylbenzene, xylene.
OCP	Organochlorin pesticides.

OPP	Organophosphate pesticides.
PAH	Polycyclic aromatic hydrocarbons. Multi-ring compounds found in fuels, oils and creosote. These are also common combustion products.
TPH	Total petroleum hydrocarbons.
TRH	Total recoverable hydrocarbons

Appendix A

Drawings



LEGEND

- Approximate Lot boundary location
- Approximate fill mound location
- Approximate location of 50m asset protection zone (considered extent of potential development)

NOTE:
Aerial image taken from Nearmap July 5 2017
(used in accordance with commercial licence)

N

0 37.5 75
metres

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

SITE DETAILS AND LOCALITY REMEDIAL ACTION PLAN LOTS 412 & 413 DP1063902 MEDOWIE, NSW

CLIENT Diocese of Maitland-Newcastle c/o Webber Architects				RCA Ref	13156a-401/1
DRAWN BY	KS	SCALE	1:1,250 (A3)	DRAWING 1	REV 1
APPROVED BY	FB	DATE	8/10/2018	OFFICE	NEWCASTLE

TP28 (1.0m)		
Analyte	**Guideline**	**Concentration**
TRH >C_{16}-C_{34}	300[B]	410
Benzo(a) pyrene	0.7[B]	8.7
Carcinogenic PAH (B(a)P equivalent)	3[C]	12.358

TP27 (0.3m)		
Analyte	**Guideline**	**Concentration**
Benzene	0.5[A]	1.3
Benzo(a) pyrene	0.7[C]	2.4
Carcinogenic PAH (B(a)P equivalent)	3[C]	3.36

TP26 (1.2m)		
Analyte	**Guideline**	**Concentration**
Benzene	0.5[A]	0.8
Benzo(a) pyrene	0.7[B]	2.3
Carcinogenic PAH (B(a)P equivalent)	3[D]	3.174

TP25 (0.3m)		
Analyte	**Guideline**	**Concentration**
Benzo(a) pyrene	0.7[B]	4
Carcinogenic PAH (B(a)P equivalent)	3[C]	5.909

TP25 (1.2m)		
Analyte	**Guideline**	**Concentration**
Benzo(a) pyrene	0.7[B]	7.1
Carcinogenic PAH (B(a)P equivalent)	3[C]	10.069

BH17B (0.2m)		
Analyte	**Guideline**	**Concentration**
TRH >C_{16}-C_{34}	300mg/kg[B]	460
Benzo(a)pyrene	0.7mg/kg[C]	10
Carcinogenic PAH (B(a)P equivalent)	3mg/kg[D]	13.6
Naphthalene	2.5 µg/L[A]	5.3
Phenanthrene	0.6 µg/L[A]	8.4
Anthracene	0.01 µg/L[A]	1.3

BH17C (1.2m)		
Analyte	**Guideline**	**Concentration**
Benzo(a)pyrene	0.7mg/kg[C]	4.1
Carcinogenic PAH (B(a)P equivalent)	3mg/kg[D]	5.5
Phenanthrene	0.6 µg/L[A]	3.9

Leachate Guidelines
All concentrations in µg/L
[A] ANZG 2018 99% Protection Level fresh environments

Soil Guidelines
All concentrations in mg/kg
[A] NEPM 2013 Human Health Screening Levels (HSL) 'A' Residential
[B] NEPM 2013 Ecological Screening Levels (ESL) 'URPOS' Urban Residential and Public Open Space
[C] NEPM 2013 Health Investigation Levels (HIL) 'A' Residential with access to soil
Guidelines are based on geological stratum and depth

TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP8 TP9 TP10 TP11 TP12 TP13 TP14 TP15 TP16 TP17 TP18 TP19 TP20
BH18 BH19
Northern Fill Mound
TP21 TP22 TP23 TP24 TP25 TP26 TP27 TP28
BH17
South Western Fill Mound

LEGEND

- Approximate Lot boundary location
- Approximate location of test pits
- Approximate location previous boreholes
- Approximate fill mound location
- Approximate location of 50m asset protection zone (considered extent of potential development)

NOTE:
Aerial image taken from Nearmap July 5 2017
(used in accordance with commercial licence)

N

0 30 60
metres

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

CRITERIA EXCEEDANCES REMEDIAL ACTION PLAN LOTS 412 & 413 DP1063902 MEDOWIE, NSW

CLIENT Diocese of Maitland-Newcastle c/o Webber Architects				RCA Ref	13156a-401/1
DRAWN BY	KS	SCALE	1:1,000 (A3)	DRAWING 2	REV 1
APPROVED BY	FB	DATE	8/10/2018	OFFICE	NEWCASTLE

Appendix B

Results from Previous Assessment (Ref [1])

Sample Identification	Sample Depth (m) [B]	Date	Sample Profile	Dominant Stratum [C]	Sample Purpose	Sample Collected by	Benzene, Toluene, Ethylbenzene, Xylene (BTEX)	Benzene	Toluene	Ethylbenzene	meta- and para-Xylene	ortho-Xylene	Total Xylenes	Polycyclic Aromatic Hydrocarbons (PAH)	Naphthalene	Total Recoverable Hydrocarbons (TRH)	TRH C_6-C_{10}	TRH >C_{10}-C_{16}	TRH >C_{16}-C_{34}	TRH >C_{34}-C_{40}	F1	F2
Guideline [A]					HSL 'A' HSL 'B'	SAND 0-<1m		0.5	160	55			40		3						45	110
						SILT 0-<1m		0.6	390	NL			95		4						40	230
					ESL URPOS	Coarse		50	85	70			105		170			120	300	2800	180	
						Fine		65	85	125			45		170			120	1300	5600	180	
					Sensitive ML	Coarse											700	1000	2500	10000		
						Fine											800	1000	3500	10000		
					DC A			100	14000	4500			12000		1400		4400	3300	4500	6300		
Laboratory PQL								0.2	0.5	0.5	0.5	0.5	1		1		10	50	100	100	10	50
BH17A	0	12/02/2018	TOPSOIL/FILL, Sandy LOAM, fine to medium grained, brown, trace gravel	SAND	Mound Investigation	RCA- KS/ZL		<0.2	<0.5	<0.5	<0.5	<0.5	0.5		<1		<10	<50	<100	<100	<10	<50
BH17B	0	12/02/2018	FILL, Silty SAND, fine to coarse grained, with gravels, includes brick, stone and concrete	SAND	Mound Investigation	RCA- KS/ZL		<0.2	<0.5	<0.5	<0.5	<0.5	0.5		2		<10	<50	460	330	<10	<50
BH17C	0	12/02/2018	FILL, Silty Gravelly Sandy CLAY, fine to coarse grained sand, trace asphalt, brick, stone and concrete	SAND	Mound Investigation	RCA- KS/ZL		<0.2	<0.5	<0.5	<0.5	<0.5	0.5		<1		<10	<50	260	320	<10	<50
BH17D	0	12/02/2018	Silty CLAY, brown	SILT	Mound Investigation	RCA- KS/ZL		--	--	--	--	--	--		--		--	--	--	--	--	--
BH18A	0	12/02/2018	FILL, Silty CLAY, brown, with gravel, fine to coarse, includes stone, brick and asphalt, trace organic material	SAND	Mound Investigation	RCA- KS/ZL		<0.2	<0.5	<0.5	<0.5	<0.5	0.5		<1		<10	<50	<100	<100	<10	<50
BH18B	0	12/02/2018	FILL, Silty CLAY, brown, with gravel, fine to coarse, includes stone, brick and asphalt, trace organic material	SAND	Mound Investigation	RCA- KS/ZL		<0.2	<0.5	<0.5	<0.5	<0.5	0.5		<1		--	--	--	--	--	--
BH18C	0	12/02/2018	FILL, Silty CLAY, grey and red mottling	SILT	Mound Investigation	RCA- KS/ZL		--	--	--	--	--	--		--		--	--	--	--	--	--
BH19A	0	12/02/2018	FILL, Sandy SILT, fine to medium grained, brown, trace gravel	SAND	Mound Investigation	RCA- KS/ZL		<0.2	<0.5	<0.5	<0.5	<0.5	0.5		<1		<10	<50	<100	<100	<10	<50
BH19B	0	12/02/2018	Silty CLAY, red-brown, trace sand	SILT	Mound Investigation	RCA- KS/ZL		--	--	--	--	--	--		--		--	--	--	--	--	--

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 >C10-C16 minus naphthalene. F2 PQL deemed = TRH >C10-C16.

