RioTinto

Dampier Desalination Plant

18 September 2020

Parker Point Power Station Pond Sediment Quality Study

Report to Hamersley Iron Pty Limited

From

MScience Pty Ltd
Western Australia

mScience
marine research

Dampier Desalination Plant

Parker Point Power Station Pond Sediment Quality Study

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Acronyms and Abbreviations

Abbreviation	Definition
Al	Aluminium
Ag	Silver
ALS	Australian Laboratory Services
ANZG	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
As	Arsenic
ASS	Acid Sulphate Soils
B	Boron
Ba	Barium
Be	Beryllium
BTEXN	Benzene, Toluene, Ethylbenzene, Xylene, Naphthalene
Cd	Cadmium
Co	Cobalt
COPC	Contaminant of Potential Concern
Cr	Chromium
Cu	Copper
DQO	Data Quality Objective
DWER	Department of Water and Environmental Regulation
EILs	Ecological Investigation Levels
Fe	Iron
Hg	Mercury
HILs	Health Investigation Levels
LOR	Limit of Reporting
NATA	National Association of Testing Authorities
NEPM	National Environment Protection (Assessment of Site Contamination) Measure
Ni	Nickel
OC/OP	Organochlorine/Organophosphorus
PP	Parker Point
PAH	Polycyclic Aromatic Hydrocarbon
Pb	Lead
PSD	Particle Size Distribution
QA/QC	Quality Assurance and Quality Control
RO	Reverse Osmosis
RTIO	Rio Tinto Iron Ore
Sb	Antimony
Se	Selenium
SQGV	Sediment Quality Guideline Value
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
UCL	Upper Confidence Limit
V	Vanadium
Zn	Zinc

EXECUTIVE SUMMARY

Hamersley Iron Pty Limited (Hamersley, the Proponent), is undertaking an assessment of the environmental impacts of constructing and operating a reverse osmosis (RO) desalination plant at its Parker Point facility within its Dampier Operations within the Port of Dampier in Western Australia's (WA) Pilbara Region. The Proponent is a wholly owned company of Rio Tinto Iron Ore (RTIO) and the project is being managed by RTIO on behalf of the Proponent.

Hamersley propose to locate the plant's associated seawater intake and brine discharge pipes near existing port infrastructure. The seawater intake is proposed to be located at the site of the decommissioned Power Station pond (the Pond). The Pond has been partially infilled by sediments since being decommissioned and will require excavation. It is anticipated that the excavated material will be disposed to landfill. The *National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended in 2013* (NEPM 2013) provides guidance on the assessment of site contamination. In WA, contaminated sites are regulated by the Department of Water and Environmental Regulation (DWER) through the *Contaminated Sites Act 2003* and *Contaminated Sites Regulations 2006*. Material that is to be disposed to landfill should be characterised in accordance with Schedule B2 of the NEPM (2013) and classified using criteria provided in *Landfill Waste Classification and Waste Definitions 1996, as amended 2019* (DWER 2019). The assessment of sediments is not covered in detail in the NEPM, but DWER provides additional guidance specific to WA within the Contaminated Sites Guidelines (CSG) Assessment and management of contaminated sites (DWER 2014). The CSG suggest sediment quality should be assessed against the default sediment quality guideline values (SQGVs) provided in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG) (2018).

A study to assess the sediment quality within the decommissioned Power Station pond was undertaken to provide a preliminary view of compliance with the relevant sediment quality and contaminated site guidelines. The objective of the study was to screen for a comprehensive suite of the metals, hydrocarbons, nutrients, pesticides and herbicides recommended in the NEPM and ANZG. On the 13 August 2020, samples were collected from sediments around the edges of the Pond and subsequently assayed for relevant analytes.

When analysed for particle sizing, approximately 70-80% of the sediments from the Power Station pond reported to the coarse sand and gravel fractions (500 – 10000 µm). Sediment from sites 2 and 3 reported a higher fraction of fines with the clay and silt fraction (sediments <62 µm), comprising 45 – 50% of the sample, and the remaining fraction being represented by sand (62 – 2000 µm) and gravel. Fine to medium sand (62 – 500 µm) contributed to approximately 10 – 20% of the sample at each site.

Concentrations of most metals were relatively low. The investigation into metal and metalloid concentrations in sediments showed that 95% UCL concentrations of all sediment metals were below the available ANZG and NEPM screening guideline levels. Concentrations of iron were elevated when compared to derived SQGVs, but were consistant with previous recent assessments of sediments in the Port of Dampier (MScience 2015; MScience 2020) and are considered to be representative of ambient conditions. Assessment of 95% UCL concentrations of sediment metals against the landfill waste contaminant threshold levels (DWER 2019) indicated sediments within the Pond would be suitable for disposal in a Class III landfill facility.

Results of assays for the suite of organic compounds (TPH, PAH, BTEXN, OC/OP pesticides and phenoxyacetic acid herbicides) were below levels of detection in every sample.

The nutrient concentrations reported were generally low and similar to other studies of marine sediments in the Port of Dampier (MScience 2007; Worley Parsons 2009).

Overall, concentrations of candidate contaminants of potential concern in sediment samples collected for this study were shown to be below the default SQGVs described in the ANZG, below the ecological investigation levels and health investigation levels prescribed by the NEPM and below the contaminant threshold levels for a Class III landfill as detailed in the DWER landfill waste guidelines; noting there are no screening guidelines for some of the analytes investigated in this survey. This preliminary assessment of compliance against the relevant guidelines suggests that sediment from the edges of the decommissioned Parker Point Power Station pond would be suitable for disposal within a Class III landfill facility, however further sampling to characterise the sediment located in the middle of the pond, which was not accessed here, may be required prior to excavation and disposal. If the sediment was stockpiled on land prior to disposal at a landfill, additional sample collection may be required at the stockpile location to determine background concentrations, depending on the sensitivity of the area around the stockpile site. The decant water from the excavated material will also need to be managed if it is to be stockpiled on land prior to disposal at a Class III landfill. Excavated material will be at a seawater level of salinity with readily leachable salts, which has the potential to impact terrestrial environmental quality.

1 INTRODUCTION

1.1 Background

Hamersley Iron Pty Limited (Hamersley, the Proponent), is undertaking an assessment of the environmental impacts of constructing and operating a reverse osmosis (RO) desalination plant at its Parker Point facility within its Dampier Operations within the Port of Dampier in Western Australia's (WA) Pilbara Region. MScience Pty Ltd (MScience) have been commissioned to conduct a variety of studies to support that assessment. The Proponent is a wholly owned company of Rio Tinto Iron Ore (RTIO) and the project is being managed by RTIO on behalf of the Proponent.

Hamersley propose to locate the plant's associated seawater intake and brine discharge pipes near existing port infrastructure. The seawater intake is proposed to be located at the site of the decommissioned Power Station pond (the Pond). The Pond has been partially infilled by sediments since being decommissioned and will require excavation, it is anticipated that the excavated material will be disposed to landfill.

The *National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended in 2013* (NEPM 2013) provides guidance on the assessment of site contamination. In WA, contaminated sites are regulated by the Department of Water and Environmental Regulation (DWER) through the *Contaminated Sites Act 2003* and *Contaminated Sites Regulations 2006*. Material that is to be disposed to landfill should be characterised in accordance with Schedule B2 of the NEPM (2013) and classified using criteria provided in *Landfill Waste Classification and Waste Definitions 1996, as amended 2019* (DWER 2019). The assessment of sediments is not covered in detail in the NEPM, the DWER provides additional guidance specific to WA within the Contaminated Sites Guidelines (CSG) Assessment and management of contaminated sites (DWER 2014). The CSG suggest sediment quality should be assessed against the default sediment quality guideline values (SQGVs) provided in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG) (2018).

A study to assess the sediment quality within the decommissioned Power Station pond was undertaken to provide a preliminary view of compliance with the relevant sediment quality and contaminated site guidelines. The objective of the study was to screen for a comprehensive suite of the metals, hydrocarbons, nutrients, pesticides and herbicides recommended in the NEPM and ANZG. Sampling was conducted on 13 August 2020 and the results of subsequent analyses are described in this report.

1.2 Structure of this Document

The document contains:

- The methods used for sampling and analysis;
- The results of sediment assays for chemistry and particle size; and
- A discussion of the significance of the results relative to NEPM and ANZG guidelines.

The document is current as at the date on the cover page and is referenced as Version 1 (Documents with a lower version number are superseded by this document).

2 METHODS

2.1 Contaminants of Potential Concern

Testing of marine sediments for contaminants of potential concern (COPC) within the Port of Dampier has been undertaken on many occasions for dredging programs with spoil proposed for disposal at sea (MScience 2016). Sediments within Parker Point were most recently tested in July 2020 (MScience 2020) under the National Assessment Guidelines for Dredging. On the basis of past investigations of sediment chemistry within the Port of Dampier, the potential for pesticides and herbicides to be used on the land surrounding the Pond and recommendations in the NEPM (2013) and ANZG (2018), the following analytes were investigated:

- Particle Size Distribution (PSD)
- Metals (Ag, Al, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Hg, Mn, Ni, Pb, Sb, Se, V, Zn)
- Total Organic Carbon (TOC)
- Total Petroleum Hydrocarbons (TPH)
- Polycyclic Aromatic Hydrocarbons (PAH)
- Benzene, Toluene, Ethylbenzene, Xylene, Naphthalene (BTEXN)
- Organochlorine/Organophosphorus (OC/OP) pesticides
- Phenoxyacetic Acid Herbicides

Nutrients such as ammonium, phosphate and nitrate are generally not considered COPC, however they may become chemical stressors at high concentrations (Simpson et al. 2013), therefore their concentrations were also investigated.

