Port of Port Hedland Channel Entry Project – Capital Dredging

Photo of Utah Point courtesy of Pilbara Ports Authority.

28 June 2022

Sampling and Analysis Plan Implementation Report

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Acronyms and Abbreviations

Abbreviation	Definition
Al	Aluminium
Ag	Silver
ALS	Australian Laboratory Services
ARL	Analytical Reference Laboratory
As	Arsenic
ASAP	Annual Sampling and Analysis Plan
Cd	Cadmium
COPC	Contaminant of Potential Concern
Cr	Chromium
Cu	Copper
DAWE	Department of Agriculture, Water and the Environment
DBT	Dibutyltin
DQO	Data Quality Objective
Hg	Mercury
LOR	Limit of Reporting
LTDMP	Long-Term Dredge Management Plan
MBT	Monobutyltin
Mn	Manganese
NAGD	National Assessment Guidelines for Dredging
NATA	National Association of Testing Authorities
Ni	Nickel
PAH	Polycyclic Aromatic Hydrocarbon
Pb	Lead
PPA	Pilbara Ports Authority
PQL	Practical Quantitation Limit
PSD	Particle Size Distribution
QA/QC	Quality Assurance and Quality Control
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SAP	Sampling and Analysis Plan
Sb	Antimony
SDP	Sea Dumping Permit
SG	Spoil Ground
SGS	SGS Environmental
SQGV	Sediment Quality Guideline Value
TBT	Tributyltin
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
UCL	Upper Confidence Limit
Zn	Zinc

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EXECUTIVE SUMMARY

Pilbara Ports Authority (PPA) is proposing to carry out capital dredging, and associated dredge spoil activities, of areas of shallow bathymetry in the vicinity of Beacons 30/31 at the Port of Port Hedland as part of its proposed Channel Entry Project (CEP). Following capital dredging of the high areas, PPA also intends to obtain a permit for future maintenance dredging of the route between the pilot boarding ground, Beacon 26 and the Beacon 30/31 entry. PPA will seek approval from the Australian Department of Agriculture, Water and the Environment (DAWE) to place suitable dredged material at established spoil grounds within the Port of Port Hedland under the *Environment Protection (Sea Dumping) Act 1981*. Prior to completing an application for a sea dumping permit (SDP), PPA is required to undertake appropriate investigations to characterise the physical and chemical nature of sediments to be dredged and disposed, as specified in the National Assessment Guidelines for Dredging (NAGD). PPA developed a Sampling and Analysis Plan (SAP) to outline the requirements for an assessment of sediment characterisation (GHD 2020a). In accordance with prescriptions of the NAGD for capital dredging projects, a combination of two sampling methods targeting the 0 to 0.15 m (surface) sediment horizon and the 0.5 to 1.0 m (near surface) horizon was proposed in the SAP, namely grab samples and diver operated cores.

Sampling was conducted on 05 May (diver cores) and 07 May (grabs) 2022. Diver cores met refusal before the target depth of 1.0 m during multiple collection attempts at all five diver core sites. Therefore, sediment profiles for the core samples were separated into surface (0 – 0.15 m) and sub-surface (0.15 m to refusal) depth profiles. Sampling met all field DQOs. No analytes were detected from analysis of the trip blank samples. The laboratory QA/QC process identified one instance where the acceptability criteria for QC assessment of PAH species concentrations was not met due to matrix spike interference. The field replicate QA/QC process showed almost no intra-laboratory variance and inter-laboratory variance was small and confined to a small number of analytes, suggesting methods were accurate and analyte concentrations should be considered precise. The triplicate analyses showed all analytes (except TRH Fraction 3) met the required RPDs suggesting that samples were representative of the sediment at each site.

All samples were assessed for PSD, with particular attention paid to the fines (<62 µm) component, as this fraction is often associated with contaminants. Sediment from most samples collected within Zone A were shown to be predominantly (80-90%) sorted into the fine to coarse sand (62 – 2000 µm) and gravel (2000 – 10000 µm) fractions, with only one sample reporting greater than 20% of the fines (<62 µm) fraction. The majority of the samples in the zone (16 of the 20 samples collected) consisted of sediments from the larger fractions tested, comprising over 50% coarse sand and gravel (500 – 10000 µm). Sediment collected from sites located in the south of Zone A, within the targeted area for dredging, reported higher proportions (over 60%) of fine to medium sand (62 – 500 µm) (sites 01 and 02) and relatively high fines content (16 and 39% within the sub-surface samples from sites 03 and 04, respectively) compared to the sediments collected in other areas of the zone. The PSD reported for sediments collected at sites 03 and 04 was consistent with diver observations of hard clays underlying a veneer of coarse sand. Sediment samples collected within Zone B were similar to those in Zone A. Sediments were shown to be predominantly (>90%) sorted into the larger fractions (fine to coarse sand and gravel). Eight of the ten samples collected consisted of over 50% coarse sand and gravel, with two samples reporting higher (55 to 80%) proportions of the fine to medium sand fractions.

The Phase II investigation into metal and metalloid concentrations in sediments showed that sediment concentrations of metals within Zone A and Zone B were below the screening guideline levels for all metals, with the exception of arsenic. Arsenic concentrations were shown to exceed the numerical screening level listed in Table 2 of the NAGD. Further examination of the relationship of arsenic with aluminium from recent spoil ground data showed that arsenic did not show a significant correlation and could not be normalised for grain size.

Mean arsenic concentrations were above the screening level derived from the 80th percentile concentration of the aggregated spoil ground data ("I", 7B and 9A), but below the 80th percentile concentration at Spoil

Ground 7B. High arsenic concentrations have been reported in previous surveys within the outer harbour of the Port of Port Hedland (Jacobs 2017; MScience 2022a; SKM 2011), specifically, sampling of sediments within the approved spoil grounds has shown arsenic to exceed the NAGD screening guidelines (Jacobs 2017; MScience 2022a). During the history of sediment sampling within the port, arsenic has exceeded the guideline value (relevant at the time of sampling) multiple times, however, detailed assessment of the source of the metal has concluded that the levels are naturally occurring (GHD 2020b). High arsenic concentrations in sediments from the Pilbara is a well-documented feature, and the highest concentrations at Port Hedland have often been reported from offshore sites (Stoddart et al. 2019). Stoddart *et al* (2019) speculate that patterns of arsenic concentrations in the Pilbara are consistent with a detrital origin and often higher in surface sediments close to areas of biomass. The benthic habitats of the outer harbour of Port Hedland have been mapped and observed to be dominated by sand plains interspersed with a series of hard substrate ridgelines capable of supporting benthic primary producers (MScience 2022b; SKM 2009). On this basis, the concentration of arsenic in these sediments was not interpreted as evidence to prevent unconfined ocean disposal. Sediment concentrations of all other metals assayed in this survey suggest that they met the criteria for unconfined ocean disposal.

Petroleum hydrocarbons were detected from TRH Fraction 3 (C15 – C28) at low concentration (<5 mg/kg) in one sample from Zone A and one sample from Zone B. The same sample from Zone B also reported low concentrations of TRH Fraction 2 (C10 – C14) and Fraction 4 (C29 – C36). The concentration of aggregated TRH fractions were well below the NAGD screening level. No petroleum hydrocarbons were detected in the samples collected within the targeted dredge area of Zone A. No species of PAH were detected above LOR in any sample collected for analysis. This finding aligns with previous sediment characterisation studies completed in the outer harbour of Port Hedland (Jacobs 2017; SKM 2011; Worley Parsons 2012), which have shown hydrocarbons have never been found at concentrations near the NAGD (low) screening levels. Therefore, TRH and PAH should not be considered as contaminants of potential concern, and, at these concentrations, the sediment would be considered safe for unconfined ocean disposal at the approved spoil grounds.

No MBT was detected in any sample. Similarly, no DBT or TBT was detected in any sample collected within the targeted dredge area of Zone A. DBT and TBT were detected above LOR at one site located in Zone B, however, the 95% UCL for normalised DBT and TBT within all samples was below the NAGD screening guideline of 9 µgSn/kg. Similar to the findings of previous surveys (MScience 2017; O2 Marine 2020a; Worley Parsons 2012), incident levels of elevated TBT appear to be consistent with its presence in the form of infrequent paint flakes rather than any widespread occurrence.

Overall, sediment concentrations of candidate COPCs were shown to be either below the initial screening levels described in the NAGD or of natural origin; noting there are no fixed screening guidelines for some of the analytes investigated in this survey. These findings suggest that sediment from proposed capital dredging footprint and future maintenance dredging footprint of the Channel Entry Project meet NAGD criteria for unconfined ocean disposal at the approved spoil grounds.

1 INTRODUCTION

1.1 Background

Pilbara Ports Authority (PPA) is proposing to carry out capital dredging and associated dredge spoil activities at the Port of Port Hedland as part of its proposed Channel Entry Project (CEP). The proposed dredging activity is located to the north east of the Port Hedland Channel (the Channel) and aims to remove isolated high spots in the vicinity of Beacons 30/31 and deepen the Channel entry area from 9.5 m to 10.0 m Channel Depth (CD), noting that the remainder of the approach is naturally deep and allows for safe passage. Removing these isolated high spots will allow for empty bulk vessels to sail a straight course into the existing Channel, avoiding directional change manoeuvres, improving both navigational safety and vessel efficiency as these vessels approach the inner harbour. The CEP's dredging program will generate approximately 180,000 m^3 of capital dredged material.

The CEP involves dredging located in coastal waters (State waters) within relatively undisturbed areas, with plans to dispose of this material at sea within existing designated spoil disposal sites located within Commonwealth waters. Disposal of dredge spoil at sea requires approval by the Department of Agriculture, Water and the Environment (DAWE) under the *Environment Protection (Sea Dumping) Act 1981*.

Following capital dredging of the high areas to achieve a depth of 10 m CD, PPA also intends to obtain a permit for future maintenance dredging of the route between the pilot boarding ground and Beacon 26 and the Beacon 30/31 entry.