[A] ASC NEPM 1999 (amended April 2013) Vapour Based Health Screening Levels (HSL) 'A' (Residential)

[A] ASC NEPM 1999 (amended April 2013) Ecological Screening Levels (ESL) URPOS (Urban Residential and Public Open Space)

[A] ASC NEPM 1999 (amended April 2013) Management Limits (ML) Sensitive Sites (Residential, open space)

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

[B] Samples collected over depths from 0.05-1.4m however have been set as 0 to allow flexibity in the use of the material as criteria are based on depth.

[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

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

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.

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

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

Sample Identification	PQL	Guideline [A]		BH17A	BH17B	BH17C	BH17D	BH18A	BH18B	BH18C	BH19A	BH19B
Sample Depth (m) [B]		HIL 'A'	EIL URPOS	0.05	0.2	1.2	1.4	0.05	0.4	0.8	0.05	0.4
Date				12/2/18	12/2/18	12/2/18	12/2/18	12/2/18	12/2/18	12/2/18	12/2/18	12/2/18
Sample Profile				TOPSOIL/FILL, Sandy LOAM, fine to medium grained, brown, trace gravel	FILL, Silty SAND, fine to coarse grained, with gravels, includes brick, stone and concrete	FILL, Silty Gravelly Sandy CLAY, fine to coarse grained sand, trace asphalt, brick, stone and concrete	Silty CLAY, brown	FILL, Silty CLAY, brown, with gravel, fine to coarse, includes stone, brick and asphalt, trace organic material	FILL, Silty CLAY, brown, with gravel, fine to coarse, includes stone, brick and asphalt, trace organic material	FILL, Silty CLAY, grey and red mottling	FILL, Sandy SILT, fine to medium grained, brown, trace gravel	Silty CLAY, red-brown, trace sand
Sample Purpose				Mound Investigation	Mound Investigation	Mound Investigation	Mound Investigation	Mound Investigation	Mound Investigation	Mound Investigation	Mound Investigation	Mound Investigation
Sample collected by				RCA- KS/ZL	RCA- KS/ZL	RCA- KS/ZL	RCA- KS/ZL	RCA- KS/ZL	RCA- KS/ZL	RCA- KS/ZL	RCA- KS/ZL	RCA- KS/ZL
Electrical Conductivity												
Electrical Conductivity	0.001			0.126	0.098	0.21	0.068	0.054	0.082	0.113	0.087	0.083
Polycyclic Aromatic Hydrocarbons (PAH)												
Naphthalene	0.5		170	<0.5	1.2	0.5	<0.5	<0.5	<0.5	--	<0.5	--
Acenaphthylene	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	<0.5	--
Acenaphthene	0.5			<0.5	1.9	0.6	<0.5	<0.5	<0.5	--	<0.5	--
Fluorene	0.5			<0.5	2.4	0.8	<0.5	<0.5	<0.5	--	<0.5	--
Phenanthrene	0.5			<0.5	27.4	9.7	0.8	<0.5	<0.5	--	<0.5	--
Anthracene	0.5			<0.5	5.6	2	<0.5	<0.5	<0.5	--	<0.5	--
Fluoranthene	0.5			1.2	32.1	13.9	1.7	0.6	1	--	<0.5	--
Pyrene	0.5			1.2	27.8	12.2	1.4	0.7	1.1	--	<0.5	--
Benz(a)anthracene	0.5			<0.5	9.5	4	<0.5	<0.5	0.5	--	<0.5	--
Chrysene	0.5			<0.5	8.9	3.8	<0.5	<0.5	0.6	--	<0.5	--
Benzo(b)&(j)&(k)fluoranthene	0.5			0.5	13.6	5.9	<0.5	0.8	1	--	<0.5	--
Benzo(a) pyrene	0.5		0.7	<0.5	10	4.1	<0.5	0.6	1	--	<0.5	--
Indeno(1,2,3-c,d)pyrene	0.5			<0.5	3.9	1.5	<0.5	<0.5	<0.5	--	<0.5	--
Dibenz(a,h)anthracene	0.5			<0.5	0.8	<0.5	<0.5	<0.5	<0.5	--	<0.5	--
Benzo(g,h,i)perylene	0.5			<0.5	4.2	1.6	<0.5	0.6	0.7	--	<0.5	--
Carcinogenic PAH (B(a)P equivalent)	1.2	3		0.6	**13.6**	**5.5**	0.6	1.0	1.4	--	0.6	--
Sum of reported PAH	7.5	300		5.9	149.6	61.1	6.9	5.8	7.9	--	3.8	--
Metals												
Arsenic	5	100	100	<5	<5	<5	<5	<5	<5	<5	<5	<5
Cadmium	1	20		<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	2	100	190	28	23	15	18	29	28	23	30	21
Copper	5	6000	280	7	6	20	<5	6	7	<5	<5	<5
Mercury	0.1	40		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lead	5	300	1100	16	14	24	7	19	12	6	9	9
Nickel	2	400	30	10	6	11	3	5	4	<2	5	4
Zinc	5	7400	230	30	13	25	<5	104	39	7	14	10
Organochlorine Pesticides (OCP)												
alpha-BHC	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Hexachlorobenzene (HCB)	0.05	10		<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
beta-BHC	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
gamma-BHC	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
delta-BHC	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Heptachlor	0.05	6		<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Aldrin	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Heptachlor epoxide	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Total Chlordane (sum)	0.1	50		<0.1	--	--	<0.1	<0.1	--	<0.1	<0.1	<0.1
trans-Chlordane	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
alpha-Endosulfan	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
cis-Chlordane	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Dieldrin	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
4.4`-DDE	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Endrin	0.05	10		<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
beta-Endosulfan	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
4.4`-DDD	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Endrin aldehyde	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Endosulfan sulfate	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
4.4`-DDT	0.2		180	<0.2	--	--	<0.2	<0.2	--	<0.2	<0.2	<0.2
Endrin ketone	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Methoxychlor	0.2	300		<0.2	--	--	<0.2	<0.2	--	<0.2	<0.2	<0.2
DDT+DDD+DDE	0.3	240		0.15	--	--	0.15	0.15	--	0.15	0.15	0.15
Aldrin + Dieldrin	0.1	6		0.05	--	--	0.05	0.05	--	0.05	0.05	0.05
Endosulfan	0.1	270		0.05	--	--	0.05	0.05	--	0.05	0.05	0.05
Organophosphorous Pesticides (OPP)												
Dichlorvos	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Demeton-S-methyl	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Monocrotophos	0.2			<0.2	--	--	<0.2	<0.2	--	<0.2	<0.2	<0.2
Dimethoate	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Diazinon	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Chlorpyrifos-methyl	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Parathion-methyl	0.2			<0.2	--	--	<0.2	<0.2	--	<0.2	<0.2	<0.2
Malathion	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Fenthion	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Chlorpyrifos	0.05		160	<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Parathion	0.2			<0.2	--	--	<0.2	<0.2	--	<0.2	<0.2	<0.2
Pirimphos-ethyl	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Chlorfenvinphos	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Bromophos-ethyl	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Fenamiphos	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Prothiofos	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Ethion	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Carbophenothion	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Azinphos Methyl	0.05			<0.05	--	--	<0.05	<0.05	--	<0.05	<0.05	<0.05
Herbicides												
2,4,5-T	0.04 / 0.02	600		<0.04	--	--	<0.02	<0.04	--	<0.02	<0.04	<0.04
2,4-D	0.04 / 0.02	900		<0.04	--	--	<0.02	<0.04	--	<0.02	<0.04	<0.04
MCPA	0.04 / 0.02	600		<0.04	--	--	<0.02	<0.04	--	<0.02	<0.04	<0.04
MCPB	0.04 / 0.02	600		<0.04	--	--	<0.02	<0.04	--	<0.02	<0.04	<0.04
Mecoprop	0.04 / 0.02	600		<0.04	--	--	<0.02	<0.04	--	<0.02	<0.04	<0.04
Picloram	0.04 / 0.02	4500		<0.04	--	--	<0.02	<0.04	--	<0.02	<0.04	<0.04
Per- and poly-fluoroalkyl substances (PFAS)												
PFOS	0.0002		0.01	--	--	--	--	--	--	--	--	--
PFOS + PFHxS	0.0002	0.009		--	--	--	--	--	--	--	--	--
PFOA	0.0002	0.1	0.7	--	--	--	--	--	--	--	--	--