The shorelines of Dampier have only minimal development of mangroves where sediments may accumulate and are generally rocky substrates (Semeniuk et al. 1982). There is no significant record of acid-generating soils at Parker Point and none are expected within the pond, therefore the presence of acid sulphate soils (ASS) was not investigated.

2.2 Sampling Design

The NEPM (2013) recommends that sample numbers should be based on the estimated volume of material to be disposed to landfill. Since the volume of material to be disposed was not known at the time of the study, sampling followed a spatially balanced design, where sites were randomly selected but distributed across the study area with a view to maximise the spatial independence between the sample sites. Site selection was constrained by access restrictions. At the time of the study it was not possible to access the middle of the Pond safely and all samples were collected from around its edge. Sample collection occurred at the four corners of the Pond, with an additional sample randomly collected along the Pond's edge at a more central location. The distribution of sample numbers is shown in Figure 2-1, with sampling coordinates for the 5 sites shown in Table 2-1. The sampling design was implemented on 13 August 2020.

Table 2-1. Sampling point names and locations

Site ID	Easting (GDA2020Z50)	Northing (GDA2020Z50)	Longitude (WGS84)	Latitude (WGS84)
1	470742	7716578	-20.64985316	116.71913104
2	470698	7716642	-20.64927417	116.71870972
3	470730	7716660	-20.64911202	116.71901720
4	470768	7716625	-20.64942887	116.71938141
5	470713	7716620	-20.64947319	116.71885335

2.3 Field Procedures

Sample collection and processing were conducted in accordance with the methods prescribed by the ANZG (2018).

2.3.1 Sample collection

Surface sediments (from the top 0 - 15 cm) were collected using a stainless-steel Petite Ponar Grab sampler (the Grab). To collect sediments, the Grab was manually deployed from the edge of the pond and retrieved once the bucket had closed over the substrate. Retrieval was conducted carefully to maximise retention of all sediments. Sample material in the Grab was transferred to a stainless-steel bowl, photographed and homogenised prior to being placed into a pre-labelled sample jar supplied by the laboratory. Sediments to be analysed for volatiles were collected from the centre of the Grab prior to homogenisation.

All field staff in contact with the sample material wore Nitrile gloves while transferring sample material. Before the initial deployment of the Grab and between each subsequent deployment, the Grab and all sampling equipment (e.g. sample mixing bowls, scoops) were washed with Decon 90 cleaning solution and then rinsed twice with deionised water. Representative photographs of the sediment samples are included in **Appendix A**.

2.3.2 Sample handling, preservation, storage and transport

Once collected into pre-labelled jars, the samples were stored in a dark cooler box with ice and were freighted on Thursday 13 August to the MScience Perth offices. Samples arrived in Perth on Monday 17 August where they received a final check before being express couriered cold the same day to the nominated laboratory with the attendant chain of custody (CoC) form. All samples reached the laboratory within nominated holding times for relevant assays.

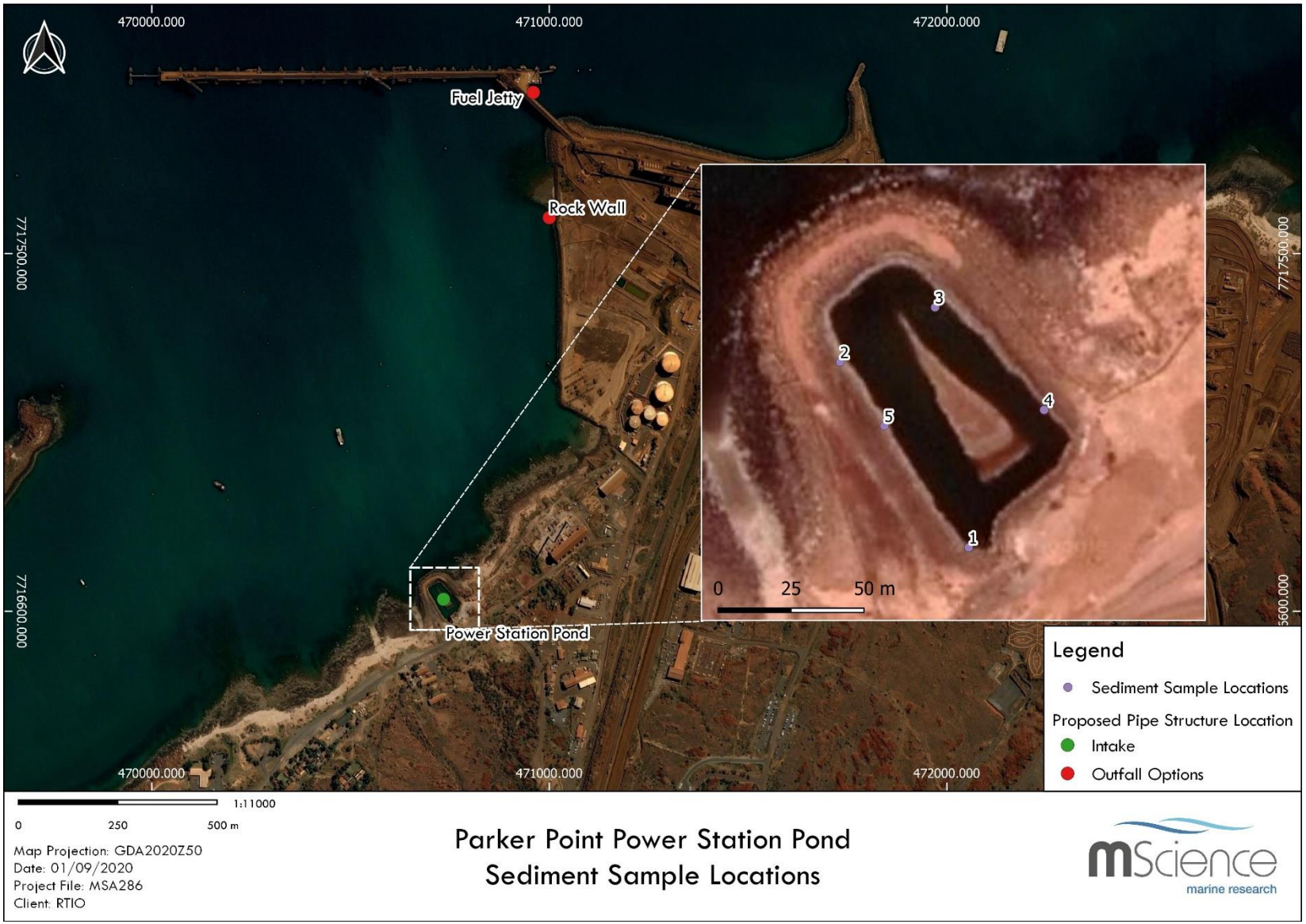

Figure 2-1. Map of sediment sample collection sites

2.4 Sample Analyses

The methods and detection limits for the analyses performed are provided in Table 2-2. Analyses were undertaken by Australian Laboratory Services (ALS) using methods accredited under the National Association of Testing Authorities (NATA) for the parameters to be measured. Samples were consigned using a CoC to ALS for analysis. As part of their standard procedures, ALS undertook the required testing of blanks, spikes and standards, and completed laboratory duplicates to the satisfaction of NATA. Reports of these results are provided in **Appendix C**. Field replicates were not collected for the study.

Table 2-2. Analytes investigated with assay methods, limits of reporting (LOR) and storage method.

Analyte	Method Reference	LOR	Storage container	Storage conditions
Metals (Ag, Al, As, Ba, Be, B, Ca, Cr, Co, Cu, Fe, Hg, Pb, Mn, Ni, Sb, Se, V, Zn)	USEPA 6010 ALPHA 3112 Hg - B	0.01 – 50 mg/kg	250 ml Soil Glass Jar – Unpreserved	≤4°C, in the dark
TRH/BTEXN/PAH	USEPA 8015/8260/8270	0.2 – 100 mg/kg	250 ml Soil Glass Jar – Unpreserved	≤4°C, in the dark
TOC	In house (EP003)	0.02 %	150 ml Soil Glass Jar – Unpreserved	≤4°C, in the dark
Phenoxyacetic acids	In house (EP202)	0.02 mg/kg	150 ml Soil Glass Jar – Unpreserved	≤4°C, in the dark
OC/OP Pesticides	USEPA 8270	0.05 – 0.2 mg/kg	250 ml Soil Glass Jar – Unpreserved	≤4°C, in the dark
Total N + Total P	9171/APHA 4500-Norg D/APHA 4500-Norg/N03/APHA 4500-PB&H	0.1 – 20 mg/kg	250 ml Soil Glass Jar – Unpreserved	≤4°C, in the dark
Ammonia as N	APHA 4500-NH3 B/G/H	20 mg/kg	250 ml Soil Glass Jar – Unpreserved	≤4°C, in the dark
PSD (Sieve and Hydrometer analysis)	AS 1289.3.6.3 AS 1289.3.5.1	1%/ 0.01g/cm^3	2 x 500 ml Ziploc bag	1- 4°C, in the dark

2.5 Data Analysis

Sediment quality for the area has been described by the upper 95th percentile of the confidence limit of the test site distribution (95% UCL) in comparison to the ANZG (2018) default sediment quality guideline values (SQGVs). The USEPA's ProUCL software was used to calculate and recommend the most appropriate 95% UCL test to apply based on the data size, data distribution and skewness.

Material that is to be disposed to landfill should be characterised in accordance with Schedule B2 of the NEPM (2013) and classified using criteria provided in the DWER landfill waste classification and waste definition guidelines (DWER 2019). The NEPM guidelines consist of ecological investigation levels (EILs), and health investigation levels (HILs). The DWER guidelines consist of contaminant threshold (CT) values for Class I to IV landfills. Whilst the NEPM recommends these values should not be directly applied to assess the contamination of marine sediments, where COPC were detected (metals), the 95% UCL of the test site distribution was compared to these values for reference.