Prior to completing an application for disposal at sea, proponents are required to undertake appropriate investigations to characterise the physical and chemical nature of sediments to be dredged and disposed, as specified in the NAGD (Commonwealth of Australia 2009). PPA has developed a SAP to outline the requirements for an assessment of sediment characterisation (GHD 2020a).

The proposed areas for capital dredging and future maintenance dredging considered by the SAP have been divided into two distinct zones. Zone A includes the targeted area proposed for capital dredging (including a 0.5 m allowance for over dredging), and adjacent areas of natural depth that may require maintenance dredging in the future due to sediment accretion. Zone B is not proposed to be dredged at this stage but may require material to be removed in future if sufficient accretion of sediments has occurred as a result of natural forces such that safe navigation may be impeded.

PPA contracted MScience marine research (MScience) to undertake the implementation of the SAP. Sampling was conducted on 05 and 07 May 2022 using methods consistent with the contents of the SAP. The results of subsequent analyses have been described in this implementation report.

1.2 Structure of this Document

The document lists:

- The methods used for sampling and analysis;
- The results of sediment assays for chemistry and particle size;
- QA/QC procedures; and
- A discussion of the significance of the results relative to NAGD guidelines.

The document is current as at the date on the cover page and is referenced as Version 2 (Documents with a lower version number are superseded by this document).

2 METHODOLOGY

2.1 Sampling Design

The sampling design implemented was consistent with prescriptions of the SAP (GHD 2020a). In accordance with the SAP and prescriptions of the NAGD for capital dredging projects, a combination of two sampling methods targeting the 0 to 0.15 m (surface) sediment horizon and the 0.5 to 1.0 m (sub surface) horizon was conducted, namely grab samples and diver operated cores. Diver operated cores were collected on 05 May 2022 and grab samples were collected on 07 May 2022.

2.1.1 Deviations from the SAP

As detailed in the SAP, previous sampling programs have found difficulties in obtaining sediment cores from depths greater than 0.5 m in the outer harbour of Port Hedland (Jacobs 2017; SKM 2011; Worley Parsons 2012). The same difficulties were encountered for the current SAP implementation and even after following contingency sampling procedures (detailed in Section 2.2.1.1), it was not possible to collect samples from the 0.5 to 1.0 m depth horizon. Therefore, sediment profiles for the core samples were separated into a surface (0 – 0.15 m) depth profile and subsurface (0.15 m to refusal) depth profile. Core refusal depth varied at each site. The depth of refusal and likely reasons for refusal have been detailed in Section 3.1.1 and Table 3-1.

2.1.2 Sampling Locations

The distribution of sampling sites and sample numbers within the proposed sampling zones is detailed in Table 2-1 and shown in Figure 2.1. Coordinates and sediment collection method for the 25 sites, as listed in the SAP (GHD 2020a), have been detailed in Table 2-2. Note that the grab sampling coordinates listed are actual locations for sample collection recorded during the survey (+/- GPS error). Diver cores were collected within 4 m of the listed coordinates (+/- GPS error) as a result of the refusal encountered at each site.

Coordinates for triplicate sites are recorded as the location where collection of the first sample occurred.

Table 2-1. Number of sites and samples from the SAP

Location	# Sites	# Surface Samples	# Sub-Surface Samples
Zone A – Targeted Dredge Area	11	11	5
Zone A – Sediment Characterisation	4	4	-
Zone B – Sediment Characterisation	10	10	-
Total	**25**	**25**	**5**

Table 2-2. Sample site name, location and method of collection

Site	Depth (m)	Location	Collection Method	Easting (GDA2020Z50)	Northing (GDA2020Z50)
01	15.1	Zone A – Targeted Dredge Area	Diver Core	663902	7760973
02(t)	11		Grab Sample	663878	7761101
03	16.7		Diver Core	663718	7761183
04	16.5		Diver Core	663837	7761213
05(s)	11		Grab Sample	663686	7761303
06	11		Grab Sample	663818	7761353
07	16.1		Diver Core	663533	7761393
08	14.5		Grab Sample	663653	7761436
09	16.1		Diver Core	663470	7761634
10	14		Grab Sample	663691	7761681
11	13.7		Grab Sample	663325	7762236
12(t)	13.5	Zone A – Sediment Characterisation	Grab Sample	663426	7762766
13	13		Grab Sample	663523	7762419
14	20		Grab Sample	663315	7763168
15	15		Grab Sample	663260	7763903
16	14.7	Zone B – Sediment Characterisation	Grab Sample	662368	7763035
17(s)	15.6		Grab Sample	661849	7764028
18	16		Grab Sample	662863	7764037
19	16		Grab Sample	662869	7765029
20	16		Grab Sample	661867	7765543
21	16		Grab Sample	662372	7766535
22	18		Grab Sample	661356	7768018
23(t)	18		Grab Sample	662884	7768541
24	18		Grab Sample	662351	7769038
25	20		Grab Sample	662356	7769436

(s) Split site; (t) Triplicate Site

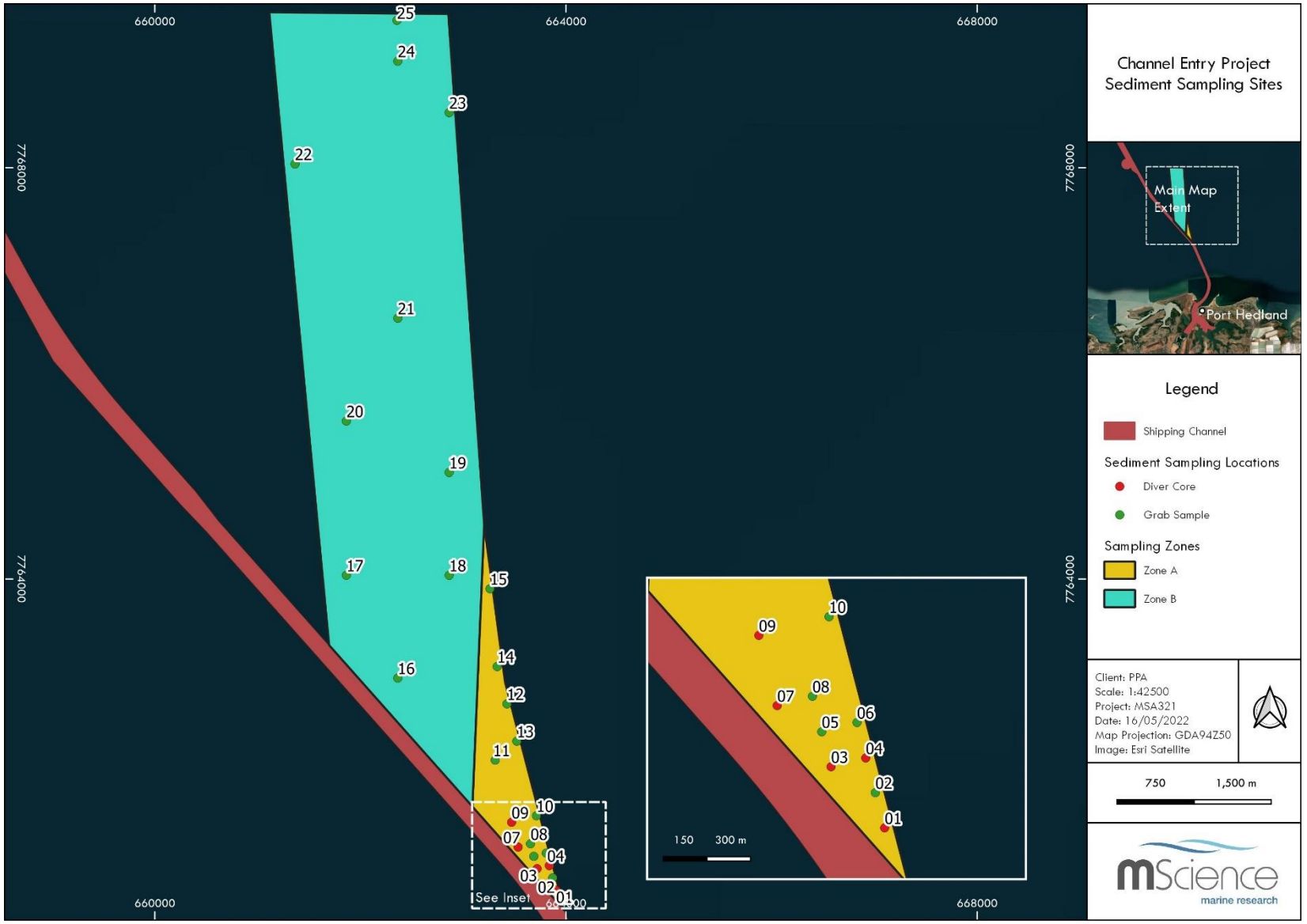


Figure 2.1. CEP sediment sampling sites

2.2 Field Procedures

Sample collection and processing were conducted in accordance with the procedures stated in Section 3 of the SAP (GHD 2020a).

2.2.1 Sample collection

2.2.1.1 DIVER CORES

Sediment cores were collected at five sites via diver using 6 cm x 120 cm transparent polycarbonate cores. The cores were manually screwed and/or hammered into the seabed sediments. In accordance with the SAP (GHD 2020a), core collection was attempted to a depth of 1.0 m, however as detailed in Section 2.1, core refusal before 1.0 m was met at all predetermined site coordinates. When initial core refusal was encountered, subsequent attempts were made at one-meter increments in a concentric circle pattern from the original site location. As per direction in the SAP, a maximum of four attempts were made to obtain a core of sufficient depth. Each site required four attempts. The sediment core collected on the fourth attempt was retained. Once collected, the core was capped at the seabed before being returned to the surface for processing.

2.2.1.2 GRAB SAMPLES

Surface sediments (from the top 0 – 0.15 m) were collected from 20 sites using a grab sampler (the grab). To collect sediments, the grab was manually deployed over the side of the vessel as close to vertical as possible. The grab was stopped at approximately two metres above the seabed to reduce pressure waves acting on the fine fractions of the sediment below. The grab was then lowered onto the seabed, triggered and retrieved once the scoops had closed over the substrate.