All results are in units of mg/kg except Electrical conducitvity (dS/m)

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] ASC NEPM 1999 (amended April 2013) Health Investigation Levels (HIL) 'A' (Residential), PFAS criteria OEH 20/4/17

[A] ASC NEPM 1999 (amended April 2013) Ecological Investigation Levels (EIL) URPOS (Urban Residential and Public Open Space). PFAS criteria OEH 20/4/17 are for Indirect Exposure and account for bioaccumulation and off-site transport

[B] Start of sample, generally over a 0.10m interval

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

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, PFAS) calculation includes components reported as non detected as 1/2 PQL.

Appendix C

Screening Levels and Guidelines

NATIONAL ENVIRONMENT PROTECTION (ASSESSMENT OF SITE CONTAMINATION) MEASURE 1999 AS AMENDED 2013

Soil

The investigation and screening levels (ISL) utilised for the assessment of the soil on site were sourced from the National Environment Protection Measure for the Assessment of Site Contamination (ASC NEPM, Ref [8]). 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 day care 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 (e.g. ovals) secondary schools and footpaths. It does not include undeveloped public open space (such as urban bushland and reserves).
  - HIL 'D' - Commercial/industrial such as shops, offices, factories and industrial sites.

  The exposure scenario for the derivation of the relevant land use setting is set out in the table below.

  Health screening levels (HSL) have been determined for risks associated from vapour intrusion from petroleum[2] 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 ASC NEPM, however these are provided in CRC Care Technical Report 10 (Ref [16]) which is the source document for the HSL.

- 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.

[2] 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.

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 ASC NEPM (Ref [8]) 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 (e.g. 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, e.g. 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 (e.g. 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 e.g., penetration of, or damage to, in-ground services by hydrocarbons.

The ASC NEPM (Ref [8]) 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 ASC NEPM (Ref [8]) to illustrate the assessment methodology in regards to petroleum contamination.

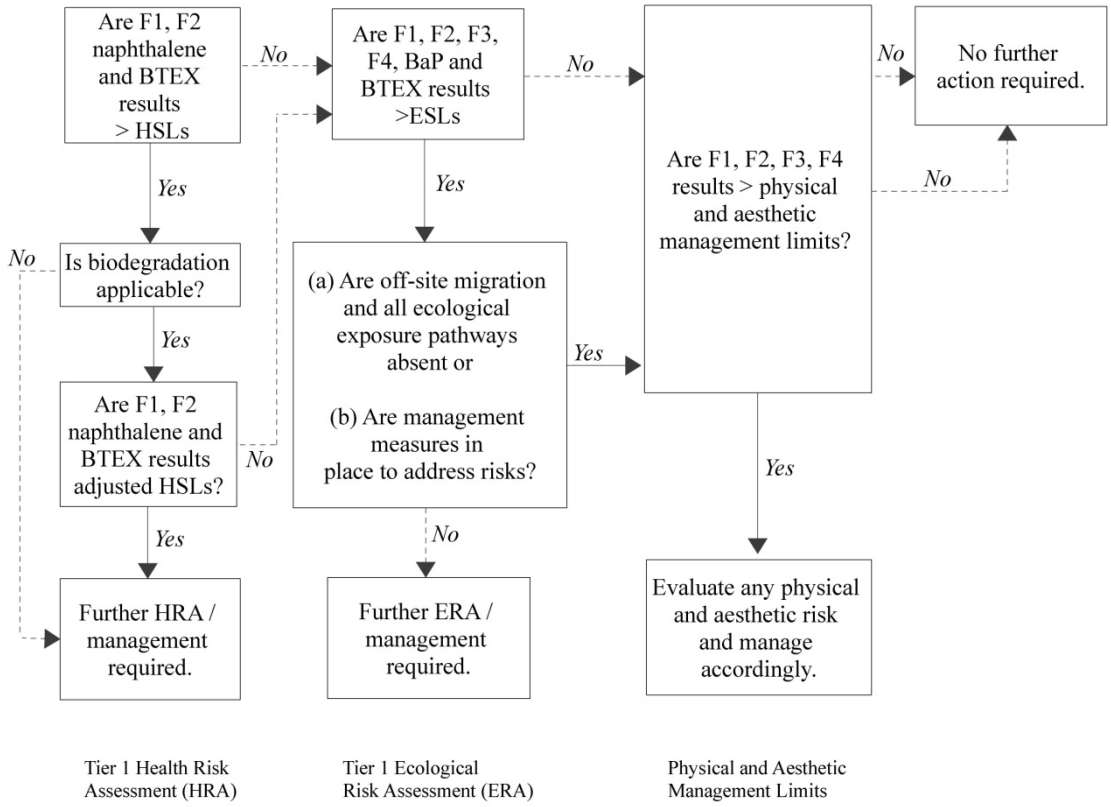


Figure 1 *Flowchart for the Tier 1 human and ecological risk assessment of petroleum hydrocarbon contamination – application of HSL and ESL and consideration of management limits*

Residential with Garden/Accessible soil

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	50 [2]	100 [2]
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	4	4
Home-grown fraction of vegetables consumed	F_{HG}	%	10	10
Vegetable & fruit consumption rate	C_y (veg and fruit)	g/day	400	280
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 A scenario include the ingestion of both outdoor soil, including soil adhering to home-grown produce, and indoor dust (derived from outdoor soil tracked indoors)

NSW EPA 2014, WASTE CLASSIFICATION GUIDELINES

The waste classification guidelines (Ref [9]) 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.

RESOURCE RECOVERY ORDERS AND EXEMPTIONS

Resource recovery orders (orders) and resource recovery exemptions (exemptions) allow some wastes to be beneficially and safely re-used independent of the usual NSW laws that control applying waste to land, using waste as a fuel, or using waste in connection with a process of thermal treatment.

Existing Orders and Exemptions can be used without NSW EPA approval as long as all the conditions of the Order and Exemption being utilised are met in regards to the material and the proposed use. Record keeping requirements apply.

A specific Order/Exemption can be sought from the NSW EPA where there is none available for the material. If granted, the specific Order/Exemption will identify what the material is and how it can be used: the specific Order/Exemption cannot be applied to other material.

ACID SULFATE SOIL MANUAL

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 above the 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 sulphide 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 has a pH <2.5, after the addition of hydrogen peroxide, strongly indicates the presence of ASS.

The 'Acid Sulfate Soil Manual' outlines:

- The assessment process for different types of projects (such as linear, bulk disturbance) including:
    - Number of samples.
    - Depth of samples.
    - Sampling methodology.
    - Sampling handling and storage.
- Analytical methods.
- Assessment criteria.
- Water Assessment.
- Requirements for management plans.
- Monitoring.
- Treatment.

Appendix D

Quality Assurance Review and Laboratory Report Sheets

The collection of all soil samples was undertaken in compliance with the details provided in **Section 6** of the report.

A total of four (4) soil duplicate samples were submitted blind to the laboratory for analysis with the batch of samples, comprising two (2) interlaboratory and two (2) intralaboratory duplicates. This represents a percentage of 10%, in accordance with the frequency recommended by the ASC NEPM (Ref [8]), Australian Standard AS 4482.1-2005 (Ref [17]) and RCA protocol.

One (1) trip blank and one (1) trip spike was submitted. This submission is in accordance with /less than the frequency recommended by the ASC NEPM (Ref [8]), Australian Standard AS 4482.1-2005 (Ref []) and RCA protocol.