COPC concentrations below the LOR were assigned a value of LOR/2 for inclusion in statistical analysis.

3 RESULTS

This section presents the results of the physical and chemical sediment quality assessment. The laboratory QA/QC processes for data validation have also been presented in this section. Following data validation, data from the Pond were compared to screening levels and ambient background concentrations in accordance with the guidelines in the NEPM (2013), ANZG (2018) and DWER (2019).

3.1 Sediment Quality

3.1.1 Field Observations

Field observations and photographs of sediment have been presented in **Appendix A.**

3.1.2 Particle Size Distribution

Particle sizing was undertaken by wet sieving and hydrometric analysis of samples. The grain size classification aligned size classes reported by the laboratories with the Wentworth scale. The raw data results of the PSD analysis are supplied in **Appendix B,** while summary data are presented in this section.

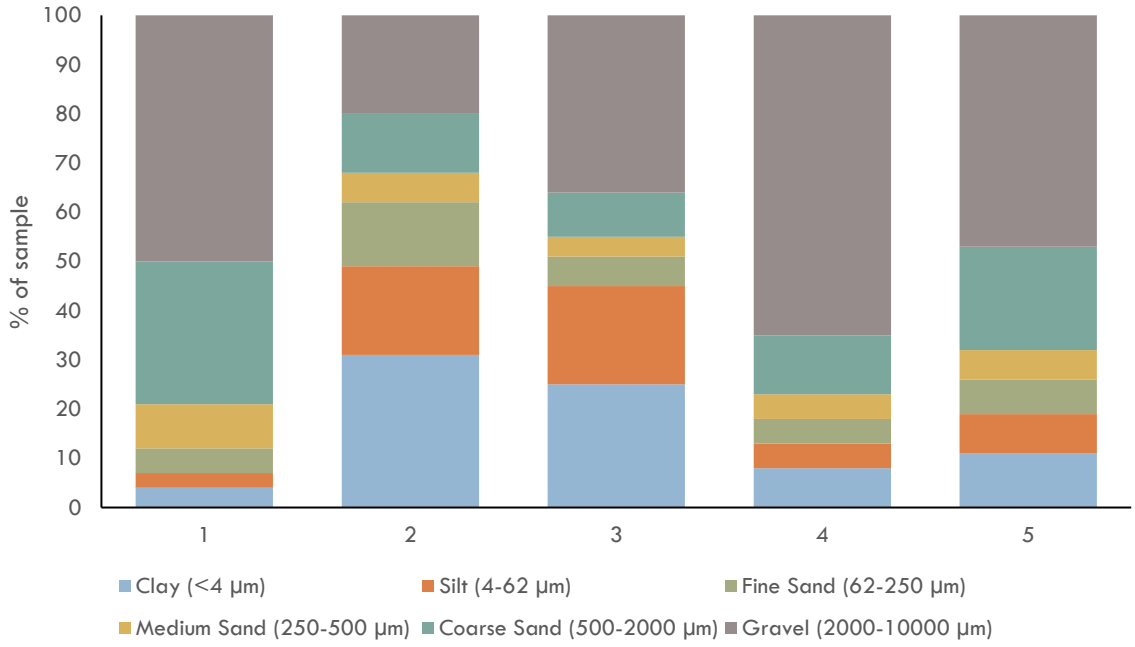

Figure 3-1. Particle size distribution of the power station pond samples

The composition of sediment for individual samples is shown in Figure 3-1. When analysed for particle sizing, approximately 70-80% of the sediments from the Pond were shown to be sorted into the coarse sand and gravel fractions (500 – 10000 µm). Sediment from sites 2 and 3 reported a higher fraction of fines with the clay and silt fraction (sediments <62 µm), comprising 45 – 50% of the sample, and the remaining fraction being represented by sand (62 – 2000 µm) and gravel. Fine to medium sand (62 – 500 µm) contributed to approximately 10 – 20% of the sample at each site.

Sites 2 and 3, which reported the higher fraction of fines, were located close to the rock wall separating the pond from the ocean.

3.2 Metals and Metalloids

Assay results for metals and metalloids are shown in Table 3-1. Laboratory certificates of raw data are shown in **Appendix B**.

The mean, median and 95% UCL of the test site distribution, as well as the relevant ANZG (2018), NEPM (2013) and DWER (2019) screening levels are presented in Table 3-1.

3.2.1 Metals with default and derived SQGV screening levels

The 95% UCL concentrations of metals listed in the ANZG (2018) (arsenic, antimony, cadmium, chromium, copper, lead, mercury, nickel, silver and zinc) were compared to their respective default SQGVs.

Antimony, cadmium, silver and mercury were not detected above the LOR. The 95% UCL concentrations of all other metals in this category were found below the default SQGV screening levels. Concentrations of most metals were relatively low.

The laboratory reported LORs for antimony and silver were above the default SQGV prescribed by the ANZG (2018). On this basis, the concentration of these two metals should be considered as estimates, rather than precise values, and conservative for the purposes of reporting against the ANZG (2018) screening levels. However, neither of these metals have been found in concentrations above the SQGVs in past studies of sediments in nearby areas (MScience 2016; MScience 2020), and it is unlikely that testing against a lower LOR would change the outcome of the assessment.

SQGVs for metals without a default screening level are determined by procedures set out in Simpson *et al* (2013) and ANZG (2018). In these cases, the SQGV is the mean background concentration multiplied by two to account for sampling and analytical variability and the range of natural values in the area, to provide a level against which to compare the median concentration at the test site. As an interim measure, prior to collecting samples from the disposal area (if material is stockpiled prior to going to landfill), recent reference site data collected during surveys implemented to support disposal of dredged material at sea were used to derive background levels for aluminium, cobalt, iron, manganese, selenium and vanadium (MScience 2015; MScience 2020).

The median concentrations of aluminium, cobalt, manganese, selenium and vanadium were below the derived SQGVs, while median concentrations of iron were above the SQGV. Iron levels were consistent with previous recent assessments of sediments in the Port of Dampier (MScience 2015; MScience 2020) and are likely to be representative of ambient conditions for potential stockpile sites.

SQGVs could not be derived for barium, beryllium or boron due to the lack of available background data.

3.2.2 Metals compared to NEPM screening levels

The 95% UCL concentrations of all metals were below the ecological investigation levels (EILs) and health investigation levels (HILs) for commercial and industrial land use prescribed by the NEPM (2013).

3.2.3 Metals compared to landfill contaminant thresholds

The 95% UCL concentrations of all metals were below the contaminant threshold (CT) values for disposal at a Class III landfill as per DWER (2019).

Table 3-1. Comparison of sediment concentration of metals with the ANZG (2018) and NEPM (2013) screening levels

Site	Al	Sb	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Ni	Se	Ag	V	Z	Hg
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR	50	5	5	10	1	50	1	2	2	5	50	5	5	2	5	2	5	5	0.1
1	2570	<5	5	10	<1	<50	<1	12	2	6	6970	2.5	77	5	<5	<2	11	21	<0.1
2	8410	<5	10	40	<1	<50	<1	44	6	15	33700	6	216	18	<5	<2	37	47	<0.1
3	10100	<5	12	30	<1	<50	<1	52	8	17	32800	6	216	22	<5	<2	42	51	<0.1
4	5410	<5	7	20	<1	<50	<1	28	4	10	17900	2.5	123	12	<5	<2	26	36	<0.1
5	6600	<5	7	20	<1	<50	<1	30	5	12	33300	2.5	186	14	<5	<2	28	37	<0.1
Mean	6618	2.5*	8.2	24	0.5*	25*	0.5*	33.2	5	12	24934	3.9	163.6	14.2	2.5*	1*	28.8	38.4	0.05*
Median	6600	2.5*	7	20	0.5*	25*	0.5*	30	5	12	32800	2.5	186	14	2.5*	1*	28	37	0.05*
95% UCL	9364	2.5*	10.85	34.87	0.5*	25*	0.5*	47.95	7.13	16.1	36423	5.73	222.3	20.32	2.5*	1*	40.2	49.5	0.05*
SQGV	13772#	2	20	-	-	-	1.5	80	9.7#	65	28283#	50	315#	21	0.64#	1	45.9#	200	0.15
SQGV-high	-	25	70	-	-	-	10	370	-	270	-	220	-	52	-	4	-	410	1.0
HILs^	-	-	3000	-	500	300000	900	3600	-	240000	340	1500	60000	6000	10000	-	-	400000	730
EILs	-	-	160	-	-	-	-	310-660	-	140-340	-	1800	-	55-960	-	-	-	110-2000	-
CT3**			140		20		4	100				20		40	20	200			2

* The distribution of data shows no variance, reported value is ½ LOR

2 x the mean of background concentration; data derived from recent local surveys of reference marine sediments (MScience 2015; MScience 2020)

^ HIL D – Commercial/industrial land use

'-' no value available

** Contaminant threshold values for waste disposal at a Class III landfill not requiring a leach test. A Class III landfill is lined and designed to accept putrescible and inert wastes for burial

3.3 Organic Compounds

Total organic carbon (TOC) was analysed in all samples. Sediment concentrations of TOC for the current survey ranged from 0.22% to 0.42% (see **Appendix B**). Interpretation of concentrations of organic contaminants requires their normalisation against levels of TOC. The relatively low levels of TOC found here mean that when organic contaminants are normalised to 1% TOC, they will be considerably higher than their raw concentration in the sediment. Normalisation is only appropriate over the TOC range 0.2–10% and equates to multiplication factors of 5 to 0.1, respectively. Where TOC was less than 0.2%, a multiplication factor of 5 is recommended. In the current investigation, none of the samples analysed for organic compounds had a TOC below 0.2%.