2.2.2 Sample Processing

Each diver core was separated for sample processing into surface (0 to 0.15 m) and sub surface (0.15 to refusal) depth profiles. Sediment within the cores was photographed and examined before being extracted to determine whether material had been lost or disturbed.

Sample material in the cores/grab was transferred to a clean stainless-steel bowl where it was photographed and described in accordance with AS1726 - *Geotechnical site investigations*. Sample material to be tested for volatiles was placed in pre-labelled sample jars prior to homogenisation. The remaining sample material was homogenised with a stainless-steel spoon and placed into pre-labelled sample jars and bags supplied by the nominated laboratories.

All field staff in contact with the sample material wore Nitrile gloves while transferring sample material into laboratory jars. Before the initial deployment, and between each subsequent deployment, all sampling equipment (e.g. cores, grabs, mixing bowls and spoons) was rinsed in seawater, washed with Decon 90 cleaning solution, rinsed again with ambient seawater and then received a final rinse with distilled water.

2.2.3 Sample handling, preservation, storage and transport

Once collected into pre-labelled jars and bags, the samples were stored in cool boxes with ice on board the vessel. At the end of the day the samples proposed for analysis of organotins were transferred to a freezer and frozen to extend the holding time for this analysis. All other samples were transferred to a refrigerator and kept at 3°C. The samples were express freighted to Perth on Tuesday 10 May in cool boxes with ice bricks. Samples arrived in Perth on Friday 13 May where they received a final check before being express couriered cold the same day to the analytical laboratories with the attendant chain of custody (CoC) forms.

2.3 Laboratories

The methods and detection limits for the analyses performed are provided in Table 2-3. Analyses were undertaken by laboratories using methods accredited under the National Association of Testing Authorities (NATA) for the parameters to be measured. Samples were consigned using a CoC to Australian Laboratory Services (ALS) for primary analysis, and Analytical Reference Laboratory (ARL) for secondary analysis:

Table 2-3. Analytes investigated with primary laboratory assay methods, limits of reporting (LOR) and storage method

Analyte	Method Reference	LOR	Storage container	Storage conditions
Metals (Ag, Al, As, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Sb, Zn)	USEPA 6010/6020 ALPHA 3112 Hg - B	0.01 – 50 mg/kg	150 ml Soil Glass Jar – Unpreserved	≤4°C, in the dark
Total Organic Carbon (TOC)	EP003	0.02 %	150 ml Soil Glass Jar – Unpreserved	≤4°C, in the dark
PSD (Sieve and Hydrometer analysis)	AS 1289.3.6.3 - 2003/AS 1289.3.5.1 - 2006	1%/ 0.01g/cm^3	2 x 500 ml Ziploc bag	1- 4°C, in the dark
Organotins (TBT, DBT, MBT)*	USEPA 8270	0.5 – 1 µgSn/kg	150 ml Soil Glass Jar – Unpreserved	≤4°C, in the dark
Total Recoverable Hydrocarbons (TRH)*	USEPA 8260/8270	0.2 – 5 mg/kg	150 ml Soil Glass Jar – Unpreserved	≤4°C, in the dark
Polycyclic Aromatic Hydrocarbons (PAH)*	USEPA 8270	4 – 5 µg/kg	150 ml Soil Glass Jar – Unpreserved	≤4°C, in the dark

*Only tested for at eight of the 25 sampling locations.

2.3.1 QA/QC Procedures

Four types of QA/QC samples were included in the field sediment sampling program:

- **Triplicates**: At 10% of sites field triplicates (three separate samples taken at the same location) were sampled to determine the variability of the physical and chemical sediment characteristics at the scale of sampling. Samples receiving the full suite of analytes were tested in triplicate.
- **Splits**: At 5% of the site's split samples were collected. That is, one sample was thoroughly homogenised as normal and then split into three containers to assess laboratory variation. Split samples were labelled consecutively with different ID numbers, so they were not apparent as splits at nominated laboratories. Samples receiving the full suite of analytes were tested as the inter and intra laboratory split.
- **Trip Blanks**: For each day of sampling, a sealed sample jar accompanied collected samples and was analysed for the volatile portion of the Total Recoverable Hydrocarbons.

Triplicate and split sample numbers were calculated from the total number of samples (30) described in the SAP. As such, three triplicates (sites 02, 12 and 23) and two splits (sites 05 and 17) were collected.

As part of their standard procedures, all laboratories undertook the required testing of blanks, spikes and standards, and completed laboratory duplicates in line with the NATA accreditation. Reports of these results are provided in **Appendix E**.

2.4 Data Analysis

2.4.1 Statistics

Statistics were calculated as set out within Section 6.5 of the SAP (i.e. 95% upper confidence limit [UCL] were calculated using Pro UCL). Additional statistics were calculated as recommended by the NAGD, and Simpson et al. (2013), and were derived from either Microsoft Excel 2016™ or Statistica 11 (StatSoft Inc 2011).

For sampling sites where samples were split, results were averaged to provide a single value for the site. Results from the secondary laboratory, which was used for QA purposes, have not been included in estimating Contaminants of Potential Concern (COPC) concentrations at a site. Concentrations below the LOR were assigned a value of LOR/2 for inclusion in statistics.

2.4.2 Development of Sediment Quality Guideline Values (SQGV)

SQGVs are a useful tool in assessing concentrations of metals which do not have a fixed screening level, or which exceed the fixed screening level in the NAGD. SQGVs are determined by procedures set out in Simpson *et al* (2013) and ANZG (2018). These procedures indicate that the concentration at test sites should be compared to ambient baseline levels for sediments of comparable grainsize in the vicinity of the disposal site.

For metals without a fixed screening level, the SQGV is the mean background concentration multiplied by two; the multiplication is to account for sampling and analytical variability and the range of natural values in the area. The SQGV is then compared against the 95% UCL for that metal.

For metals exceeding fixed guideline values, the SQGV is the 80th percentile of the background concentration which is compared against the mean concentration of the test sites (Commonwealth of Australia 2009; Simpson et al. 2013).

Data for the calculation of background concentrations of most metals for the Spoil Grounds (I, 7B and 9A) were drawn from recent sampling of those areas (MScience 2022a). Iron was not analysed in the recent sampling of the spoil grounds, therefore data for the calculation of background concentrations of iron was drawn from past sampling at those areas conducted within the last five years (Jacobs 2017).

3 RESULTS AND DISCUSSION

This section presents the results of the physical and chemical sediment quality assessment from implementation of the SAP (GHD 2020a) and discusses the data in relation to similar studies completed in the Port of Port Hedland. The QA/QC processes for data validation have also been presented in this section.

Following data validation, data from proposed maintenance dredge areas were compared to screening levels and ambient background concentrations in accordance with the guidelines in the NAGD. Where issues were identified with a particular contaminant, that contaminant was subject to additional analyses in accordance with the guidelines in the NAGD.

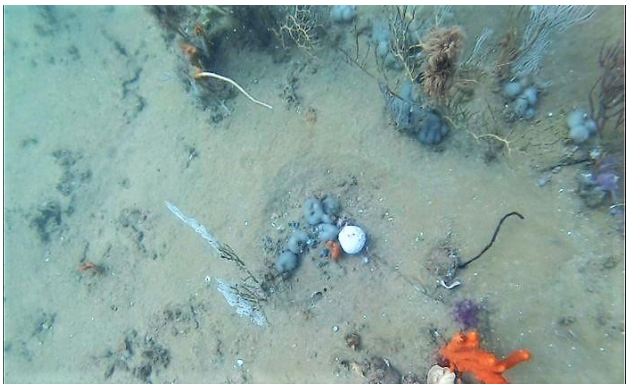
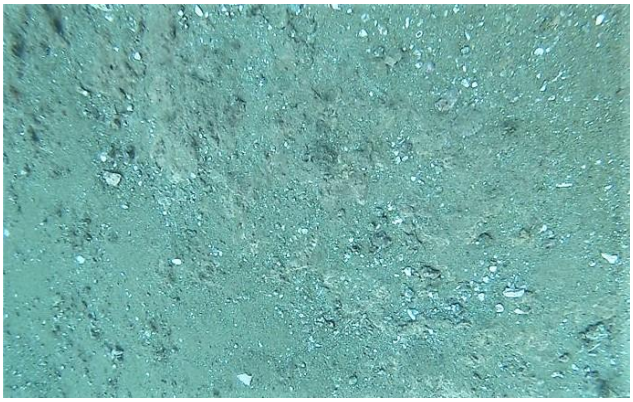
3.1 Sediment Quality

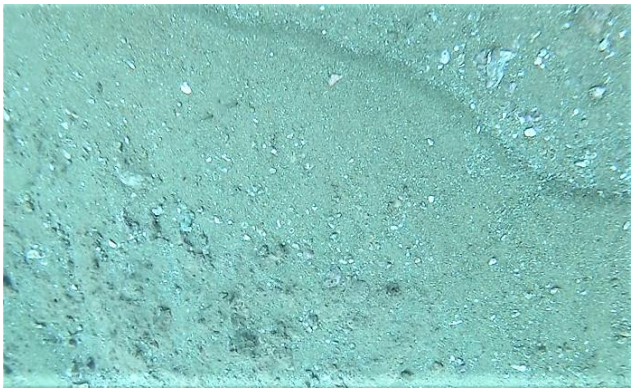
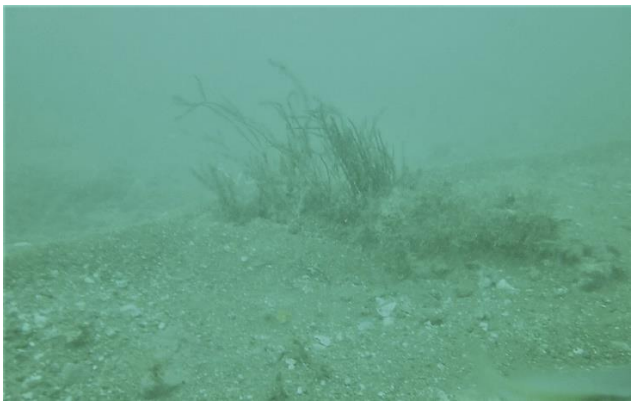
3.1.1 Field Observations

Field observations and photographs of sediment collected via grab and diver core have been presented in **Appendix A.**

Diver cores met refusal before the target depth of 1.0 m at all five diver core sites, the refusal depth and description of the sites has been provided in Table 3-1. Surficial sediments typically encountered at sample locations were coarse red and brown sands with gravel and shell fragments. Visibility during the collection of diver cores was <3 m due to strong easterly winds and spring tides.