RCA omitted the field blank due to the low potential for cross contamination during the sampling process and equipment wash due to the low potential for cross contamination from the sampling equipment based on the methodology used.

Results, as shown further in this **Appendix**, indicate a total of two (2) soil analyses which report RPD in excess of the acceptance criteria which are not related to different detection limit in non-detected results:

- TP 1.0/ QA1 Reported elevated RPD for arsenic, chromium, lead, nickel and zinc. This sample is described as sandy clay with the presence of gravels and therefore it is considered that sample heterogeneity is the likely cause of the high RPD. There is some uncertainty associated with this sample, and in some cases the duplicate reported higher concentrations, however as the highest results are well below the applicable guideline criteria, the uncertainty is not considered to be significant.
- TP5 0.3/ QA3 Reported elevated RPD for arsenic, lead, nickel and zinc. This sample is described as sandy clay with the presence of gravels and therefore it is considered that sample heterogeneity in the likely cause of the high RPD. There is some uncertainty associated with this sample, and in some cases the duplicate reported higher concentrations, however as the highest results are well below the applicable guideline criteria, the uncertainty is not considered to be significant.
- TP24 0.3 / QA6 Reported an elevated RPD for zinc. This sample is described as sandy clay with the presence of gravels and therefore it is considered that sample heterogeneity in the likely cause of the high RPD. There is some uncertainty associated with this sample, and the duplicate reported the highest concentration, however as the highest result (11mg/kg) is well below the applicable guideline criterion (230mg/kg), the uncertainty is not considered to be significant.

Results show that the trip blank reported non-detectable concentrations of analytes.

ALS prepared the trip spike prior to fieldwork and issued one portion to RCA (TS) and retained the other portion (TC) at the laboratory. Both samples were analysed upon submission of samples to ALS and RCA have compared the results based on a duplicate assessment. Results were within the RPD criterion, noting that there was no detectable benzene in the control sample retained at the laboratory and naphthalene was not detected in either sample. This is considered to represent the loss of volatiles during the mixing process during preparation rather than a loss during fieldwork.

ALS was chosen as the primary laboratory and Eurofins mgt was chosen as the secondary laboratory. Both laboratories used are NATA accredited and are experienced in the analytical requirements for potentially contaminated soil.

ALS and Eurofins mgt undertook internal quality assurance testing. Results are contained within the laboratory report sheets, included in this **Appendix**. **Table 7** presents a summary of the ALS testing.

Table 7 *Internal Quality Assurance Review*

	Number Samples (including QA)	Laboratory Duplicates	Spikes	Laboratory Control Samples	Laboratory Blanks
Requirement		**10%**	**5%**	**One every batch**	**One every batch**
Soil					
Metals (As, Cd, Cr, Cu, Ni, Pb, Zn)	44	4 (3)	2 (2)	4	4
Mercury	44	4 (3)	2 (2)	4	4
TRH C_6-C_{10}	47	5 (2)	2 (2)	4	4
TRH $C_{>10}$-C_{40}	44	5 (2)	2 (2)	4	4
BTEX	47	5 (2)	2 (2)	4	4
PAH	44	5 (2)	3 (1)	4	4
OCP	23	3 (1)	3 (1)	4	4
OCC	23	3 (1)	3 (1)	4	4
CRS	10	1 (1)	0	1	1

Numbers in brackets refer the tests undertaken on samples not from this project but within the same laboratory batch.

Examination of the above table reveals that ALS and Eurofins mgt have undertaken laboratory quality assurance testing in accordance with the ASC NEPM (Ref [8]).

- Recoveries of Surrogates were within acceptance criteria of 70-130% with the exception of:
  - ES1826526 OCP surrogate, Dibromo-DDE, in TP18 1.5 reported a recovery of 133%. This indicates that there may be some uncertainty, however the recovery suggests there is a potential for over estimation and as the results were below the PQL, any uncertainty is not considered to be significant.
  - ES1826526 OCP surrogate, DEF, in six (6) samples reported recoveries between 62.2% and 68.2%. This is considered to indicate some uncertainty with the results, however as all samples were below the PQL which is well below the guideline criterion and the other QA results considered generally acceptable, any uncertainty is not considered to be significant.
  - ES1826526 PAH surrogates reported some recoveries outside of the acceptable range, with the lowest recovery at 65.8%. These are considered a minor non-compliance and therefore the uncertainty is not considered significant.

  - 616699 BTEX surrogate reported a recovery of 69% in QA3. This is considered a minor non-compliance and therefore the uncertainty is not considered significant.
  - 616699 OCP surrogates in QA3 reported recoveries of 133 and 137%. These indicate that there may be some uncertainty, however the recovery suggests there is a potential for over estimation and as the results were below the PQL, any uncertainty is not considered to be significant.
- Holding Times were within laboratory specified time frames noting that CRS samples were not received by the laboratory frozen and were identified as being out of holding times. Samples had been frozen initially and then stored in a refrigerator between screening and issuing for further analytical testing.
- Recoveries of laboratory control samples were within the acceptance criteria of 70-130% with the exception of:
  - ES1826525 OCP compound Azinphos Methyl reported recoveries of 66.8% and 67.3%. This is considered a minor non-compliance and therefore the uncertainty is not considered to be significant.
- Recoveries of Spikes were within acceptance criteria of 70-130%.
- Relative Percentage Differences for duplicates were within acceptance criteria as defined for intralaboratory duplicates.
- No Laboratory Blank result was detected above the practical quantification limit (PQL).

It is therefore considered that the data obtained from this testing is accurate and reliable in as far as it can be ascertained.