No organic analytes included for testing here were detected in any of the samples and concentrations were set to 50% of the limit of detection. Any variance as a result of normalising these samples to 1% TOC would be entirely due to variance in TOC concentrations rather than in the organic analytes being normalised. As such, normalisation to TOC was not performed for any organic analyte. Since all organic contaminants analysed in samples from this survey returned concentrations below the LOR, 95% UCLs were not calculated.

3.3.1 Total Petroleum Hydrocarbons (TPH)

Results of the TPH analysis are presented in Table 3-2. For the current investigation, the sum of fractions used to calculate total TPH were:

- Fraction 1 - TPH C6-C9 (LOR = 10 mg/kg);
- Fraction 2 - TPH C10 - C14 (LOR = 50 mg/kg);
- Fraction 3 - TPH C15 - C28 (LOR = 100 mg/kg); and
- Fraction 4 - TPH C29 - C36 (LOR = 100 mg/kg).

Hydrocarbons from all TPH Fractions were below detection limits in all samples. The concentrations of these organic fractions were not normalised to 1% TOC and calculation of the 95% UCLs were not performed since there was no variance in TPH concentrations from which to derive this statistic.

Table 3-2. Concentration of TPH in sediments

Units (mg/kg)	Assay LOR	SQGV	SQGV-high	Pond Sites (n=5)
Fraction 1: C6-C9	10	280	550	<10
Fraction 2: C10-C14	50			<50
Fraction 3: C15-C28	100			<100
Fraction 4: C29-C36	100			<100

3.3.2 Polyaromatic Hydrocarbons (PAH)

PAHs were analysed in all samples. No species of PAH were detected in any of the samples analysed (Table 3-3). As was the case for TPH, since there was no variance in the PAH concentrations, normalisation and calculation of the 95% UCL were not performed.

Table 3-3. PAH concentrations in sediments

Units (µg/kg)	Assay LOR	SQGV	SQGV-high	Pond Sites (n=5)
Naphthalene	0.5	10,000	50,000	<0.5
Acenaphthylene	0.5			<0.5
Acenaphthene	0.5			<0.5
Fluorene	0.5			<0.5
Phenanthrene	0.5			<0.5
Anthracene	0.5			<0.5
Fluoranthene	0.5			<0.5
Pyrene	0.5			<0.5
Benz(a)anthracene	0.5			<0.5
Chrysene	0.5			<0.5
Benzo(b+j)fluoranthene	0.5			<0.5
Benzo(k)fluoranthene	0.5			<0.5
Benzo(a)pyrene	0.5			<0.5
Perylene	0.5			<0.5
Benzo(g.h.i)perylene	0.5			<0.5
Dibenz(a.h)anthracene	0.5			<0.5
Indeno(1.2.3.cd)pyrene	0.5			<0.5
Sum of PAHs	0.5			<0.5

3.3.3 Benzene, Toluene, Ethylbenzene, Xylene, Naphthalene (BTEXN)

BTEXN compounds were analysed in all samples and were not detected – LOR for Benzene was 0.2 mg/kg and Naphthalene was 1 mg/kg, all other LORs were 0.5 mg/kg.

3.3.4 Organochlorine/Organophosphorus (OC/OP) Pesticides

OC/OP Pesticides were analysed in all samples and were not detected (Table 3-4). Calculation of the 95% UCL was not performed since there was no variance in concentrations.

Table 3-4. OC/OP Pesticide concentrations in sediments

Units (mg/kg)	Assay LOR	SQGV	SQGV-high	Pond Sites (n=5)
Organophosphorus Pesticides				
Dichlorvos	0.05	-	-	<0.05
Demeton-S-methyl	0.05	-	-	<0.05
Monocrotophos	0.2	-	-	<0.2
Dimethoate	0.05	-	-	<0.05
Diazinon	0.05	-	-	<0.05
Chlorpyrifos-methyl	0.05	-	-	<0.05
Parathion-methyl	0.2	-	-	<0.2
Malathion	0.05	-	-	<0.05
Fenthion	0.05	-	-	<0.05
Chlorpyrifos	0.05	-	-	<0.05
Parathion	0.2	-	-	<0.2
Pirimphos-ethyl	0.05	-	-	<0.05
Chlorfenvinphos	0.05	-	-	<0.05
Bromophos-ethyl	0.05	-	-	<0.05
Fenamiphos	0.05	-	-	<0.05

Units (mg/kg)	Assay LOR	SQGV	SQGV-high	Pond Sites (n=5)
Prothiofos	0.05	-	-	<0.05
Ethion	0.05	-	-	<0.05
Carbophenothion	0.05	-	-	<0.05
Azinphos Methyl	0.05	-	-	<0.05
Organochlorine Pesticides				
alpha-BHC	0.05	-	-	<0.05
Hexachlorobenzene (HCB)	0.05	-	-	<0.05
beta-BHC	0.05	-	-	<0.05
gamma-BHC	0.05	-	-	<0.05
delta-BHC	0.05	-	-	<0.05
Heptachlor	0.05	-	-	<0.05
Aldrin	0.05	-	-	<0.05
Heptachlor epoxide	0.05	-	-	<0.05
Total Chlordane (sum)	0.05	4.5	9.0	<0.05
trans-Chlordane	0.05	-	-	<0.05
alpha-Endosulfan	0.05	-	-	<0.05
cis-Chlordane	0.05	-	-	<0.05
Dieldrin	0.05	2.8	7.0	<0.05
4.4`-DDE	0.05	1.4	7.0	<0.05
Endrin	0.05	2.7	60	<0.05
Endosulfan (sum)	0.05	-	-	<0.05
beta-Endosulfan	0.05	-	-	<0.05
4.4`-DDD	0.05	3.5	9.0	<0.05
Endrin aldehyde	0.05	-	-	<0.05
Endosulfan sulfate	0.05	-	-	<0.05
4.4`-DDT	0.2	1.2	5.0	<0.2
Endrin ketone	0.05	-	-	<0.05
Methoxychlor	0.2	-	-	<0.2
Sum of DDD + DDE + DDT	0.05	-	-	<0.05
Sum of Aldrin + Dieldrin	0.05	-	-	<0.05

3.3.5 Phenoxyacetic Acid Herbicides

Phenoxyacetic acid herbicides were analysed in all samples and were not detected (Table 3-5). Since there was no variance between samples, calculation of the 95% UCL was not performed.

Table 3-5. Phenoxyacetic acid herbicide concentrations in sediments

Phenoxyacetic acid	Assay LOR (mg/kg)	Pond Sites (n=5)
Dichlorvos	0.02	<0.02
Demeton-S-methyl	0.02	<0.02
Monocrotophos	0.02	<0.02
Dimethoate	0.02	<0.02
Diazinon	0.02	<0.02
Chlorpyrifos-methyl	0.02	<0.02
Parathion-methyl	0.02	<0.02
Malathion	0.02	<0.02
Fenthion	0.02	<0.02
Chlorpyrifos	0.02	<0.02
Parathion	0.02	<0.02
Pirimphos-ethyl	0.02	<0.02
Chlorfenvinphos	0.02	<0.02

Phenoxyacetic acid	Assay LOR (mg/kg)	Pond Sites (n=5)
Bromophos-ethyl	0.02	<0.02

3.4 Nutrients

Concentrations of nutrients could not be compared to screening levels in the ANZG or NEPM as guidelines do not exist for these analytes. Assay results for the nutrients investigated are shown in Table 3-6.

The nutrient concentrations reported were similar to other studies of marine sediments in the Port of Dampier (MScience 2007; Worley Parsons 2009) and were generally low, which can be attributed to the relatively low nutrient supply.

Table 3-6. Nutrient concentrations in sediments

Site	Ammonia	Nitrite + Nitrate	Total Nitrogen	Total Phosphorus
Units	mg/kg	mg/kg	mg/kg	mg/kg
LOR	20	0.1	20	2
1	<20	0.2	300	314
2	<20	0.05*	780	348
3	<20	0.2	950	321
4	<20	0.1	450	246
5	<20	0.05*	470	293
Mean	<20	0.1	590	304
Median	<20	0.1	470	314
Port of Dampier Background Range**	2 - 12	0.05 – 0.2	120 - 410	33 - 530

* reported value is ½ LOR
** Range of values from Worley Parsons (2009)

3.5 Data Validation – Quality Assurance and Quality Control (QA/QC)

This section examines the validity of the analytical data used in this assessment. The QA/QC compliance report generated by ALS (**Appendix C**) sets out data quality objectives (DQO) relating to analysis and outlines the results of the internal QA/QC procedures. Field replicates were not collected for the study.

3.5.1 Sample Holding Times

Sample integrity was maintained in accordance with the ANZG (2018) by ensuring samples were stored in the laboratory supplied containers, preserved at the correct temperature and CoC records were maintained and receipted throughout the transfer of samples to the analytical laboratories.

Analysis of all sediment samples was completed within the recommended holding times for all analytes.

3.5.2 Laboratory Blanks

As part of the method validation, blank samples are assayed and the results are then compared to the LOR to identify any outliers. There were no method blank outliers reported for the ALS QC investigation (**Appendix C**).

3.5.3 Standards and Spikes

Laboratory control standards (LCS) and matrix spike (MS) recoveries are measured as the percentage of analyte recovered from the sample compared to the amount of analyte spiked into the sample. LCS were required to have recovery limits of 80 - 120% as outlined in the ANZG (2018). The ALS QC report indicated there were no laboratory control outliers or surrogate recovery outliers, however there were matrix spike recovery outliers reported.

There was a matrix spike recovery issue for the analysis of Total Phosphorus in one sample (not specified) which showed a matrix spike recovery was not determined due to the background level being greater than or equal to 4 x the spike level.