Table 3-1. Diver core refusal depth and description

Site ID	Refusal Depth (m)	Site Habitat Description	Seafloor Image at location
01	0.46	Thin veneer of coarse sand overlying hard consolidated substrate (limestone pavement) supporting low density filter feeder communities*	
03	0.20	Thin veneer of coarse sand with shell fragments overlying consolidated clay	

Site ID	Refusal Depth (m)	Site Habitat Description	Seafloor Image at location
04	0.20	Thin veneer of coarse sand with shell fragments overlying consolidated clay	
07	0.28	Berm of coarse sand overlying hard consolidated substrate adjacent to the dredged channel (sediment layer likely to be impacted by vessel prop wash)	
09	0.40	Gravel and cobbles with large shell fragments	

*Refer to MScience (2022) for further detail on benthic communities and habitats found in the area

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 D**, while summary data are presented in this section.

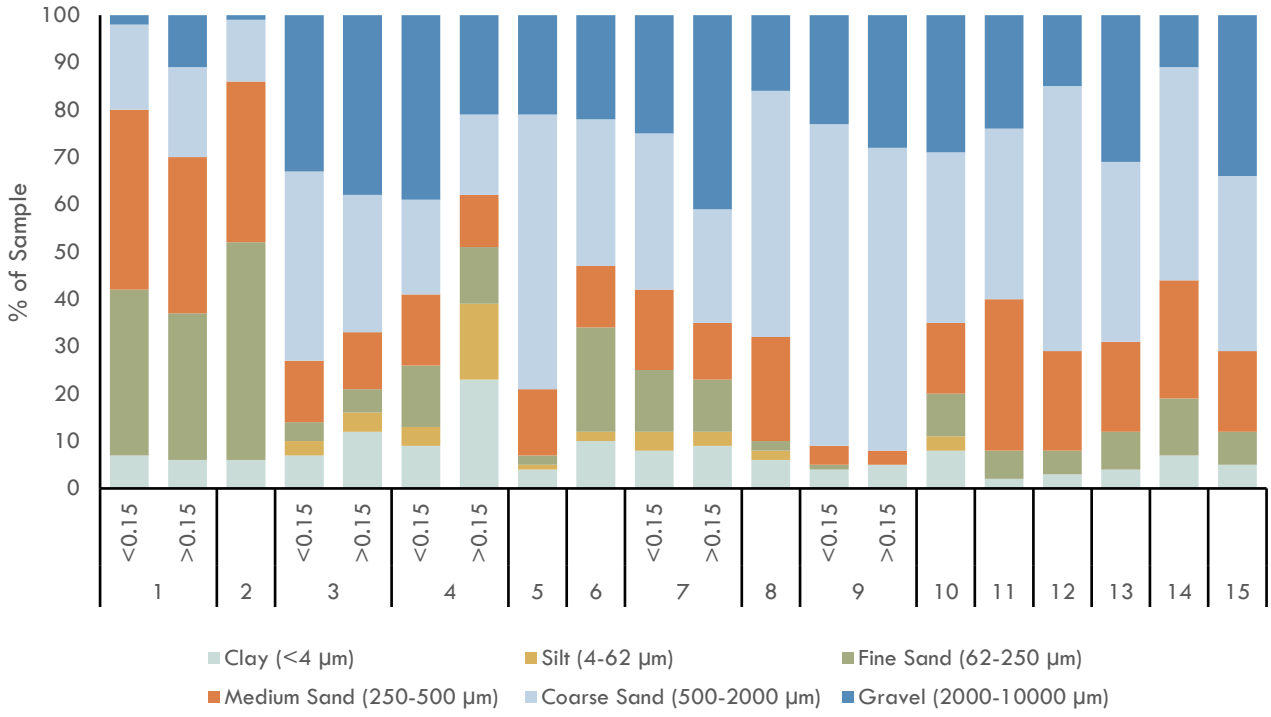


Figure 3.1. Particle size distribution for samples collected within Zone A (<0.15 m = surface; >0.15 m = sub surface) within targeted capital dredging (sites 01-11) and future maintenance dredging (sites 12-15) areas.

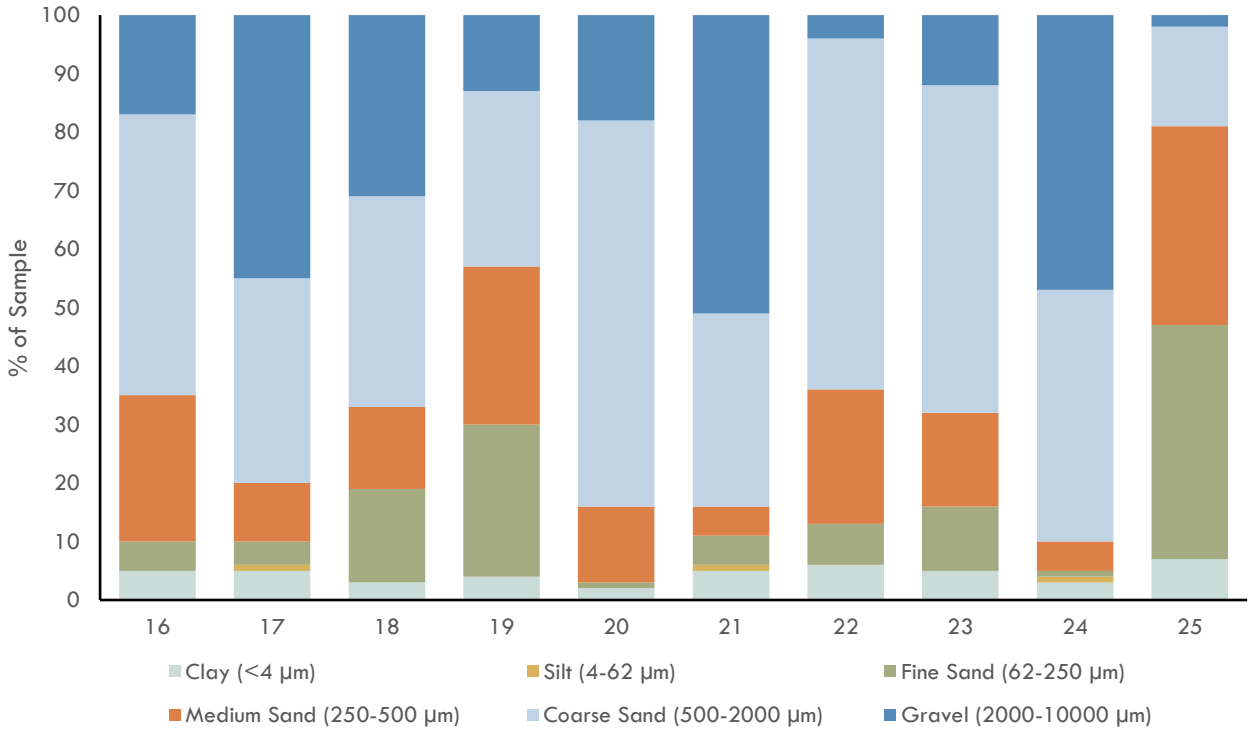


Figure 3.2. Particle size distribution for samples collected within Zone B.

The composition of sediment for individual samples collected from Zone A and Zone B is shown in Figure 3.1 and Figure 3.2, respectively. The two depth horizons reported from the diver core sites within Zone A (<0.15 = surface sediments, >0.15 = sub surface sediments) have been presented side by side for comparison.

Sediment samples collected from sites 01 to 11 were located within the targeted dredge area of Zone A. Sediments collected from sites 12 to 15 were located within the potential future area for maintenance dredging within Zone A. Sediment from most samples collected within Zone A were shown to be predominantly (80-90%) sorted into the fine to coarse sand (62 – 2000 µm) and gravel (2000 – 10000 µm) fractions, with only one sample reporting greater than 20% of the fines (<62 µm) fraction. Sediments from 16 of the 20 samples collected in this zone consisted of over 50% coarse sand and gravel (500 – 10000 µm). Three samples (from both depth horizons at site 01 and from site 02) reported higher proportions (over 60%) of fine to medium sand (62 – 500 µm) compared to the coarse sand and gravel fractions. In addition, the two sub surface (>0.15 m) diver core samples collected at sites 03 and 04 reported relatively high fines content (16 and 39%, respectively) compared to the near surface (<0.15 m) samples. The PSD reported for sediments collected at sites 03 and 04 was consistent with diver observations of hard clays underlying a veneer of coarse sand, recorded at these sites during sample collection.

With the exception of the reported sediment fractions from sites 03 and 04, sediments from the near surface depth horizon of the core samples reported a comparable percentage of sediment fractions to the surface depth horizon.

Sediment collected from the ten sites within Zone B were similar to those in Zone A. Sediments were shown to be predominantly (>90%) sorted in the fine to coarse sand and gravel fractions. Eight of the ten samples consisted of over 50% coarse sand and gravel, with two samples reporting higher (55 to 80%) proportions of the fine to medium sand fractions.

These results are consistent with previous analysis of PSD in sediments from the outer harbour of Port Hedland (Jacobs 2017; MScience 2022a; SKM 2011).

3.2 Metals and Metalloids

This section presents the 95% UCL concentrations for each of the metals and metalloids where the NAGD provides fixed screening guidelines as SQGVs. Individual sample data are summarised in **Appendix B** and raw data are shown in **Appendix D**. LORs for all metals and metalloids met or were below the Practical Quantitation Limit (PQL) listed in the SAP, meeting that data quality objective (DQO).