Sample Identification	Primary PQL	Secondary PQL		TP1 1.0	QA1	RPD %	TP5 0.3	QA3	RPD %	TP24 0.3	QA6	RPD %	TP18 0.3	QA7	RPD %	TB	TS	TSC	RPD %
Sample Depth (m)				1			0.3			0.3			0.3				N/A		
Date				5/9/18			5/9/18			6/9/18			5/9/18			5/9/18	5/9/18		
Sample Profile				FILL, Sandy CLAY, brown, with angular and sub angular gravel			FILL, Sandy CLAY, brown mottled white, with angular and sub angular gravel, rootlets			FILL, Sandy CLAY, brown mottled orange, with rootlets, sub angular and angular gravel			FILL, Sandy CLAY, brown mottled orange, with sub angular and angular gravel			Trip Blank	Trip Spike & Control		
Laboratory Reference Number				ES1826526	616699		ES1826526	616699		ES1826526			ES1826526				ES1826526		
Sample Purpose				Characterisation			Characterisation			Characterisation			Characterisation				QA/QC		
Sample collected by				RCA-RJL			RCA-RJL			RCA-RJL			RCA-RJL				ALS		
Duplicate Type				Interlaboratory			Interlaboratory			Intralaboratory			Intralaboratory				Intralaboratory		
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)																			
Benzene	0.2	0.1		0.1	0.05	*66.7*	0.1	0.05	*66.7*	0.1	0.1	*0.0*	0.1	0.1	*0.0*	<0.2	0.2	0.1	*66.7*
Toluene	0.5	0.1		0.25	0.05	*133.3*	0.25	0.05	*133.3*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	<0.5	8.8	8.1	*8.3*
Ethylbenzene	0.5	0.2		0.25	0.1	*85.7*	0.25	0.1	*85.7*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	<0.5	1.1	1	*9.5*
meta- and para-Xylene	0.5	0.1		0.25	0.05	*133.3*	0.25	0.05	*133.3*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	<0.5	5.7	5.1	*11.1*
ortho-Xylene	0.5	0.1		0.25	0.05	*133.3*	0.25	0.05	*133.3*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	<0.5	2.3	2	*14.0*
Total Xylenes	1	0.2		0.5	0.1	*133.3*	0.5	0.1	*133.3*	0.5	0.5	*0.0*	0.5	0.5	*0.0*	--	8	7.1	*11.9*
Polycyclic Aromatic Hydrocarbons (PAH)																			
Naphthalene	1	0.5		0.5	0.25	*66.7*	0.5	0.25	*66.7*	0.5	0.5	*0.0*	0.5	0.5	*0.0*	<1	0.5	0.5	*0.0*
Total Recoverable Hydrocarbons (TRH)																			
TRH C_6-C_{10}	10	50		5	25	*133.3*	5	25	*133.3*	5	5	*0.0*	5	5	*0.0*	<10	31	28	*10.2*
TRH >C_{10}-C_{16}	50	100		25	50	*66.7*	25	50	*66.7*	25	25	*0.0*	25	25	*0.0*	--	--	--	--
TRH >C_{16}-C_{34}	100	100		50	50	*0.0*	50	50	*0.0*	50	50	*0.0*	50	50	*0.0*	--	--	--	--
TRH >C_{34}-C_{40}	100	20		50	10	*133.3*	50	10	*133.3*	50	50	*0.0*	50	50	*0.0*	--	--	--	--
F1	10	50		5	25	*133.3*	5	25	*133.3*	5	5	*0.0*	5	5	*0.0*	--	12.9	11.7	*9.8*
F2	50	100		25	50	*66.7*	25	50	*66.7*	25	25	*0.0*	25	25	*0.0*	--	--	--	--
Polycyclic Aromatic Hydrocarbons (PAH)																			
Acenaphthene	0.5	0.5		0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	--	--	--	--
Acenaphthylene	0.5	0.5		0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	--	--	--	--
Anthracene	0.5	0.5		0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	--	--	--	--
Benz(a)anthracene	0.5	0.5		0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	--	--	--	--
Benzo(a) pyrene	0.5	0.5		0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	--	--	--	--
Benzo(b)&(j)fluoranthene	0.5	0.5		0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	--	--	--	--
Benzo(g,h,i)perylene	0.5	0.5		0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	--	--	--	--
Benzo(k)fluoranthene	0.5	0.5		0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	--	--	--	--
Chrysene	0.5	0.5		0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	--	--	--	--
Dibenz(a,h)anthracene	0.5	0.5		0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	--	--	--	--
Fluoranthene	0.5	0.5		0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	--	--	--	--
Fluorene	0.5	0.5		0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	--	--	--	--
Indeno(1,2,3-c,d)pyrene	0.5	0.5		0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	--	--	--	--
Naphthalene	0.5	0.5		0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	--	--	--	--
Phenanthrene	0.5	0.5		0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	--	--	--	--
Pyrene	0.5	0.5		0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	0.25	0.25	*0.0*	--	--	--	--
Carcinogenic PAH (B(a)P equivalen	1.21	1.21		0.605	0.605	*0.0*	0.605	0.605	*0.0*	0.605	0.605	*0.0*	0.605	0.605	*0.0*	--	--	--	--
Sum of reported PAH	8	8		4	4	*0.0*	4	4	*0.0*	4	4	*0.0*	4	4	*0.0*	--	--	--	--
Metals																			
Arsenic	5	2		2.5	5.8	***79.5***	2.5	4.8	***63.0***	2.5	2.5	*0.0*	2.5	2.5	*0.0*	--	--	--	--
Cadmium	1	0.4		0.5	0.2	*85.7*	0.5	0.2	*85.7*	0.5	0.5	*0.0*	0.5	0.5	*0.0*	--	--	--	--
Chromium	2	5		29	51	***55.0***	33	42	*24.0*	40	31	*25.4*	34	40	*16.2*	--	--	--	--
Copper	5	5		2.5	2.5	*0.0*	2.5	2.5	*0.0*	2.5	2.5	*0.0*	2.5	2.5	*0.0*	--	--	--	--
Mercury	0.1	0.01		0.05	0.05	*0.0*	0.05	0.05	*0.0*	0.05	0.05	*0.0*	0.05	0.05	*0.0*	--	--	--	--
Lead	5	5		9	14	***43.5***	10	15	***40.0***	10	11	*9.5*	12	11	*8.7*	--	--	--	--
Nickel	2	5		3	8.5	***95.7***	3	6.1	***68.1***	8	7	*13.3*	4	5	*22.2*	--	--	--	--
Zinc	5	5		7	9.9	***34.3***	8	12	***40.0***	7	11	*44.4*	11	13	*16.7*	--	--	--	--
Pesticides																			
Chlordane	0.05	0.1		---	---	---	0.025	0.05	*66.7*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
DDD	0.05	0.05		---	---	---	0.025	0.025	*0.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
DDE	0.05	0.05		---	---	---	0.025	0.025	*0.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
DDT	0.2	0.05		---	---	---	0.1	0.025	*120.0*	0.1	0.1	*0.0*	---	---	---	--	--	--	--
alpha-BHC	0.05	0.05		---	---	---	0.025	0.025	*0.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Aldrin	0.05	0.05		---	---	---	0.025	0.025	*0.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
b-BHC	0.05	0.05		---	---	---	0.025	0.025	*0.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
d-BHC	0.05	0.05		---	---	---	0.025	0.025	*0.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Dieldrin	0.05	0.05		---	---	---	0.025	0.025	*0.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Endosulfan 1	0.05	0.05		---	---	---	0.025	0.025	*0.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Endosulfan 2	0.05	0.05		---	---	---	0.025	0.025	*0.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Endosulfan sulfate	0.05	0.05		---	---	---	0.025	0.025	*0.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Endrin	0.05	0.05		---	---	---	0.025	0.025	*0.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Endrin aldehyde	0.05	0.05		---	---	---	0.025	0.025	*0.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Endrin ketone	0.05	0.05		---	---	---	0.025	0.025	*0.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
g-BHC (Lindane)	0.05	0.05		---	---	---	0.025	0.025	*0.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Heptachlor	0.05	0.05		---	---	---	0.025	0.025	*0.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Heptachlor epoxide	0.05	0.05		---	---	---	0.025	0.025	*0.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
HCB	0.05	0.05		---	---	---	0.025	0.025	*0.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Methoxychlor	0.2	0.05		---	---	---	0.1	0.025	*120.0*	0.1	0.1	*0.0*	---	---	---	--	--	--	--
DDT+DDD+DDE	0.3	0.15		---	---	---	0.15	0.075	*66.7*	0.15	0.15	*0.0*	---	---	---	--	--	--	--
Aldrin + Dieldrin	0.1	0.1		---	---	---	0.05	0.05	*0.0*	0.05	0.05	*0.0*	---	---	---	--	--	--	--
Endosulfan	0.1	0.1		---	---	---	0.05	0.05	*0.0*	0.05	0.05	*0.0*	---	---	---	--	--	--	--
Organophosphorous Pesticides (OPP)																			
Dichlorvos	0.05	0.2		---	---	---	0.025	0.1	*120.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Chlorpyrifos (total)	0.1	0.4		---	---	---	0.05	0.2	*120.0*	0.05	0.05	*0.0*	---	---	---	--	--	--	--
Demeton-S-methyl	0.05	0.2		---	---	---	0.025	0.1	*120.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Monocrotophos	0.2	2		---	---	---	0.1	1	**163.6**	0.1	0.1	*0.0*	---	---	---	--	--	--	--
Dimethoate	0.05	0.2		---	---	---	0.025	0.1	*120.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Diazinon	0.05	0.2		---	---	---	0.025	0.1	*120.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Parathion-methyl	0.2	0.2		---	---	---	0.1	0.1	*0.0*	0.1	0.1	*0.0*	---	---	---	--	--	--	--
Malathion	0.05	0.2		---	---	---	0.025	0.1	*120.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Fenthion	0.05	0.2		---	---	---	0.025	0.1	*120.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Parathion	0.2	0.2		---	---	---	0.025	0.1	*120.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Pirimphos-ethyl	0.05	0.2		---	---	---	0.1	0.1	*0.0*	0.1	0.1	*0.0*	---	---	---	--	--	--	--
Chlorfenvinphos	0.05	0.2		---	---	---	0.025	0.1	*120.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Bromophos-ethyl	0.05	---		---	---	---	0.025	---	---	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Fenamiphos	0.05	---		---	---	---	0.025	---	---	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Prothiofos	0.05	0.2		---	---	---	0.025	0.1	*120.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Ethion	0.05	0.2		---	---	---	0.025	0.1	*120.0*	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Carbophenothion	0.05	---		---	---	---	0.025	---	---	0.025	0.025	*0.0*	---	---	---	--	--	--	--
Azinphos Methyl	0.05	---		---	---	---	0.025	---	---	0.025	0.025	*0.0*	---	---	---	--	--	--	--

All units in mg/kg

BOLD *identifies where RPD results > 30% and unrelated to different PQL in non-detected samples*

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

Results underlined were not detected and are reported as half the detection limit for statistical purpose.