Matrix spike recoveries are used to document precision and bias of a method in a given sample matrix. Combined QC test results suggest that the recovery problem was due to matrix interference with spike recovery, rather than being system related. These qualified results suggest that the heterogenous nature of the sediment has affected the precision of results in one sample where analytes have failed to meet the recovery limits. In the case of most analytes and samples, LCS and MS recoveries were sufficient to meet the data quality objectives for classification of results as exact values.

3.5.4 Laboratory Duplicates

The repeatability of the analytical method is determined with laboratory analysis of duplicate samples. Laboratory duplicate (DUP) and matrix spike duplicate (MSD) relative percent differences are measured against their original counterpart samples according to the formula: the absolute difference of the two results divided by the average of the two results as a percentage.

Duplicate assessment was performed as part of the laboratory in-house validation process, with the ALS QC report indicating all duplicate analyses were within the ±35% range. These results suggest that the precision of the assays were appropriate, and results should be considered as exact values.

4 DISCUSSION & CONCLUSIONS

Hamersley Iron Pty Limited is undertaking an assessment of the environmental impacts of constructing and operating a reverse osmosis desalination plant at its Parker Point facility within its Dampier Operations within the Port of Dampier in Western Australia's Pilbara Region. Hamersley propose to locate the plant's associated seawater intake and brine discharge pipes near existing port infrastructure, with the seawater intake proposed to be located at the site of the decommissioned Power Station Pond. That pond requires excavation to accommodate the intake and it is anticipated that the excavated material will be disposed to landfill. This study has been undertaken to provide a preliminary view as to whether the chemical quality of sediments likely to require disposal from the pond are compliant with Western Australia's guidelines on contaminated sites.

Sampling was conducted on 13 August 2020. Quality Assurance/Quality Control (QA/QC) tests within the laboratory analysis process identified one instance where the acceptability criteria for QC assessment of nutrient concentrations was not met. Total phosphorus did not meet the acceptability criteria for matrix spike recovery in one sample, results for this analyte should be considered estimates. However, at the concentrations recorded, error in measurement was not great enough to invalidate the outcomes of the assessment.

Approximately 70-80% of the sediments from the Power Station pond were shown to be sorted into the coarse sand and gravel (500 – 10000 µm) fractions. Sediment from sites 2 and 3 reported a higher fraction of fines (sediments <62 µm), with the clay and silt fraction comprising 45 – 50% of the samples, and the remaining fraction being represented by sand (62 – 2000 µm) and gravel. Fine to medium sand (62 – 500 µm) contributed to approximately 10 – 20% of the sample at each site.

The investigation into metal and metalloid concentrations in sediments showed that sediment 95% upper confidence limit (UCL) concentrations of metals were below the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG), the *National Environment Protection (Assessment of Site Contamination) Measure, 1999* (NEPM) and the Department of Water and Environmental Regulation (DWER) screening guideline levels (where available) for all metals. Concentrations of most metals were relatively low. Concentrations of iron exceeded the derived sediment quality guideline values (SQGVs), however, levels were consisted with previous recent assessments of sediments in the Port of Dampier (MScience 2015; MScience 2020) and are likely to be representative of ambient conditions for potential disposal sites.

Assays for the suite of organic compounds (Total Petroleum Hydrocarbons, Polyaromatic Hydrocarbons, Benzene, Toluene, Ethylbenzene, Xylene, Naphthalene, Organochlorine/Organophosphorus pesticides and phenoxyacetic acid herbicides) proposed for analysis showed that none of these compounds were detected in any sample.

The nutrient concentrations reported were similar to other studies of marine sediments in the Port of Dampier (MScience 2007; Worley Parsons 2009) and were generally low, which can be attributed to the relatively low nutrient supply.

Overall, sediment concentrations of candidate contaminants of potential concern (COPC) were shown to be below the default SQGVs described in the ANZG, below the environmental investigation levels (EILs) and health investigation levels (HILs) prescribed by the NEPM and below the contaminant threshold (CT) values detailed in the DWER landfill waste guidelines; noting there are no screening guidelines for some of the analytes investigated in this survey.

This preliminary assessment of compliance against the relevant guidelines suggests that sediment from the decommissioned Parker Point Power Station pond would be suitable for disposal within a Class III landfill facility, however further sampling to characterise the sediment located in the middle of the pond, which was not sampled here, may be required prior to excavation and disposal. If the sediment was stockpiled on land prior to disposal at a landfill, additional sample collection may be required at the stockpile location to determine background concentrations, depending on the sensitivity of the area around the stockpile site. The decant water of the excavated material will also need to be managed if it is to be stockpiled on land prior to disposal at a Class III landfill. Excavated marine sediments will be at a seawater level of salinity with readily leachable salts, which has the potential to impact terrestrial environmental quality.

5 REFERENCES

ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. www.waterquality.gov.au/anz-guidelines.

DWER (2014) Assessment and management of contaminated sites. Contaminated sites guidelines.

DWER (2019) Landfill Waste Classification and Waste Definitions 1996 (as amended 2019).

MScience (2007) Dampier Port Authority: DCW Capital Dredging: Sediment Quality Report - March 2007. Report: MSA78R5, Unpublished Report to Dampier Port Authority by MScience Pty Ltd, Perth, WA

MScience (2015) Dampier Maintenance Dredging Program: Sampling and Analysis Plan Implementation Report. Report: MSA227R03, Report Prepared for Pilbara Iron Pty Ltd.

MScience (2016) Long Term Dredging Sea Dumping Permit Port of Dampier. Sampling and Analysis Plan (SAP). Prepared for Plibara Iron Pty Ltd, Perth, W.A.

MScience (2020) Long Term Dredging Sea Dumping Permit Port of Dampier. Sampling and Analysis Plan Implementation Report. Report: MSA299R01, Report Prepared for Rio Tinto Iron Ore., Perth, W.A.

NEPM (2013) National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013.

Semeniuk V, Chalmer PN, Le Provost I (1982) The marine environments of the Dampier Archipelago. J R Soc West Aust 65:97–114.

Simpson SL, Batley GE, Chariton AA (2013) Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines. Report: CSIRO Land and Water Science Report 08/07, CSIRO

Worley Parsons (2009) Dampier Marine Services Facility: Preliminary Site Investigation Sampling and Analysis Plan Implementation Report. Perth Western Australia

6 APPENDIX A: FIELD OBSERVATIONS

Site ID	Depth (m)	Description	Image
1	2	Brown, well sorted coarse sand with gravel, sub angular, shells present, no odour	
2	2	Brown, clay/silt, well sorted with some gravel, rounded, no odour	
3	2	Brown, clay/silt, well sorted with some gravel, rounded, shells present, no odour	
4	2	Brown, well sorted coarse sand with gravel, sub angular, shells present, no odour	
5	2	Brown, well sorted coarse sand with gravel, sub angular, shells present, no odour	

7 APPENDIX B: RAW DATA

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP2008635**	Page	: 1 of 8
Amendment	: **1**		
Client	: **MSCIENCE PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: Iain Posnett	Contact	: Nick Courts
Address	: 322 LORD ST HIGHGATE WA, AUSTRALIA 6003	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: +61-8-9406 1301
Project	: MSA286	Date Samples Received	: 17-Aug-2020 10:50
Order number	: ----	Date Analysis Commenced	: 20-Aug-2020
C-O-C number	: ----	Issue Date	: 07-Sep-2020 14:33
Sampler	: Matt Frapple		
Site	: ----		
Quote number	: EP/599/20_V2		
No. of samples received	: 5		
No. of samples analysed	: 5		

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Aleksandar Vujkovic	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
David Viner	SENIOR LAB TECH	Perth Organics, Wangara, WA
Efua Wilson	Metals Chemist	Perth Inorganics, Wangara, WA
Franco Lentini	LCMS Coordinator	Sydney Organics, Smithfield, NSW
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

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

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

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

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

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

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP003 conducted by ALS Brisbane, NATA Site No. 818.
- EA150/EA152 conducted by ALS Newcastle, NATA accreditation no. 825, site no 1656.
- EP202 conducted by ALS Sydney, NATA accreditation no. 825, site no 10911.
- EP202: Particular samples required dilution due to matrix interferences. LOR values have been adjusted accordingly.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.
- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP068: Where reported, Total Chlordane (sum) is the sum of the reported concentrations of cis-Chlordane and trans-Chlordane at or above the LOR.
- EP068: Where reported, Total OCP is the sum of the reported concentrations of all Organochlorine Pesticides at or above LOR.
- EP075(SIM): Where reported, Total Cresol is the sum of the reported concentrations of 2-Methylphenol and 3- & 4-Methylphenol at or above the LOR.
- Amendment (07/09/2020): This report has been amended and re-released to allow the reporting of additional analytical data. [Reporting Al, Fe, Sb, Ag on all 5 samples]