The 95% UCL concentrations for metals with a screening value provided in Table 2 of the NAGD are presented in Table 3-2 for the two zones (A and B) described in the SAP. Note that as there were only four samples analysed from the area proposed to inform sediment characterisation for future maintenance dredging in Zone A, it was only possible to calculate a 95% UCL for the combined data set (targeted dredge area and future maintenance dredging area) for Zone A. The 95% UCL concentrations for surface (0 – 0.15 m) and sub-surface (0.15 to refusal) samples collected within Zone A have been provided separately for reference. Aluminium and iron are non-toxic contaminants for the purpose of the NAGD and their concentration is presented for reference. Of the ten metals in that category, arsenic, was the only metal to show an exceedance of the NAGD screening levels.

Sediment concentrations of arsenic reporting above NAGD screening guidelines is common for sediments in the Pilbara (Stoddart et al. 2019) and is consistent with previous sediment surveys conducted within the outer harbour of the Port of Port Hedland (Jacobs 2017; SKM 2011). Metal concentrations are frequently controlled by the degree to which sediments bind some metals (Simpson et al. 2013). Binding capacity is usually indicated by the relative composition of fines within sediments, which may often be represented by the use of aluminium concentration as a surrogate measure. Therefore, the relationship of metals and aluminium is investigated in **Appendix C** on a metal by metal basis as an aid to interpreting the status of metals which do not pass the preliminary screening test (e.g. arsenic).

Table 3-2. Comparison of sediment concentration of metals with the NAGD screening levels

Units (mg/kg)	Assay LOR	NAGD PQL	NAGD Screening Level	95%UCL Zone A			95%UCL Zone B (n=10)	95%UCL All Samples (n=30)
				All Samples (n=20)	Surface Samples (n=15)	Sub-surface Samples (n=5)		
Iron	50	100	N/A	12613	12050	14887	12566	12207
Aluminium	50	200	N/A	2970	2354	5269	2176	3124
Antimony	0.5	0.5	2	0.25#	0.25#	0.25#	0.5*	0.3*
Arsenic	1	1	20	**26.9**	**28.0**	**30.4**	**32.2**	**27.3**
Cadmium	0.1	0.1	1.5	0.05#	0.05#	0.05#	0.1*	0.1*
Chromium	1	1	80	19.9	17.9	28.3	16.1	18.3
Copper	1	1	65	4.0**	3.1***	6.9	2.9	3.4**
Lead	1	1	50	3.3	3.0	4.4	3.4	3.3
Mercury	0.01	0.01	0.15	0.005#	0.005#	0.005#	0.005#	0.005#
Nickel	1	1	21	8.2	6.9	13.3	6.6	7.4**
Silver	0.1	0.1	1	0.05#	0.05#	0.05#	0.05#	0.05#
Zinc	1	1	200	8.3***	7.5	11.7	6.5	7.5

*Distribution of data was not normal - non-parametric distribution test results have been reported (95% Chebyshev (mean, sd) UCL)
** Distribution of data was not normal – lognormal distribution test results have been reported (95% H-UCL)
***Distribution of data was not normal – gamma distribution test results have been reported (95% adjusted Gamma)
#The distribution of data shows no variance, reported value is ½ LOR.
Red cells indicate an exceedance of the screening level.

Derived SQGVs are presented in Table 3-3 for metals without a numerical screening guideline in the NAGD and metals that did not meet the numerical NAGD screening level (e.g. arsenic). Background levels for comparison were derived from the most recent data collected from the spoil grounds SG-I, SG-7B and SG-9A (MScience 2022a), with the exception of iron. The spoil grounds vary in their distances from shore, thus, values for each spoil ground are shown separately as well as in aggregate.

Table 3-3. SQGV for selected metals at the spoil grounds

Units (mg/kg)	SQGV				Basis for SQGV
	All (n=29)	**SG-I (n=10)**	**SG-7B (n=10)**	**SG-9A (n=09)**	
Iron*	22091	21894	27860	16520	Twice the mean
Aluminium	3997	2308	6632	2945	Twice the mean
Manganese	497.4	230.6	704.2	564	Twice the mean
Arsenic	18.8	4.3	30.2	18.0	80th percentile

*Data from Jacobs (2017), n=30 for 'All' and n=10 for "SG-9A)

The CEP SAP lists iron, aluminium and manganese as analytes to be tested, however these metals do not have a fixed screening level in the NAGD. The NAGD indicates that iron and aluminium are not toxic contaminants, therefore their concentration is not considered further.

Table 3-4 shows the comparison of the 95% UCL concentrations of manganese with the SQGV derived in Table 3-3 from the aggregate of spoil grounds. These comparisons show that manganese concentrations within Zone A (both depth horizons) and Zone B were below the average SQGV for all spoil grounds.

Table 3-4. Sediment concentration of metals without a fixed screening level in the NAGD

Units (mg/kg)	Assay LOR	SQGV* (n=29)	95%UCL Zone A			95%UCL Zone B (n=10)	95%UCL All Samples (n=30)
			All Samples (n=20)	**Surface Samples (n=15)**	**Sub-surface Samples (n=5)**		
Manganese	10	497	291	278	413	463	336

* 2 x the mean of the background sites from Table 3-3

For metals where the 95% UCL exceeded the NAGD fixed screening level, the mean concentrations were compared to the SQGV derived from the aggregated spoil ground data (Table 3-5). Mean arsenic concentrations in sediments from all surveyed areas (and depth horizons) were above the 80th percentile concentration of the aggregated spoil ground data, but below the 80th percentile concentration at Spoil Ground 7B. Note that these comparisons are made in the absence of any correction for differing grain sizes. To account for the different grain size for sediments at the dredge and disposal sites, the 80th percentile concentration should be normalised by calculating it from the relationship of binding potential and metal concentration at the spoil grounds and relating that to the binding potential (using aluminium) of the spoil ground samples (see **Appendix C** for further detail). Correlation of metals with aluminium concentrations at

spoil grounds showed five metals as highly positively correlated ($p < 0.05$) with aluminium, however arsenic did not show a significant correlation and could not be normalised.

Table 3-5. Comparison of metals which exceeded fixed screening levels in the NAGD

Units (mg/kg)	Assay LOR	SQGV* All (n=29)	SQGV* SG-7B (n=10)	Mean Zone A			Mean Zone B (n=10)	Mean All Samples (n=30)
				All Samples (n=20)	Surface Samples (n=15)	Sub-surface Samples (n=5)		
Arsenic	1	18.8	30.2	24.0	24.5	22.3	26.0	24.6

* 80th%ile of the background sites from Table 3-3

Survey results for metal concentrations were similar to previous SAP implementation results for the Port of Port Hedland (Jacobs 2017; MScience 2021; O2 Marine 2020a; O2 Marine 2020b; SKM 2011). While comparison of the mean arsenic concentration was above the 80th percentile concentration of the aggregated spoil ground data, concentrations were below the 80th percentile concentration at Spoil Ground 7B.

The 95% UCL concentration of arsenic within Spoil Ground 7B (27.2 mg/kg) exceeded the NAGD screening guideline of 20 mg/kg during the most recent survey of this area (MScience 2022a), and a number of individual samples collected from spoil grounds "I" and 9A also reported arsenic concentration exceeding the screening guideline. This is consistent with sampling at spoil grounds 7 and 9 prior to their first use as spoil grounds which showed the 95% UCL concentrations of arsenic within both areas exceeded the NAGD screening guideline (Jacobs 2017). Adjacent to the Project area, SKM (2011) found the 95% UCL concentrations of arsenic exceeded the NAGD screening guideline in the surficial sediments collected within all areas investigated for the proposed BHP Outer Harbour Development (calculated from 213 samples). Furthermore, arsenic was found to exceed the NAGD screening guideline in samples collected to a depth of 4 m in boreholes from these areas. SKM (2011) concluded that exceedances of screening levels were associated with naturally occurring levels.

Sediments in the Port of Port Hedland, and surrounding areas, have been widely sampled since 1990 (see GHD 2020b and references therein). During the history of sediment sampling within the port, arsenic has exceeded the guideline value (relevant at the time of sampling) multiple times, however, detailed assessment of the source of the metal has concluded that the levels are naturally occurring (GHD 2020b).

High arsenic concentrations in sediments from the Pilbara is a well-documented feature (Stoddart et al. 2019). Arsenic in the marine environment is frequently concentrated by biota (Neff 1997) and found in an organic form that is easily broken down (Francesconi and Edmonds 1998). The highest arsenic concentrations at Port Hedland have often been reported in surface sediments from offshore sites close to areas of biomass, which is consistent with a detrital origin (Stoddart et al. 2019). The benthic habitats of the outer harbour of Port Hedland have been mapped and observed to be dominated by sand plains interspersed with a series of hard substrate ridgelines capable of supporting benthic primary producers (MScience 2022b; SKM 2009). A hard substrate ridgeline runs through the north of Zone B.

Given the above information, and the suitability for use of Spoil Ground 7B, further investigation by way of bioavailability testing was not considered necessary.

Based on the Phase II investigations of metal and metalloid sediment concentrations, sediments within both Zones A and B should be considered suitable for unconfined ocean disposal.

3.3 Organic Compounds

Total organic carbon (TOC) was analysed in all samples as part of the basic suite described in the SAP (GHD 2020a). Sediment concentrations of TOC for the current survey ranged from 0.07% to 3.35% (see **Appendix B**), which was similar to the range reported in previous surveys conducted within the outer harbour of the Port of Port Hedland (Jacobs 2017; SKM 2011; Worley Parsons 2012). Where organic contaminants are normalised to 1% TOC, sites with low levels of TOC 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 was used. In the current investigation 26 out of the 30 samples analysed for organic compounds had a TOC below 0.2%.