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Corporate Site Number 18077
Accredited for compliance with ISO/IEC 17025 - Testing

Robert Carr & Associates
92 Hill Street
Carrington NSW 2294

Attention: Katy Shaw

Project:	RCA ref 13156a-601/0		
Date:	11/09/2018		
Client reference:	Diocese of Maitland		
Received date:	6/09/2018	**Number of samples:**	79
Client order number:	Not Supplied	**Testing commenced:**	7/09/2018

CERTIFICATE OF ANALYSIS

1 ANALYTICAL TEST METHODS

ANALYSIS	METHOD	UNITS	ANALYSING LABORATORY	NATA ANALYSIS / NON NATA	Measurement of Uncertainty Coverage Factor 2
Acid Sulphate Soil	ENV-LAB032	pH	RCA Laboratories - Environmental	NATA	±0.54

2 RESULTS

ANALYSIS	UNITS	TP1/0.3	TP1/1	TP1/1.5	TP2/0.3	TP2/1	TP2/1.5
Acid Sulfate Soil Screening Test							
Sample Number	-	091813156a001	091813156a002	091813156a003	091813156a004	091813156a005	091813156a006
Date Sampled	-	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018
pHF	pH unit	5.71	5.99	6.46	5.22	5.39	3.28
pHFOX		4.33	4.6	4.67	4.15	4.09	4.24
pHF – pHFOX		1.38	1.39	1.79	1.07	1.3	-0.96
Reaction Rate^	-	2	2	2	2	2	2
Soil Type	-	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied

.

ANALYSIS	UNITS	TP3/0.3	TP3/1	TP3/1.7	TP4/0.3	TP4/1	TP4/1.8
Acid Sulfate Soil Screening Test							
Sample Number	-	091813156a007	091813156a008	091813156a009	091813156a010	091813156a011	091813156a012
Date Sampled	-	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018
pHF	pH unit	4.98	4.76	4.81	5.93	4.88	4.82
pHFOX		4.1	3.51	3.73	2.94	4.04	3.82
pHF – pHFOX		0.88	1.25	1.08	2.99	0.84	1
Reaction Rate^	-	2	2	2	2	2	1
Soil Type	-	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied

ANALYSIS	UNITS	TP5/0.3	TP5/1	TP5/1.6	TP6/0.3	TP6/1	TP6/1.5
Acid Sulfate Soil Screening Test							
Sample Number	-	091813156a013	091813156a014	091813156a015	091813156a016	091813156a017	091813156a018
Date Sampled	-	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018
pHF	pH unit	5.33	5.04	6.31	5.61	5.77	5.43
pHFOX		4.37	4.1	5.5	4.46	4.6	4.64
pHF – pHFOX		0.96	0.94	0.81	1.15	1.17	0.79
Reaction Rate^	-	2	1	4	2	2	3
2S3oil Type	-	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied

ANALYSIS	UNITS	TP7/0.3	TP7/1	TP7/1.6	TP8/0.3	TP8/1	TP8/1.7
Acid Sulfate Soil Screening Test							
Sample Number	-	091813156a019	091813156a020	091813156a021	091813156a022	091813156a023	091813156a024
Date Sampled	-	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018
pHF	pH unit	5.2	5.55	5.58	5.05	4.39	5.34
pHFOX		4.5	4.54	4.23	4.21	4.3	4.19
pHF – pHFOX		0.7	1.01	1.35	0.84	0.09	1.15
Reaction Rate^	-	2	3	2	2	2	1
Soil Type	-	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied

ANALYSIS	UNITS	TP9/0.3	TP9/1	TP9/1.5	TP10/0.3	TP10/1	TP10/1.9
Acid Sulfate Soil Screening Test							
Sample Number	-	091813156a025	091813156a026	091813156a027	091813156a028	091813156a029	091813156a030
Date Sampled	-	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018
pHF	pH unit	5.11	5.13	5.02	5.04	5.38	5.14
pHFOX		4.08	4	4.14	4.34	4.11	4.07
pHF – pHFOX		1.03	1.13	0.88	0.7	1.27	1.07
Reaction Rate^	-	2	2	2	2	2	2
Soil Type	-	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied

ANALYSIS	UNITS	TP11/0.3	TP11/1	TP11/1.5	TP12/0.3	TP12/1	TP12/1.7
Acid Sulfate Soil Screening Test							
Sample Number	-	091813156a031	091813156a032	091813156a033	091813156a034	091813156a035	091813156a036
Date Sampled	-	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018
pHF	pH unit	5.08	4.94	5.24	5.26	4.92	4.91
pHFOX		4.2	4.15	4.36	4.37	4.07	4
pHF – pHFOX		0.88	0.79	0.88	0.89	0.85	0.91
Reaction Rate^	-	2	2	1	2	2	2
Soil Type	-	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied

ANALYSIS	UNITS	TP13/0.3	TP13/1	TP13/1.7	TP14/0.3	TP14/1	TP14/1.6
Acid Sulfate Soil Screening Test							
Sample Number	-	091813156a037	091813156a038	091813156a039	091813156a040	091813156a041	091813156a042
Date Sampled	-	6/09/2018	6/09/2018	6/09/2018	6/09/2018	5/09/2018	5/09/2018
pHF	pH unit	5.21	5.28	4.76	4.63	4.64	4.78
pHFOX		4.35	4.35	4.56	4.23	4.19	4.26
pHF – pHFOX		0.86	0.93	0.2	0.4	0.45	0.52
Reaction Rate^	-	2	2	2	2	2	2
Soil Type	-	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied

ANALYSIS	UNITS	TP15/0.3	TP15/1	TP15/1.5	TP16/0.3	TP16/1	TP16/1.6
Acid Sulfate Soil Screening Test							
Sample Number	-	091813156a043	091813156a044	091813156a045	091813156a046	091813156a047	091813156a048
Date Sampled	-	5/09/2018	5/09/2018	5/09/2018	5/09/2018	5/09/2018	5/09/2018
pHF	pH unit	4.85	5.19	5.39	5.41	4.8	5.11
pHFOX		4.43	4.6	4.56	4.51	4.1	4.32
pHF – pHFOX		0.42	0.59	0.83	0.9	0.7	0.79
Reaction Rate^	-	2	2	2	2	2	2
Soil Type	-	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied

ANALYSIS	UNITS	TP17/0.3	TP17/1	TP17/1.8	TP18/0.3	TP18/1	TP18/1.5
Acid Sulfate Soil Screening Test							
Sample Number	-	091813156a049	091813156a050	091813156a051	091813156a052	091813156a053	091813156a054
Date Sampled	-	5/09/2018	5/09/2018	5/09/2018	5/09/2018	5/09/2018	5/09/2018
pHF	pH unit	5.24	5.02	5.3	5.32	5.06	4.9
pHFOX		4.67	4.4	4.22	4.28	4.18	4.04
pHF – pHFOX		0.57	0.62	1.08	1.04	0.88	0.86
Reaction Rate^	-	2	2	2	2	2	2
Soil Type	-	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied

ANALYSIS	UNITS	TP19/0.3	TP19/1	TP19/1.7	TP20/0.3	TP20/1	TP20/1.5
Acid Sulfate Soil Screening Test							
Sample Number	-	091813156a055	091813156a056	091813156a057	091813156a058	091813156a059	091813156a060
Date Sampled	-	5/09/2018	5/09/2018	5/09/2018	5/09/2018	5/09/2018	5/09/2018
pHF	pH unit	5.17	5.15	5.1	5.46	5.21	5.34
pHFOX		4.38	4.18	4.25	4.76	4.45	4.71
pHF – pHFOX		0.79	0.97	0.85	0.7	0.76	0.63
Reaction Rate^	-	2	2	2	2	2	2
Soil Type	-	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied