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	1	2	3	4	5
			Client sampling date / time	13-Aug-2020 00:00	13-Aug-2020 00:00	13-Aug-2020 00:00	13-Aug-2020 00:00	13-Aug-2020 00:00
Compound	CAS Number	LOR	Unit	EP2008635-001	EP2008635-002	EP2008635-003	EP2008635-004	EP2008635-005
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	22.1	40.3	43.6	32.1	30.2
EA150: Particle Sizing								
Clay (<4 µm)	----	1	%	4	31	25	8	11
Silt (4-62 µm)	----	1	%	3	18	20	5	8
Fine Sand (62-250 µm)	----	1	%	5	13	6	5	7
Medium Sand (250-500 µm)	----	1	%	9	6	4	5	6
Coarse Sand (500-2000 µm)	----	1	%	29	12	9	12	21
Gravel (2000-10000 µm)	----	1	%	50	20	36	65	47
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.67	2.75	2.69	2.72	2.71
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	2570	8410	10100	5410	6600
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	5	10	12	7	7
Barium	7440-39-3	10	mg/kg	10	40	30	20	20
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	12	44	52	28	30
Cobalt	7440-48-4	2	mg/kg	2	6	8	4	5
Copper	7440-50-8	5	mg/kg	6	15	17	10	12
Iron	7439-89-6	50	mg/kg	6970	33700	32800	17900	33300
Lead	7439-92-1	5	mg/kg	<5	6	6	<5	<5
Manganese	7439-96-5	5	mg/kg	77	216	216	123	186
Nickel	7440-02-0	2	mg/kg	5	18	22	12	14
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Silver	7440-22-4	2	mg/kg	<2	<2	<2	<2	<2
Vanadium	7440-62-2	5	mg/kg	11	37	42	26	28
Zinc	7440-66-6	5	mg/kg	21	47	51	36	37
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK055: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20	<20	<20	<20	<20
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	1	2	3	4	5
			Client sampling date / time	13-Aug-2020 00:00	13-Aug-2020 00:00	13-Aug-2020 00:00	13-Aug-2020 00:00	13-Aug-2020 00:00
Compound	CAS Number	LOR	Unit	EP2008635-001	EP2008635-002	EP2008635-003	EP2008635-004	EP2008635-005
				Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.2**	<0.1	**0.2**	**0.1**	<0.1
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**300**	**780**	**950**	**450**	**470**
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	**300**	**780**	**950**	**450**	**470**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**314**	**348**	**321**	**246**	**293**
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	**0.27**	**0.35**	**0.42**	**0.22**	**0.22**
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ Total Chlordane (sum)	----	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	1	2	3	4	5
			Client sampling date / time	13-Aug-2020 00:00	13-Aug-2020 00:00	13-Aug-2020 00:00	13-Aug-2020 00:00	13-Aug-2020 00:00
Compound	CAS Number	LOR	Unit	EP2008635-001	EP2008635-002	EP2008635-003	EP2008635-004	EP2008635-005
				Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued								
^ **Sum of DDD + DDE + DDT**	72-54-8/72-55-9/5 0-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Bromophos-ethyl	4824-78-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Prothiofos	34643-46-4	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Ethion	563-12-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Carbophenothion	786-19-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	1	2	3	4	5
				Client sampling date / time	13-Aug-2020 00:00	13-Aug-2020 00:00	13-Aug-2020 00:00	13-Aug-2020 00:00	13-Aug-2020 00:00
Compound	CAS Number	LOR	Unit		EP2008635-001	EP2008635-002	EP2008635-003	EP2008635-004	EP2008635-005
					Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Benzo(a)pyrene	50-32-8	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg		**0.6**	**0.6**	**0.6**	**0.6**	**0.6**
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg		**1.2**	**1.2**	**1.2**	**1.2**	**1.2**
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		<10	<10	<10	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg		<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg		<100	**110**	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg		<50	**110**	<50	<50	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg		<1	<1	<1	<1	<1
EP202A: Phenoxyacetic Acid Herbicides by LCMS									

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	1	2	3	4	5
				Client sampling date / time	13-Aug-2020 00:00	13-Aug-2020 00:00	13-Aug-2020 00:00	13-Aug-2020 00:00	13-Aug-2020 00:00
Compound	CAS Number	LOR	Unit		EP2008635-001	EP2008635-002	EP2008635-003	EP2008635-004	EP2008635-005
					Result	Result	Result	Result	Result
EP202A: Phenoxyacetic Acid Herbicides by LCMS - Continued									
4-Chlorophenoxy acetic acid	122-88-3	0.02	mg/kg		<0.04	<0.02	<0.02	<0.02	<0.02
2.4-DB	94-82-6	0.02	mg/kg		<0.04	<0.02	<0.02	<0.02	<0.02
Dicamba	1918-00-9	0.02	mg/kg		<0.04	<0.02	<0.02	<0.02	<0.02
Mecoprop	93-65-2	0.02	mg/kg		<0.04	<0.02	<0.02	<0.02	<0.02
MCPA	94-74-6	0.02	mg/kg		<0.04	<0.02	<0.02	<0.02	<0.02
2.4-DP	120-36-5	0.02	mg/kg		<0.04	<0.02	<0.02	<0.02	<0.02
2.4-D	94-75-7	0.02	mg/kg		<0.04	<0.02	<0.02	<0.02	<0.02
Triclopyr	55335-06-3	0.02	mg/kg		<0.04	<0.02	<0.02	<0.02	<0.02
2.4.5-TP (Silvex)	93-72-1	0.02	mg/kg		<0.04	<0.02	<0.02	<0.02	<0.02
2.4.5-T	93-76-5	0.02	mg/kg		<0.04	<0.02	<0.02	<0.02	<0.02
MCPB	94-81-5	0.02	mg/kg		<0.04	<0.02	<0.02	<0.02	<0.02
Picloram	1918-02-1	0.02	mg/kg		<0.04	<0.02	<0.02	<0.02	<0.02
Clopyralid	1702-17-6	0.02	mg/kg		<0.04	<0.02	<0.02	<0.02	<0.02
Fluroxypyr	69377-81-7	0.02	mg/kg		<0.04	<0.02	<0.02	<0.02	<0.02
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		100	91.1	95.0	86.8	97.5
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		95.2	65.2	65.3	51.6	100
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.5	%		96.4	99.4	96.4	101	97.7
2-Chlorophenol-D4	93951-73-6	0.5	%		102	105	103	107	102
2.4.6-Tribromophenol	118-79-6	0.5	%		106	114	87.3	90.2	89.6
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.5	%		123	125	109	112	110
Anthracene-d10	1719-06-8	0.5	%		112	112	115	121	110
4-Terphenyl-d14	1718-51-0	0.5	%		105	99.6	108	114	104
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		97.3	85.5	95.1	89.2	94.2
Toluene-D8	2037-26-5	0.2	%		103	93.7	107	99.6	108
4-Bromofluorobenzene	460-00-4	0.2	%		109	96.6	107	101	109
EP202S: Phenoxyacetic Acid Herbicide Surrogate									
2.4-Dichlorophenyl Acetic Acid	19719-28-9	0.02	%		48.7	56.9	65.8	69.5	79.3

Surrogate Control Limits

Sub-Matrix: **SOIL**

Compound	CAS Number	Recovery Limits (%) Low	High
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	53	152
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	28	152
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	57	119
2-Chlorophenol-D4	93951-73-6	52	130
2.4.6-Tribromophenol	118-79-6	40	132
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	53	139
Anthracene-d10	1719-06-8	68	124
4-Terphenyl-d14	1718-51-0	66	132
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	63	132
Toluene-D8	2037-26-5	66	125
4-Bromofluorobenzene	460-00-4	60	124
EP202S: Phenoxyacetic Acid Herbicide Surrogate			
2.4-Dichlorophenyl Acetic Acid	19719-28-9	45	139

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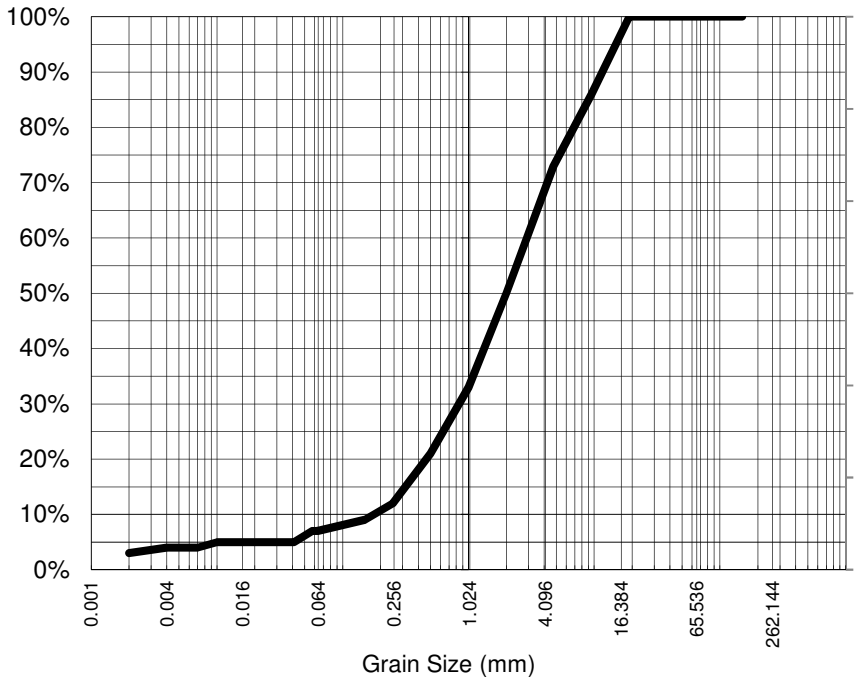
ALS Environmental

Newcastle, NSW

CLIENT:	Iain Posnett	**DATE REPORTED:**	25-Aug-2020
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	17-Aug-2020
ADDRESS:	322 Lord St	**REPORT NO:**	EP2008635-001 / PSD
PROJECT:	WA Esperance MSA286	**SAMPLE ID:**	1

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	86%
4.75	73%
2.00	50%
1.000	33%
0.500	21%
0.250	12%
0.150	9%
0.063	7%
Particle Size (microns)	
57	7%
41	5%
29	5%
20	5%
15	5%
10	5%
7	4%
5	4%
2	3%

Median Particle Size (mm)*	2.000

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:	AS1289.3.6.3 states that hydrometer analysis is not applicable for samples containing <10% fines (<75um). Results should be assessed accordingly	**Analysed:**	21-Aug-20
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.67		