3.3.1 Total Recoverable Hydrocarbons (TRH)

TRH were analysed in eight of the 30 samples collected during the survey, as specified in the SAP (GHD 2020a). Five of the samples (02, 05, 06, 08 and 10) were collected from the proposed capital dredge area in Zone A, one sample (12) in Zone A proposed to inform sediment characterisation for future maintenance dredging and two samples (17 and 23) in Zone B. Note that as there was only one sample analysed for TRH from the pool of sampling locations proposed to inform sediment characterisation for future maintenance dredging in Zone A, and two samples from Zone B, it was only possible to calculate a 95% UCL for the combined data set for Zone A and the Project area (Zones A and B) as a whole.

The results have been presented in Table 3-6. Individual site data are summarised in **Appendix B** and raw data are provided in **Appendix D.** The LOR for each fraction of TRH, and the sum of fractions, was below the PQL listed in the SAP, thereby meeting this DQO.

Note that screening guidelines referenced in the NAGD refer to total petroleum hydrocarbons (TPH) rather than TRH, however these terms may be used interchangeably for the purposes of this assessment.

For the current investigation, the sum of fractions used to calculate total TRH were:

- Fraction 1 - TRH C6-C9 (LOR = 3 mg/kg);
- Fraction 2 - TRH C10 - C14 (LOR = 3 mg/kg);
- Fraction 3 - TRH C15 - C28 (LOR = 3 mg/kg); and
- Fraction 4 - TRH C29 - C36 (LOR = 5 mg/kg);

Table 3-6. Concentration of TRH in sediments from the CEP

Units (mg/kg)	Assay LOR	NAGD PQL	NAGD Screening Level	Mean of Zone A Samples (n=6)	Mean of Zone B Samples (n=2)	Mean of All Samples (n=8)
Fraction 1: C6-C9	3	100	550	1.5	1.5	1.5
Fraction 2: C10-C14	3			1.5	2.3 (1.7)	1.7 (1.5)
Fraction 3: C15-C28	3			1.9 (4.6)	3.3 (2.3)	2.3 (4.0)
Fraction 4: C29-C36	5			2.5	3.8 (2.8)	2.8 (2.6)
95% UCL Sum of TRH (C6 – C36) for Zone A				**3.4 (6.1)**		
95% UCL Sum of TRH (C6 – C36) for All Samples				**4.8 (6.2) ***		

* Distribution of data was not normal - non-parametric distribution test results have been reported (95% Chebyshev (mean, sd) UCL)
Bracketed numbers represent concentrations normalised to 1% TOC.

TRH Fraction 1 (C6 – C9) was below detection limits for all samples, with assay LORs below the PQL prescribed by the NAGD. The concentration of this organic fraction was not normalised to 1% TOC and, as per NAGD guidance, the 95% UCL was set at half the LOR since there was no variance in TRH concentration from which to derive this statistic.

No petroleum hydrocarbons were detected in the samples collected within the targeted dredge area of Zone A. Fraction 3 (C15 - C28) was detected at a very low concentration (4 mg/kg) in one of the triplicate samples collected at site 12, located in the area proposed to inform sediment characterisation for future maintenance dredging within Zone A.

TRH Fraction 2 (C10 – C14), Fraction 3 (C15 – C28) and Fraction 4 (C29 – C36) were detected in one of the triplicate samples collected from site 23 within Zone B, however the concentrations detected were low (<5 mg/kg). Concentrations were relatively similar across each fraction in which TRH was detected.

These results are consistent with previous survey results conducted within the outer harbour of the Port of Port Hedland (Jacobs 2017; SKM 2011; Worley Parsons 2012).

The 95% UCL for the sum of all TRH fractions for all sites, normalised to 1% TOC, was well below the NAGD screening level of 550 mg/kg (Table 3-6).

On this basis, TRH was not considered a COPC and suggests that TRH concentrations in these sediments do not present an impediment for unconfined sea disposal at the approved spoil grounds.

3.3.2 Polyaromatic Hydrocarbons (PAH)

PAHs were analysed in eight of the 30 samples collected during the survey, as specified in the SAP (GHD 2020a). Five of the samples (02, 05, 06, 08 and 10) were collected from the proposed dredge area in Zone A, one sample (12) in Zone A proposed to inform sediment characterisation for future maintenance dredging and two samples (17 and 23) in Zone B. Individual site data are summarised in **Appendix B** and raw data are provided in **Appendix D.** The PQL for the sum of PAHs stated in the NAGD is 100 µg/kg, while the PQL for individual species is 5 µg/kg. Table 3-7 shows LORs for all PAH species below the PQL, thus, the DQOs were met for all PAHs.

No species of PAH were detected in any of the samples analysed (Table 3-7). Since there was no variance in the PAH concentrations, normalisation and calculation of the 95% UCLs were not performed.

These findings suggest that PAH concentrations in these sediments do not present an impediment for unconfined sea disposal at the approved spoil grounds.

Table 3-7. PAH concentrations in sediments from the CEP

Units (µg/kg)	Assay LOR	NAGD Screening Level	Mean Zone A Samples (n=6)	Mean of Zone B Samples (n=2)
Naphthalene	5	10,000	<5	<5
2-Methylnaphthalene	5		<5	<5
Acenaphthylene	4		<4	<4
Acenaphthene	4		<4	<4
Fluorene	4		<4	<4
Phenanthrene	4		<4	<4
Anthracene	4		<4	<4
Fluoranthene	4		<4	<4
Pyrene	4		<4	<4
Benz(a)anthracene	4		<4	<4
Chrysene	4		<4	<4
Benzo(b+j)fluoranthene	4		<4	<4
Benzo(k)fluoranthene	4		<4	<4
Benzo(e)pyrene	4		<4	<4
Benzo(a)pyrene	4		<4	<4
Perylene	4		<4	<4
Benzo(g.h.i)perylene	4		<4	<4
Dibenz(a.h)anthracene	4		<4	<4
Indeno(1.2.3.cd)pyrene	4		<4	<4
Coronene	5		<5	<5
Sum of PAHs	4		<4	<4

3.3.3 Organotins

Tributyltin (TBT) and the breakdown organotin species, dibutyltin (DBT) and monobutyltin (MBT), were analysed in eight of the 30 samples collected during the survey, as specified in the SAP (GHD 2020a). Five of the samples (02, 05, 06, 08 and 10) were collected from the proposed dredge area in Zone A, one sample (12) in Zone A proposed to inform sediment characterisation for future maintenance dredging and two samples (17 and 23) in Zone B. Individual site data are summarised in **Appendix B** and raw data are provided in **Appendix D.** LORs for the assay of TBT, DBT and MBT were below the PQLs stated in the NAGD and SAP, thereby meeting that DQO. Where sample concentrations were below LOR they were assigned a nominal concentration of LOR/2 for analytical purposes. Any variance in these samples was a result of the normalisation procedure due to different levels of TOC in each of the samples.

No MBT was detected in any sample, since there was no variance between samples for this organotin species, normalisation to 1% TOC and calculation of the 95% UCL was not performed.

Table 3-8. Comparison of organotin concentrations with the TBT screening level

Units (µgSn/kg)	Assay LOR	NAGD PQL^	Screening Level^	Mean Zone A Samples (n=6)	Mean Zone B Samples (n=2)	95% UCL All Samples (n=8)
MBT	1	1	9	0.5	0.5	0.5
DBT	1	1	9	0.5	1.1 (4.6)	1.0 (6.0) *
TBT	0.5	1	9	0.5	0.8 (3.7)	1.0 (4.9) *

* Distribution of data was not normal - non-parametric distribution test results have been reported (95% Chebyshev (mean, sd) UCL)
Bracketed numbers represent concentrations normalised to 1% TOC.

TBT and DBT were not detected in any sample from Zone A. DBT and TBT were detected above LOR at site 17 located in Zone B. Site 17 was a split site, therefore the intra-laboratory results were averaged to provide a single value for the site (8.8 and 7.1 µgSn/kg, normalised, for DBT and TBT, respectively). The 95% UCL for normalised DBT and TBT within all samples was below the screening guideline of 9 µgSn/kg (Table 3-8).

Similar to the findings in previous surveys conducted at Port Hedland (MScience 2017; O2 Marine 2020a; Worley Parsons 2012), incident levels of elevated TBT appear to be consistent with its presence in the form of infrequent paint flakes rather than any widespread occurrence.

The results of this survey suggest that the organotin concentrations in these sediments are at appropriate levels for unconfined ocean disposal.

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

This section examines the validity of the analytical data used in this assessment of the suitability of dredged sediments for ocean disposal. The QA/QC compliance report generated by the laboratory conducting the primary chemical analyses (**Appendix E**) sets out DQOs relating to analyses and outlines the results of the internal QA/QC procedures. Where possible these are related back to the DQOs outlined in the SAP. Procedures for collection and analysis of trip blanks, triplicate and split samples set out in the SAP provide for tests of cross contamination, in situ heterogeneity and repeatability of field estimates.

3.4.1 Sample Holding Times

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

Sample integrity was maintained in accordance with the SAP and NAGD 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.

3.4.2 Laboratory Blanks

Within the QC report, method blank results are compared to the LOR. There were no method blank outliers reported for the QC investigation conducted by each laboratory.

3.4.3 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 NAGD and the SAP. The ARL QC report indicated there were no laboratory control outliers or surrogate recovery outliers or matrix spike recovery outliers reported. The ALS report indicated there were no laboratory control outliers or surrogate recovery outliers, however matrix spike recovery outliers were reported.

There was a matrix spike recovery issue for the analysis of PAH species Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Benz(a)anthracene, Chrysene, Benzo(k)fluoranthene, Benzo(a)pyrene, Benzo(g.h.i)perylene, Dibenz(a.h)anthracene and Indeno(1.2.3.cd)pyrene in one sample (the second triplicate sample for site 02) which showed a matrix spike recovery less than the lower DQO due to possible matrix interference.

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 the result of one sample where PAH species have failed to meet the recovery limits. With the exception of the listed PAH species, LCS and MS recoveries were sufficient to meet the DQOs for classification of results as exact values. Given the low concentrations reported for PAH species (less than LOR), treating these data as estimates rather than precise values was not considered to invalidate the conclusions of the assessment.