ANALYSIS	UNITS	TP21/0.3	TP21/0.6	TP22/0.3	TP22/1	TP23/0.3	TP23/1
Acid Sulfate Soil Screening Test							
Sample Number	-	091813156a061	091813156a062	091813156a063	091813156a064	091813156a065	091813156a066
Date Sampled	-	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018
pHF	pH unit	5.1	4.85	4.24	4.79	5.04	4.78
pHFOX		3.55	3	3.26	3.74	3.89	3.76
pHF – pHFOX		1.55	1.85	0.98	1.05	1.15	1.02
Reaction Rate^	-	2	2	2	2	2	1
Soil Type	-	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied

ANALYSIS	UNITS	TP24/0.3	TP24/1	TP25/0.3	TP25/1	TP25/1.2	TP26/0.3
Acid Sulfate Soil Screening Test							
Sample Number	-	091813156a067	091813156a068	091813156a069	091813156a070	091813156a071	091813156a072
Date Sampled	-	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018
pHF	pH unit	4.72	6.33	7.25	7.68	7.59	5.63
pHFOX		3.78	6.02	6.48	6.68	6.24	4.02
pHF – pHFOX		0.94	0.31	0.77	1	1.35	1.61
Reaction Rate^	-	1	3	3	4	4	1
Soil Type	-	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied

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ANALYSIS	UNITS	TP26/1	TP26/1.2	TP27/0.3	TP27/1	TP271.1	TP28/0.3
Acid Sulfate Soil Screening Test							
Sample Number	-	091813156a073	091813156a074	091813156a075	091813156a076	091813156a077	091813156a078
Date Sampled	-	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018	6/09/2018
pHF	pH unit	7.62	7.87	7.73	8.08	7.9	8.02
pHFOX		7.43	7.72	6.53	7.16	7.13	7.53
pHF – pHFOX		0.19	0.15	1.2	0.92	0.77	0.49
Reaction Rate^	-	4	4	3	4	4	2
Soil Type	-	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied	Not supplied

ANALYSIS	UNITS	TP28/1
Acid Sulfate Soil Screening Test		
Sample Number	-	091813156a079
Date Sampled	-	6/09/2018
pHF	pH unit	8.15
pHFOX		7.41
pHF – pHFOX		0.74
Reaction Rate^	-	2
Soil Type	-	Not supplied

Acid Sulphate Soil Screening

Note: This screening test only provides an indication of the likely presence and severity of Acid Sulfate Soils. This test should not be used as a substitute for laboratory analysis which would positively identify the presence of Acid Sulfate Soils (ASS) for assessment purposes.

NATA Scope of Accreditation does not cover the sampling of soils by the client or by RCA Employee's.

Analysis for pH and Acid Sulphate Screen Testing is covered by RCA Laboratories - Environmental NATA Scope of Accreditation.

Analysis on samples is on an as received basis.

Acid Soil Screening Test Reaction Rate

^Reaction Rate: 1 = Slight, 2 = Moderate, 3 = High, 4 = Very Vigorous

Note: Due to the subjectivity the assessment of the Reaction Rate is not covered by our NATA Scope of Accreditation.

3 QUALITY CONTROL RESULTS

Acid Sulphate Soil

Screening Test Quality Control

DATE	ANALYSIS	METHOD	UNITS	QUALITY CONTROL STANDARD VALUE	QUALITY CONTROL ACCEPTANCE CRITERIA	QUALITY CONTROL STANDARD RESULT
07/09/2018	pH – Acid Sulfate Soil	ENV-LAB032	pH	7.00	6.95 - 7.05	7.04

Acid Sulphate Soil Screening Test Duplicate Analysis

SAMPLE NUMBER	DATE	ANALYSIS	METHOD	UNITS	LOR	SAMPLE RESULT	SAMPLE DUPLICATE RESULT
091813156A001	07/09/2018	pH – Acid Sulfate Soil	ENV-LAB032	pH	N/A	5.71	5.93
091813156A011	07/09/2018	pH – Acid Sulfate Soil	ENV-LAB032	pH	N/A	4.88	4.95
091813156A021	07/09/2018	pH – Acid Sulfate Soil	ENV-LAB032	pH	N/A	5.58	5.60
091813156A031	07/09/2018	pH – Acid Sulfate Soil	ENV-LAB032	pH	N/A	5.08	5.00
091813156A041	07/09/2018	pH – Acid Sulfate Soil	ENV-LAB032	pH	N/A	4.64	4.63
091813156A051	07/09/2018	pH – Acid Sulfate Soil	ENV-LAB032	pH	N/A	5.30	5.29
091813156A061	07/09/2018	pH – Acid Sulfate Soil	ENV-LAB032	pH	N/A	5.10	5.12
091813156A071	07/09/2018	pH – Acid Sulfate Soil	ENV-LAB032	pH	N/A	7.59	7.57

Please contact the undersigned if you have any queries.

Yours sincerely

Laura Schofield
Environmental Laboratory Manager
Robert Carr & Associates Pty Ltd Trading as
RCA Laboratories – Environmental
Approved Signatory

Neena Tewari
Senior Environmental Microbiologist
Robert Carr & Associates Pty Ltd Trading as
RCA Laboratories - Environmental

RCA Internal Quality Review

General

1. Laboratory QC results for Method Blanks, Duplicates and Laboratory Control Samples are included in this QC report where applicable. Additional QC data maybe available on request.
2. RCA QC Acceptance / Rejection Criteria are available on request.
3. Proficiency Trial results are available on request.
4. Actual PQLs are matrix dependant. Quoted PQLs may be raised where sample extracts are diluted due to interferences.
5. When individual results are qualified in the body of a report, refer to the qualifier descriptions that follow.
6. Samples were analysed on an 'as received' basis.
7. Sampled dates in this report are those listed on the COC or sample jars; if no sample dates are noted, the date the samples are received at the laboratory have been used.
8. All soil results are reported on a dry basis, unless otherwise stated. (ACID SULPHATE SOILS)
9. This report replaces any interim results previously issued.

Holding Times.

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample

Receipt Acknowledgment.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

##NOTE: pH duplicates are reported as a range NOT as RPD

QC - ACCEPTANCE CRITERIA

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR: RPD must lie between 0-30%

QC DATA GENERAL COMMENTS

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.

2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.

3. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data.

Glossary

UNITS

mg/kg: milligrams per Kilogram

ug/L: micrograms per litre

ppm: Parts per million

ppb: Parts per billion

%: Percentage

org/100ml: Organisms per 100 millilitres

NTU: Units

MPN/100mL: Most Probable Number of organisms per 100 millilitres

mg/L: milligrams per Litre

TERMS

Dry Where moisture has been determined on a solid sample the result is expressed on a dry basis.

LOR Limit of Reporting.

RPD Relative Percent Difference between two Duplicate pieces of analysis can be obtained upon request.

QCS Quality Control Sample - reported as value recovery

Method Blank In the case of solid samples these are performed on laboratory certified clean sands.

In the case of water samples these are performed on de-ionised water.

Duplicate A second piece of analysis from the same sample and reported in the same units as the result to show comparison.

Batch Duplicate A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.