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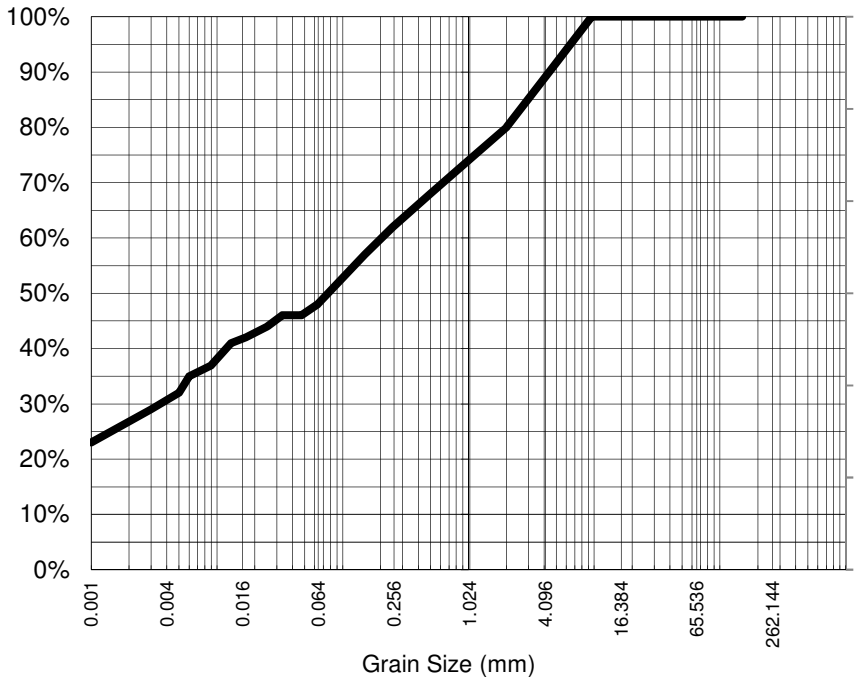
CLIENT:	Iain Posnett	**DATE REPORTED:**	25-Aug-2020
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	17-Aug-2020
ADDRESS:	322 Lord St	**REPORT NO:**	EP2008635-002 / PSD
PROJECT:	WA Esperance MSA286	**SAMPLE ID:**	2

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	91%
2.00	80%
1.000	74%
0.500	68%
0.250	62%
0.150	57%
0.063	48%
Particle Size (microns)	
47	46%
33	46%
25	44%
17	42%
13	41%
9	37%
6	35%
5	32%
1	23%

Median Particle Size (mm)*	0.082

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 21-Aug-20

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, FINES, SHELL

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.00mm) 2.75

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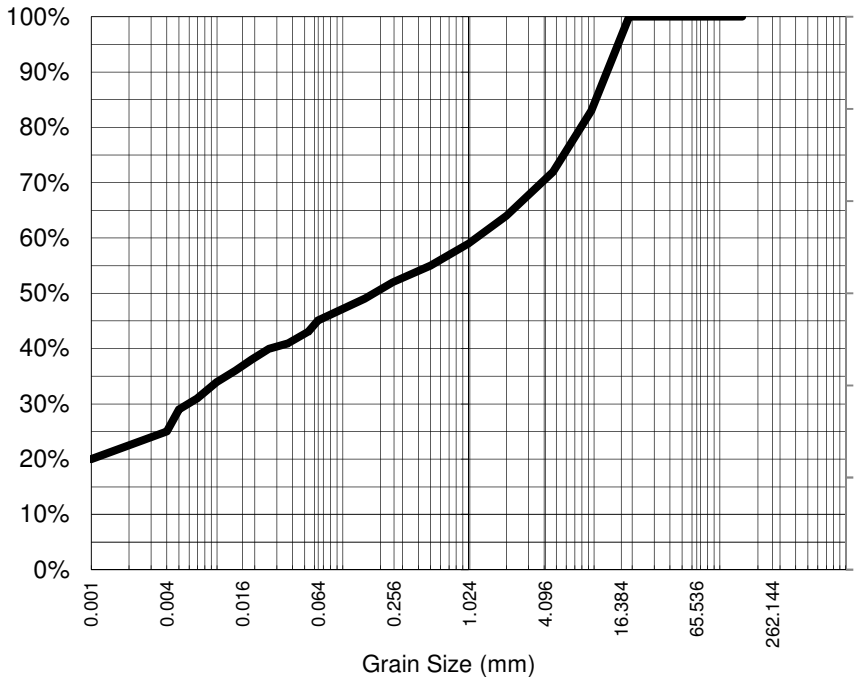
CLIENT:	Iain Posnett	**DATE REPORTED:**	25-Aug-2020
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	17-Aug-2020
ADDRESS:	322 Lord St	**REPORT NO:**	EP2008635-003 / PSD
PROJECT:	WA Esperance MSA286	**SAMPLE ID:**	3

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	83%
4.75	72%
2.00	64%
1.000	59%
0.500	55%
0.250	52%
0.150	49%
0.063	45%
Particle Size (microns)	
53	43%
37	41%
26	40%
19	38%
14	36%
10	34%
7	31%
5	29%
1	20%

Median Particle Size (mm)*	0.183

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 21-Aug-20

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, FINES, SHELL

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.00mm) 2.69

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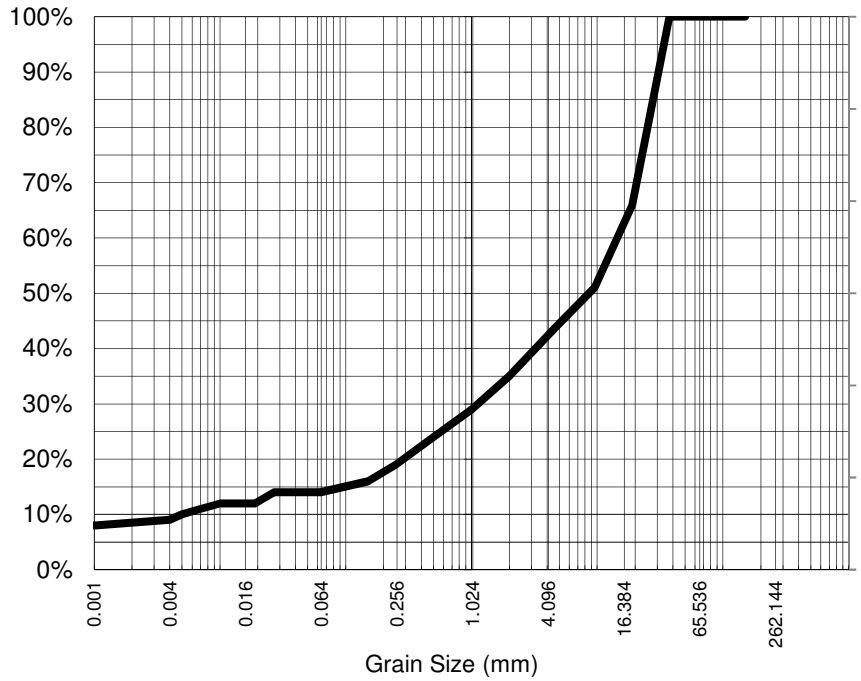
CLIENT:	Iain Posnett	**DATE REPORTED:**	25-Aug-2020
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	17-Aug-2020
ADDRESS:	322 Lord St	**REPORT NO:**	EP2008635-004 / PSD
PROJECT:	WA Esperance MSA286	**SAMPLE ID:**	4

Particle Size Distribution



Particle Size (mm)	% Passing
37.5	100%
19.0	66%
9.50	51%
4.75	44%
2.00	35%
1.000	29%
0.500	24%
0.250	19%
0.150	16%
0.063	14%
Particle Size (microns)	
54	14%
38	14%
27	14%
19	12%
14	12%
10	12%
7	11%
5	10%
1	8%

Median Particle Size (mm)*	8.821

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 21-Aug-20

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, FINES, SHELL

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.00mm) 2.72

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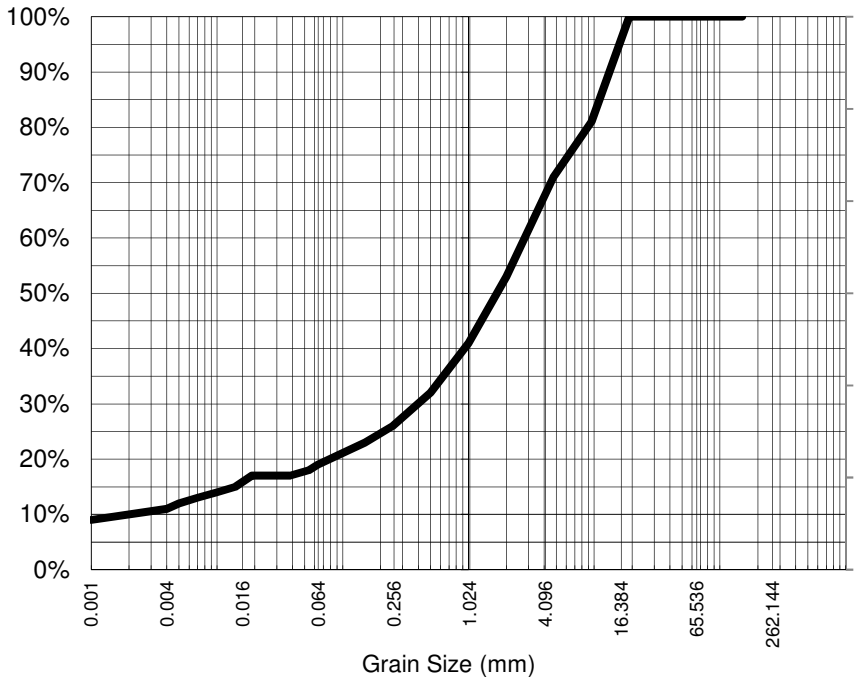
CLIENT:	Iain Posnett	**DATE REPORTED:**	25-Aug-2020
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	17-Aug-2020
ADDRESS:	322 Lord St	**REPORT NO:**	EP2008635-005 / PSD
PROJECT:	WA Esperance MSA286	**SAMPLE ID:**	5