3.4.4 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 each of the laboratory's QC reports indicating all duplicate analyses were within the ±35% range. These results suggest that the precision of the assays was appropriate, and results should be considered as exact values.

3.4.5 Trip Blanks

Trip blanks were below the limits of reporting for all volatile compounds tested (see **Appendix C** for raw data).

3.4.6 Field Replicates

Analysis of replicate samples collected in the field was also performed for the sampling program as detailed in the ASAP, with the inclusion of inter/intra-laboratory duplicates (splits) (method checks) and triplicate (in situ heterogeneity assessment) samples.

Splits

Split samples were three replicate samples obtained from the same homogenised grab sample. Two samples were sent to the primary laboratory for analyses, while the remaining sample was sent to the secondary laboratory for analysis. Comparison of samples one and two provided an estimate of intra-laboratory (within-assay) variability and comparison of sample three with the mean of samples one and two provided an estimate of inter-laboratory variability. Laboratory duplicates should be within a relative percent difference (RPD) of ±35% (Commonwealth of Australia 2009); where RPDs that fall outside of these limits are to be flagged as estimates rather than precise values.

The intra-laboratory and inter-laboratory comparisons for most analytes showed RPDs within the acceptable limits (<35%).

One metal, copper, reported an inter-laboratory RPD greater than 35% in both split samples (62% and 75%). This outcome in both samples was related to measurements nearing the LOR. The reliability of concentrations near the LOR is known to decrease as concentrations approach the LOR. On the basis of this finding, the concentration of copper should be considered as an estimate, rather than a precise value.

However, at the concentration recorded, error in measurement was not great enough to invalidate the outcomes of the assessment.

TPH and PAH were not detected above LOR in any of the split samples. Any exceedance of the inter-laboratory RPD from these results would be related to differing LORs used between laboratory methods, however the LORs used by both laboratories were below the PQL requirements in the SAP and NAGD.

Both the intra-laboratory and inter-laboratory RPD for TOC were within the allowable limits (±35%). These results suggest that the precision of the assays was appropriate, and results should be considered as exact values.

The RPDs for the intra-laboratory and inter-laboratory comparison of DBT and TBT in one split sample (G17) were above the ±35% criteria for assessment. This outcome was related to these organotin compounds being detected above LOR in just one of the primary laboratory samples. Incident levels of elevated TBT appear to be consistent with its presence in the form of infrequent paint flakes rather than any widespread occurrence.

Where PSD analyses reported substantive proportions of a particular fraction, the reported RPDs were within ±35% for the intra-laboratory assessment. Where reported fractions were small (e.g. <5%) intra-laboratory RPD's were greater than 35%; here a small difference in the proportion of a reported fraction could result in a large RPD (i.e. >35%). The same was true for exceedances of inter-laboratory RPDs for the fines fraction in both split samples. There were also inter-laboratory variations resulting in RPDs >35% for the coarse sand and gravel fractions in sample G17. This outcome was a result of where one laboratory reporting a high proportion (mean =48%) of gravel whilst the other reported a high proportion (55%) of coarse sand in the sample. This is potentially a result of a slight difference between laboratories reporting a sediment fraction size which is right on the boundary of the gravel and coarse sand classification. On the basis of this finding, PSD should be considered as estimates rather than precise values. However, given the similar percentages reported for the gravel and coarse sand fractions, the potential measurement error should not invalidate the outcome of this investigation.

Triplicates

Triplicate samples were obtained in the field by taking three separate samples from the same site. The NAGD advises that field replicates for three samples obtained from a single location should have a relative standard deviation (RSD) of ±50% (Commonwealth of Australia 2009); although they may not always do so where sediments are very heterogeneous or differ greatly in grain size.

Analysis of the RSD for the triplicate samples showed that concentrations were within the acceptable limits (<50%) for most analytes and triplicate samples. Two of the three triplicate samples (one from each of Zone A and Zone B) had an RSD greater than 50% for TRH Fraction 3 (C15 – C28). Both of these cases were related to sediments with concentrations at or around the LOR for that fraction. PSD data showed good agreement (i.e. RSD < 50%) between the data when appreciable proportions of a fraction were detected.

The triplicate analysis suggests that there was some in situ homogeneity, although the results reported from these samples should be considered representative of the sediment quality at each site.

4 CONCLUSIONS

PPA developed and implemented a SAP (GHD 2020a) to measure sediment quality within the proposed capital dredging footprint (Zone A) and potential future maintenance dredging footprint (Zone B, including part of Zone A) for the Channel Entry Project in the Port of Port Hedland. In accordance with prescriptions of the NAGD for capital dredging projects, a combination of two sampling methods targeting the 0 to 0.15 m (surface) sediment horizon and the 0.5 to 1.0 m (sub surface) horizon was proposed in the SAP, namely grab samples and diver operated cores.

Sampling was conducted on 05 May (diver cores) and 07 May (grabs) 2022. Diver cores met refusal before the target depth of 1.0 m during multiple collection attempts at all five diver core sites, therefore, sediment profiles for the core samples were separated into a 0 – 0.15 m (surface) and 0.15 m to refusal (sub surface) depth profile. Sampling met all field DQOs. No analytes were detected from analysis of the trip blank samples. The laboratory QA/QC process identified one instance where the acceptability criteria for QC assessment of PAH species concentrations was not met due to matrix spike interference, though this finding was not concluded to have invalidated the assessment outcomes. The field replicate QA/QC process showed that there almost no intra-laboratory variance and inter-laboratory variance was small and confined to a small number of analytes suggesting methods were accurate and analyte concentrations should be considered precise. The triplicate analysis showed all analytes (except TRH Fraction 3) met the required RPDs suggesting that samples were representative of the sediment at each site.

All samples were assessed for PSD, with particular attention paid to the fines (<62 µm) component, as this fraction is often associated with contaminants. Sediment from most samples collected within Zone A were shown to be predominantly (80-90%) sorted into the fine to coarse sand (62 – 2000 µm) and gravel (2000 – 10000 µm) fractions, with only one sample reporting greater than 20% of the fines (<62 µm) fraction. The majority of the samples in the zone (16 of the 20 samples collected) consisted of over 50% coarse sand and gravel (500 – 10000 µm). Sediment collected from sites located in the south of Zone A, within the targeted area for dredging, reported higher proportions (over 60%) of fine to medium sand (62 – 500 µm) (sites 01 and 02) and relatively high fines content (16 and 39% within the sub surface samples from sites 03 and 04, respectively) compared to the sediments collected in other areas of the zone. The PSD reported for sediments collected at sites 03 and 04 was consistent with diver observations of hard clays underlying a veneer of coarse sand, recorded at these sites during sample collection. Sediment collected within Zone B were similar to those in Zone A. Sediments were shown to be predominantly (>90%) sorted in the fine to coarse sand and gravel fractions. Eight of the ten samples collected consisted of over 50% coarse sand and gravel, with two samples reporting higher (55 to 80%) proportions of the fine to medium sand fractions.

The Phase II investigation into metal and metalloid concentrations in sediments showed that sediment concentrations of metals within Zone A and Zone B were below the screening guideline levels for all metals, with the exception of arsenic. Arsenic concentrations were shown to exceed the numerical screening level listed in Table 2 of the NAGD, however examining the relationship for arsenic with aluminium from recent spoil ground data showed that arsenic did not show a significant correlation and could not be normalised for grain size.

Mean arsenic concentrations were above the screening level derived from the 80th percentile concentration of the aggregated spoil ground data ("I", 7B and 9A), but below the 80th percentile concentration at Spoil Ground 7B. High arsenic concentrations have been reported in previous surveys within the outer harbour of the Port of Port Hedland (Jacobs 2017; MScience 2022a; SKM 2011), specifically, sampling of sediments within the approved spoil grounds has shown arsenic to exceed the NAGD screening guidelines (Jacobs 2017; MScience 2022a). During the history of sediment sampling within the port, arsenic has exceeded the guideline value (relevant at the time of sampling) multiple times, however, detailed assessment of the source of the metal has concluded that the levels are naturally occurring (GHD 2020b). High arsenic concentrations in sediments from the Pilbara is a well-documented feature, and the highest concentrations at Port Hedland

have often been reported from offshore sites (Stoddart et al. 2019). Stoddart *et al* (2019) speculate that patterns of arsenic concentrations in the Pilbara are consistent with a detrital origin and often higher in surface sediments close to areas of biomass. A hard substrate ridgelines capable of supporting benthic primary producers traverses through the north of Zone B (MScience 2022b; SKM 2009).

On this basis, the concentration of arsenic in these sediments was not interpreted as evidence to prevent unconfined ocean disposal. Sediment concentrations of all other metals assayed in this survey suggest that they met the criteria for unconfined ocean disposal.

Petroleum hydrocarbons were detected from TRH Fraction 3 (C15 – C28) at low concentration (<5 mg/kg) in one sample from Zone A and one sample from Zone B. The same sample from Zone B also reported low concentrations of TRH Fraction 2 (C10 – C14) and Fraction 4 (C29 – C36). The concentration of TRH fractions detected were well below the NAGD screening level. No petroleum hydrocarbons were detected in the samples collected within the targeted dredge area of Zone A. No species of PAH were detected above LOR in any sample collected for analysis. This aligns with previous sediment characterisation studies completed in the outer harbour of Port Hedland (Jacobs 2017; SKM 2011; Worley Parsons 2012) which have shown hydrocarbons have never been found at concentrations near the NAGD (low) screening levels. Therefore, TRH and PAH should not be considered as COPC, and, at these concentrations, the sediment would be considered safe for unconfined ocean disposal at the approved spoil grounds.

MBT was not detected in any sample. Similarly, DBT and TBT was not detected in any sample collected within the targeted dredge area of Zone A. DBT and TBT were detected above LOR at one site located in Zone B, however, the 95% UCL for normalised DBT and TBT within all samples was below the NAGD screening guideline of 9 µgSn/kg. Similar to the findings in previous surveys (MScience 2017; O2 Marine 2020a; Worley Parsons 2012), incident levels of elevated TBT appear to be consistent with its presence in the form of infrequent paint flakes rather than any widespread occurrence.