USEPA United States Environment Protection Authority

APHA American Public Health Association

COC Chain of Custody

CP Client Parent - QC was performed on samples pertaining to this report

NCP Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within

< indicates less than

> Indicates greater than

ND Not Detected

RCA LABORATORIES
• ENVIRONMENTAL • CONSTRUCTION MATERIALS TESTING

Ph: (02) 4902 9200 Fax: 02 4902 9299
92 Hill Street, Carrington NSW 2294
www.rca.com.au Email: labenviro@rca.com.au

ENV-F103-4

Client Name: Diocese of Maitland, Newcastle
Client Site: 507 Medowie Rd, Medowie

Contact Name: Richie Lamont
Phone Number: 0401 002 912

Email Report To: katys@rca.com.au, richiel@rca.com.au
Project Manager: Katy Shaw

Turnaround Required: ✠ Urgent ☐ Standard (5 Day)

Date Required: 10/09/2018

Expected Reporting Date: *(Laboratory Use Only)*

ANALYSIS REQUIRED

Page of

RCA Job Number: 13156a

SAMPLE INFORMATION

RCA Laboratories Environmental Sample Number	Client ID / Description	Date	Matrix	Total Samples	Acid Sulfate Screening												Notes:
091813156A001	TP1/0.3	6/09/18	S		X												
091813156A002	TP1/1	6/09/18	S		X												
091813156A003	TP1/1.5	6/09/18	S		X												
091813156A004	TP2/0.3	6/09/18	S		X												
091813156A005	TP2/1	6/09/18	S		X												
091813156A006	TP2/1.5	6/09/18	S		X												
091813156A007	TP3/0.3	6/09/18	S		X												
091813156A008	TP3/1	6/09/18	S		X												
091813156A009	TP3/1.7	6/09/18	S		X												
091813156A010	TP4/0.3	6/09/18	S		X												
091813156A011	TP4/1	6/09/18	S		X												
091813156A012	TP4/1.8	6/09/18	S		X												
091813156A013	TP5/0.3	6/09/18	S		X												
091813156A014	TP5/1	6/09/18	S		X												
091813156A015	TP5/1.6	6/09/18	S		X												

RELINQUISHED BY		RECEIVED BY		Laboratory use only (circle appropriate)
Name:R Lamont	Date: 6/9/18	Name: LOCI	Date: 6/9/18	**Received in good condition:** (Yes) No
Of:RCA	Time:	Of: RCALE	Time:	**Chilled:** ambient Yes (No)

RCA Job Number: 13156a

ANALYSIS REQUIRED

SAMPLE INFORMATION

RCA Laboratories Environmental Sample Number	Client ID / Description	Date	Matrix	Total Samples	Acid Sulfate Screening												Notes:
09181315 6A016	TP6/0.3	6/09/18	S		X												
09181315 6A017	TP6/1	6/09/18	S		X												
09181315 6A018	TP6/1.5	6/09/18	S		X												
09181315 6A019	TP7/0.3	6/09/18	S		X												
09181315 6A020	TP7/1	6/09/18	S		X												
09181315 6A021	TP7/1.6	6/09/18	S		X												
09181315 6A022	TP8/0.3	6/09/18	S		X												
09181315 6A023	TP8/1	6/09/18	S		X												
09181315 6A024	TP8/1.7	6/09/18	S		X												
09181315 6A025	TP9/0.3	6/09/18	S		X												
09181315 6A026	TP9/1	6/09/18	S		X												
09181315 6A027	TP9/1.5	6/09/18	S		X												
09181315 6A028	TP10/0.3	6/09/18	S		X												
09181315 6A029	TP10/1	6/09/18	S		X												
09181315 6A030	TP10/1.9	6/09/18	S		X												
09181315 6A031	TP11/0.3	6/09/18	S		X												
09181315 6A032	TP11/1	6/09/18	S		X												
09181315 6A033	TP11/1.5	6/09/18	S		X												
09181315 6A034	TP12/0.3	6/09/18	S		X												
09181315 6A035	TP12/1	6/09/18	S		X												
09181315 6A036	TP12/1.7	6/09/18	S		X												
09181315 6A037	TP13/0.3	6/09/18	S		X												
09181315 6A038	TP13/1	6/09/18	S		X												
09181315 6A039	TP13/1.7	6/09/18	S		X												

RELINQUISHED BY		RECEIVED BY		Laboratory use only (circle appropriate)
Name:R Lamont	Date: 6/9/18	Name:	Date: 6/9/18	**Received in good condition:** (Yes) No
Of:RCA	Time:	Of: RCAE	Time:	**Chilled:** ambient Yes (No)

RCA LABORATORIES
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Ph: (02) 4902 9200 Fax: 02 4902 9299
92 Hill Street, Carrington NSW 2294
www.rca.com.au Email: labenviro@rca.com.au

ENV-F103-4

Client Name: Diocese of Maitland, Newcastle
Client Site: 507 Medowie Rd, Medowie

Contact Name: Richie Lamont
Phone Number: 0401 002 912

Email Report To: katys@rca.com.au, richiel@rca.com.au
Project Manager: Katy Shaw

Turnaround Required: ✠ Urgent ☐ Standard (5 Day)

Date Required: 10/09/2018

Expected Reporting Date: *(Laboratory Use Only)*

ANALYSIS REQUIRED

Page of

RCA Job Number: 13156a

SAMPLE INFORMATION

RCA Laboratories Environmental Sample Number	Client ID / Description	Date	Matrix	Total Samples	Acid Sulfate Screening												Notes:
091813156A040	TP14/0.3	5/09/18	S		X												
091813156A041	TP14/1	5/09/18	S		X												
091813156A042	TP14/1.6	5/09/18	S		X												
091813156A043	TP15/0.3	5/09/18	S		X												
091813156A044	TP15/1	5/09/18	S		X												
091813156A045	TP15/1.5	5/09/18	S		X												
091813156A046	TP16/0.3	5/09/18	S		X												
091813156A047	TP16/1	5/09/18	S		X												
091813156A048	TP16/1.6	5/09/18	S		X												
091813156A049	TP17/0.3	5/09/18	S		X												
091813156A050	TP17/1	5/09/18	S		X												
091813156A051	TP17/1.8	5/09/18	S		X												
091813156A052	TP18/0.3	5/09/18	S		X												
091813156A053	TP18/1	5/09/18	S		X												
091813156A054	TP18/1.5	5/09/18	S		X												

RELINQUISHED BY		RECEIVED BY		Laboratory use only (circle appropriate)
Name:R Lamont	Date:6/9/18	Name:	Date: 6/9/18	**Received in good condition:** (Yes) No
Of:RCA	Time:	Of: RCAE	Time:	**Chilled:** ambient Yes (No)

ANALYSIS REQUIRED

RCA Job Number: 13156a

SAMPLE INFORMATION

RCA Laboratories Environmental Sample Number	Client ID / Description	Date	Matrix	Total Samples	Acid Sulfate Screening												Notes:
091813156 AO55	TP19/0.3	5/09/18	S		X												
09181315 6A056	TP19/1	5/09/18	S		X												
091813156AO57	TP19/1.7	5/09/18	S		X												
091813156A058	TP20/0.3	5/09/18	S		X												
091813156A059	TP20/1	5/09/18	S		X												
091813156AO 60	TP20/1.5	5/09/18	S		X												
091813156AO 61	TP21/0.3	6/09/18	S		X												
091813156AO62	TP21/0.6	6/09/18	S		X												
091813156A063	TP22/0.3	6/09/18	S		X												
091813156A064	TP22/1	6/09/18	S		X												
091813156A065	TP23/0.3	6/09/18	S		X												
091813156AO66	TP23/1	6/09/18	S		X												
091813156AO67	TP24/0.3	6/09/18	S		X												
68	~~TP24/0.3~~	~~6/09/18~~	~~S~~		~~X~~												Not duplicate VQA
091813156AO 68	TP24/1	6/09/18	S		X												
091813156AO 70 69	TP25/0.3	6/09/18	S		X												
091813156AO 70	TP25/1	6/09/18	S		X												
091813156A072 71	TP25/1.2	6/09/18	S		X												
091813156AO 73 72	TP26/0.3	6/09/18	S		X												
091813156AO 74 73	TP26/1	6/09/18	S		X												
091813156A078 74	TP26/1.2	6/09/18	S		X												
091813156AO 75	TP27/0.3	6/09/18	S		X												
091813156AO 77 76	TP27/1	6/09/18	S		X												
091813156AO 78 77	TP27/1.1	6/09/18	S		X												

RELINQUISHED BY		RECEIVED BY		Laboratory use only (circle appropriate)
Name:R Lamont	Date:6/9/18	Name: VQA	Date: 6/9	**Received in good condition:** (Yes) No
Of:RCA	Time:	Of: RCAVE	Time:	**Chilled:** ambient Yes (No)