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	81%
4.75	71%
2.00	53%
1.000	41%
0.500	32%
0.250	26%
0.150	23%
0.063	19%
Particle Size (microns)	
54	18%
38	17%
27	17%
19	17%
14	15%
10	14%
7	13%
5	12%
1	9%

Median Particle Size (mm)*	1.750

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 21-Aug-20

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, FINES, SHELL

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.00mm) 2.71

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8 APPENDIX C: QA/QC REPORTS FROM THE LABORATORY ANALYSIS

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP2008635**	Page	: 1 of 8
Amendment	: **1**		
Client	: **MSCIENCE PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: Iain Posnett	Telephone	: +61-8-9406 1301
Project	: MSA286	Date Samples Received	: 17-Aug-2020
Site	: ----	Issue Date	: 07-Sep-2020
Sampler	: Matt Frapple	No. of samples received	: 5
Order number	: ----	No. of samples analysed	: 5

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EK067G: Total Phosphorus as P by Discrete Analyser	EP2008606--002	Anonymous	**Total Phosphorus as P**	----	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content (Dried @ 105-110°C)							
Soil Glass Jar - Unpreserved (EA055)							
1, 2, 3, 4, 5	**13-Aug-2020**	**----**	----	----	**25-Aug-2020**	27-Aug-2020	✓
EA150: Particle Sizing							
Snap Lock Bag (EA150H)							
1, 2, 3, 4, 5	**13-Aug-2020**	**----**	----	----	**25-Aug-2020**	09-Feb-2021	✓
EA152: Soil Particle Density							
Snap Lock Bag (EA152)							
1, 2, 3, 4, 5	**13-Aug-2020**	**----**	----	----	**25-Aug-2020**	09-Feb-2021	✓
EG005(ED093)T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T)							
1, 2, 3, 4, 5	**13-Aug-2020**	**24-Aug-2020**	09-Feb-2021	✓	**25-Aug-2020**	09-Feb-2021	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T)							
1, 2, 3, 4, 5	**13-Aug-2020**	**24-Aug-2020**	10-Sep-2020	✓	**25-Aug-2020**	10-Sep-2020	✓
EK055: Ammonia as N							
Soil Glass Jar - Unpreserved (EK055)							
1, 2, 3, 4, 5	**13-Aug-2020**	**----**	----	----	**25-Aug-2020**	10-Sep-2020	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Soil Glass Jar - Unpreserved (EK059G)							
1, 2, 3, 4, 5	**13-Aug-2020**	**26-Aug-2020**	09-Feb-2021	✓	**26-Aug-2020**	09-Feb-2021	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Soil Glass Jar - Unpreserved (EK061G)							
1, 2, 3, 4, 5	**13-Aug-2020**	**21-Aug-2020**	10-Sep-2020	✓	**25-Aug-2020**	18-Sep-2020	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Soil Glass Jar - Unpreserved (EK067G)							
1, 2, 3, 4, 5	**13-Aug-2020**	**21-Aug-2020**	09-Feb-2021	✓	**25-Aug-2020**	09-Feb-2021	✓
EP003: Total Organic Carbon (TOC) in Soil							
Soil Glass Jar - Unpreserved (EP003)							
1, 2, 3, 4, 5	**13-Aug-2020**	**24-Aug-2020**	10-Sep-2020	✓	**24-Aug-2020**	10-Sep-2020	✓
EP068A: Organochlorine Pesticides (OC)							
Soil Glass Jar - Unpreserved (EP068)							
1, 2, 3, 4, 5	**13-Aug-2020**	**20-Aug-2020**	27-Aug-2020	✓	**21-Aug-2020**	29-Sep-2020	✓
EP068B: Organophosphorus Pesticides (OP)							
Soil Glass Jar - Unpreserved (EP068)							
1, 2, 3, 4, 5	**13-Aug-2020**	**20-Aug-2020**	27-Aug-2020	✓	**21-Aug-2020**	29-Sep-2020	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Soil Glass Jar - Unpreserved (EP075(SIM)) 1, 2, 3, 4, 5	**13-Aug-2020**	**20-Aug-2020**	27-Aug-2020	✓	**21-Aug-2020**	29-Sep-2020	✓
EP080/071: Total Petroleum Hydrocarbons							
Soil Glass Jar - Unpreserved (EP071) 1, 2, 3, 4, 5	**13-Aug-2020**	**20-Aug-2020**	27-Aug-2020	✓	**21-Aug-2020**	29-Sep-2020	✓
Soil Glass Jar - Unpreserved (EP080) 1, 2, 3, 4, 5	**13-Aug-2020**	**21-Aug-2020**	27-Aug-2020	✓	**21-Aug-2020**	27-Aug-2020	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Soil Glass Jar - Unpreserved (EP071) 1, 2, 3, 4, 5	**13-Aug-2020**	**20-Aug-2020**	27-Aug-2020	✓	**21-Aug-2020**	29-Sep-2020	✓
Soil Glass Jar - Unpreserved (EP080) 1, 2, 3, 4, 5	**13-Aug-2020**	**21-Aug-2020**	27-Aug-2020	✓	**21-Aug-2020**	27-Aug-2020	✓
EP080: BTEXN							
Soil Glass Jar - Unpreserved (EP080) 1, 2, 3, 4, 5	**13-Aug-2020**	**21-Aug-2020**	27-Aug-2020	✓	**21-Aug-2020**	27-Aug-2020	✓
EP202A: Phenoxyacetic Acid Herbicides by LCMS							
Soil Glass Jar - Unpreserved (EP202) 1, 2, 3, 4, 5	**13-Aug-2020**	**24-Aug-2020**	27-Aug-2020	✓	**24-Aug-2020**	03-Oct-2020	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Buchi Ammonia	EK055	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosporus By Discrete Analyser	EK067G	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Buchi Ammonia	EK055	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosporus By Discrete Analyser	EK067G	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Buchi Ammonia	EK055	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Total Mercury by FIMS	EG035T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosporus By Discrete Analyser	EK067G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Buchi Ammonia	EK055	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosporus By Discrete Analyser	EK067G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM Schedule B(3).
Particle Size Analysis by Hydrometer	EA150H	SOIL	Particle Size Analysis by Hydrometer according to AS1289.3.6.3
Soil Particle Density	EA152	SOIL	Soil Particle Density by AS 1289.3.5.1: Methods of testing soils for engineering purposes - Soil classification tests - Determination of the soil particle density of a soil - Standard method
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3)
Buchi Ammonia	EK055	SOIL	In house: Referenced to APHA 4500-NH3 B&G, H Samples are steam distilled (Buchi) prior to analysis and quantified using titration, FIA or Discrete Analyser.
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	SOIL	In house: Thermo Scientific Method D08727 and NEMI (National Environmental Method Index) Method ID: 9171. This method covers the determination of total oxidised nitrogen (NOx-N) and nitrate (NO3-N) by calculation, Combined oxidised Nitrogen (NO2+NO3) in a water extract is determined by direct colourimetry by Discrete Analyser.
TKN as N By Discrete Analyser	EK061G	SOIL	In house: Referenced to APHA 4500-Norg-D Soil samples are digested using Kjeldahl digestion followed by determination by Discrete Analyser.
Total Nitrogen as N (TKN + NOx) By Discrete Analyser	EK062G	SOIL	In house: Referenced to APHA 4500 Norg/NO3- Total Nitrogen is determined as the sum of TKN and Oxidised Nitrrogen, each determined seperately as N.
Total Phosporus By Discrete Analyser	EK067G	SOIL	In house: Referenced to APHA 4500 P-B&F This procedure involves sulfuric acid digestion and quantification using Discrete Analyser.
Total Organic Carbon	EP003	SOIL	In house C-IR17. Dried and pulverised sample is reacted with acid to remove inorganic Carbonates, then combusted in a furnace in the presence of strong oxidants / catalysts. The evolved (Organic) Carbon (as CO2) is automatically measured by infra-red detector.
Pesticides by GCMS	EP068	SOIL	In house: Referenced to USEPA SW 846 - 8270 Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM Schedule B(3).
TRH - Semivolatile Fraction	EP071	SOIL	In house: Referenced to USEPA SW 846 - 8015 Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C40. Compliant with NEPM Schedule B(3).
PAH/Phenols (SIM)	EP075(SIM)	SOIL	In house: Referenced to USEPA SW 846 - 8270. Extracts are analysed by Capillary GC/MS in Selective Ion Mode (SIM) and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
TRH Volatiles/BTEX	EP080	SOIL	In house: Referenced to USEPA SW 846 - 8260. Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve. Compliant with NEPM Schedule B(3) amended.
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202	SOIL	In house: LCMS (Electrospray in negative mode). Residues of acid herbicides are extracted from soil samples under the alkaline condition. An aliquot of the alkaline aqueous phase is taken and acidified before a SPE cleanup. After eluting off from the SPE cartridge, residues of acid herbicides are dissolved in HPLC mobile phase prior to instrument analysis.

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	SOIL	In house: Referenced to APHA 4500 Norg- D; APHA 4500 P - H. Macro Kjeldahl digestion.
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM Schedule B(3).
Extraction for Phenoxy Acid Herbicides in Soils.	EP202-PR	SOIL	In-House: Alkaline extract followed by SPE clean up of acidified portion of the sample extract.
Dry and Pulverise (up to 100g)	GEO30	SOIL	#
Methanolic Extraction of Soils for Purge and Trap	ORG16	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids	ORG17	SOIL	In house: Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.