Overall, sediment concentrations of candidate COPCs were shown to be either below the initial screening levels described in the NAGD or having a high naturally occurring background concentration; noting there are no fixed screening guidelines for some of the analytes investigated in this survey. These findings suggest that sediment from proposed capital dredging footprint and future maintenance dredging footprint of the Channel Entry Project meet NAGD criteria for unconfined ocean disposal at the approved spoil grounds.

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6 APPENDIX A – FIELD OBSERVATIONS

Site	Site Depth (m)	Sample Method	Core Depth (m)	Sample ID	Description	Image
01	15.1	Core	0.46 (refusal due to hard shoal at 0.46 m).	C1-15	Sample collected between 0 – 0.15 m depth. Brown coarse well sorted sand, gorgonians and sponges, no odour	
				C1-1	Sample collected between 0.15 – 0.4 m depth. Brown coarse well sorted sand, gorgonians and sponges, no odour	
02	11	Grab	N/A	G2	Brown, muddy and coarse sands, poorly sorted with some shell fragments, and seagrass, no odour.	

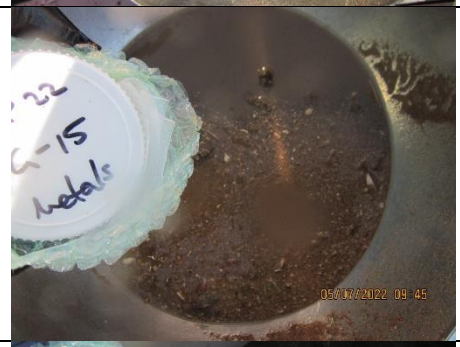
Site	Site Depth (m)	Sample Method	Core Depth (m)	Sample ID	Description	Image
03	16.7	Core	0.2 (refusal due to consolidated clay at 0.2 m).	C3-15	Sample collected between 0 – 0.15 m. Brown coarse sands and gravels, angular and poorly sorted, no odour	
				C3-1	Sample collected between 0.15 – 0.2 m depth. Fine brown well sorted clay and silts, no odour	
04	16.5	Core	0.2 (refusal due to consolidated clay at 0.2 m).	C4-15	Sample collected between 0 – 0.15 m Coarse brown, moderately sorted sands, some shell fragments, no odour.	

Site	Site Depth (m)	Sample Method	Core Depth (m)	Sample ID	Description	Image
				C4-1	Sample collected between 0.15 – 0.2 m Poorly sorted fine silts and coarse sands, no odour.	
05	11	Grab	N/A	G5	Poorly sorted, very angular brown sands with coarse shell fragments and cobbles, no odour.	
06	11	Grab	N/A	G6	Coarse poorly sorted brown muddy sands and gravels, no odour.	

Site	Site Depth (m)	Sample Method	Core Depth (m)	Sample ID	Description	Image
07	16.1	Core	0.27 m (refusal due to hard shoal at 0.27 m).	C7-15	Sample collected between 0 – 0.15 m Very coarse poorly sorted, angular red sands and shell fragments, no odour	
				C7-1	Sample collected between 0.15 – 0.27 m depth. Very coarse poorly sorted, angular red sands and shell fragments, no odour	
08	14.5	Grab	N/A	G8	Coarse brown sands, minimal fines, some shell fragments, no odour.	

Site	Site Depth (m)	Sample Method	Core Depth (m)	Sample ID	Description	Image
09	16.1	Core	0.4 (refusal due to heavy gravels at 0.4m)	C9-15	Sample collected between 0 – 0.15 m, Poorly sorted, angular coarse shell fragments and red coarse sands, no odour.	
				C9-1	Sample collected between 0.15 – 0.4 m. Poorly sorted, angular coarse shell fragments and red coarse sands, no odour.	
10	14	Grab	N/A	G10	Poorly sorted brown muds and coarse sands, no odour.	

Site	Site Depth (m)	Sample Method	Core Depth (m)	Sample ID	Description	Image
11	13.7	Grab	N/A	G11	Poorly sorted coarse grey brown sands and shell fragments, no odour.	
12	13.5	Grab	N/A	G12	Moderately sorted coarse red/brown sands and shell fragments, no odour.	
13	13	Grab	N/A	G13	Poorly sorted coarse sands, silts and shell fragments, single ascidian, no odour.	

Site	Site Depth (m)	Sample Method	Core Depth (m)	Sample ID	Description	Image
14	20	Grab	N/A	G14	Poorly sorted coarse muddy brown sands, some shell fragments, echinoderm, no odour.	
15	15	Grab	N/A	G15	Poorly sorted red/brown coarse brown sands, some silts, no odour.	
16	14.7	Grab	N/A	G16	Moderately sorted coarse brown sands, some silts and gravels, no odour.	

Site	Site Depth (m)	Sample Method	Core Depth (m)	Sample ID	Description	Image
17	15.6	Grab	N/A	G17	Poorly sorted coarse brown sands, gravels, cobbles, some fines, no odour.	
18	16	Grab	N/A	G18	Poorly sorted coarse grey/brown sands and shell fragments, no odour.	
19	16	Grab	N/A	G19	Well sorted coarse/medium grained sands, no odour.	

Site	Site Depth (m)	Sample Method	Core Depth (m)	Sample ID	Description	Image
20	16	Grab	N/A	G20	Well sorted shell fragments, gravels and coarse sands, no odour	
21	16	Grab	N/A	G21	Poorly sorted coarse gravels, minimal fines, no odour.	
22	18	Grab	N/A	G22	Poorly sorted brown coarse sand and gravels, minimal fines, no odour.	

Site	Site Depth (m)	Sample Method	Core Depth (m)	Sample ID	Description	Image
23	18	Grab	N/A	G23	Moderately sorted brown coarse sands and gravels with shell fragments, no odour.	
24	18	Grab	N/A	G24	Poorly sorted coarse brown sands and gravels with shell fragments, no odour.	
25	20	Grab	N/A	G25	Poorly sorted brown medium sands with some shell fragments, no odour.	

7 APPENDIX B – SUMMARY DATA

Analyte	Al	Fe	Sb	As	Cd	Cr	Cu	Pb	Mn	Ni	Ag	Zn	Hg	Moist.	TOC
Unit	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	50	0.5	1	0.1	1	1	1	10	1	0.1	1	0.01	0.1	0.02
C1-05	1910	8390	0.25	13.7	0.05	18.2	2.9	2.5	115	6.9	0.05	6.9	0.005	26.5	0.13
C1-1	3700	12800	0.25	15.2	0.05	27	6.4	3.8	197	11.5	0.05	12.5	0.005	28.1	0.15
G2-T1	1950	9290	0.25	15	0.05	18.7	2.5	2.5	179	7.6	0.05	7.6	0.005	21.6	0.1
C3-05	1940	12900	0.25	30.4	0.05	15	2	2.9	279	5	0.05	5.1	0.005	16.2	0.08
C3-1	4000	14000	0.25	21.2	0.05	24.4	5.3	3.7	191	11.1	0.05	7.3	0.005	13.4	0.08
C4-05	1840	10600	0.25	22.4	0.05	14.4	2	2.6	280	5.1	0.05	6.4	0.005	20.2	0.14
C4-1	6170	15700	0.25	16.8	0.05	27.7	6.8	4.8	494	14	0.05	10.4	0.005	21.8	0.08
G5	1630	11100	0.25	27.5	0.05	12.8	1.6	2.5	251	3.9	0.05	5.2	0.005	20.8	0.1
G6	3360	14600	0.25	26	0.05	23.3	4.6	3.7	249	9.6	0.05	10.2	0.005	24.8	0.14
C7-05	2240	11700	0.25	26.5	0.05	18.1	2.7	3	271	6.8	0.05	6.8	0.005	24.9	0.14
C7-1	3240	12800	0.25	21.7	0.05	21.8	5.1	3.5	241	9	0.05	10.1	0.005	19.1	0.12
G8	1730	11300	0.25	28.1	0.05	13.9	1.8	2.8	371	4.7	0.05	6	0.005	21.4	0.1
C9-05	2020	14200	0.25	41	0.05	13.7	2.6	3.4	363	5.5	0.05	5.8	0.005	22.4	0.08
C9-1	2000	13400	0.25	36.6	0.05	13.7	2.3	3.1	336	5.2	0.05	6	0.005	24.3	0.11
G10	3380	12800	0.25	20.8	0.05	22.7	4.8	3.4	224	9.3	0.05	10.7	0.005	20.4	0.16
G11	1320	9490	0.25	25	0.05	12	1.4	2.4	223	4	0.05	4.9	0.005	24.5	0.1
G12	1850	8840	0.25	22.4	0.05	13.4	2.3	2.6	255	5	0.05	5.6	0.005	22.7	0.15
G13	2200	12700	0.25	33.9	0.05	16	2.4	3	248	5.8	0.05	6.4	0.005	25.1	0.12
G14	2350	11000	0.25	22.1	0.05	18	2.8	3	243	6.5	0.05	7.6	0.005	30.1	0.19
G15	1620	6910	0.25	13.4	0.05	15.8	2	2.4	164	5.2	0.05	4.7	0.005	25.2	0.1
G16	2150	12800	0.25	31.8	0.05	15.1	2.2	3.3	342	5.6	0.05	7	0.005	29.1	0.18
G17	1820	11800	0.25	29.3	0.05	12.4	1.8	2.8	354	4.7	0.05	5.8	0.005	21.2	0.13
G18	1620	10800	0.25	26.6	0.05	14.2	1.7	2.5	402	5.3	0.05	5.2	0.005	23.5	0.12

Analyte	Al	Fe	Sb	As	Cd	Cr	Cu	Pb	Mn	Ni	Ag	Zn	Hg	Moist.	TOC
G19	1330	5910	0.25	7.56	0.05	18	2	2.3	92	5.5	0.05	4.2	0.005	23.1	0.07
G20	1770	12500	0.25	32.5	0.05	12.8	1.8	3.1	363	5	0.05	4.8	0.005	21.7	0.11
G21	2530	15700	0.25	28.7	0.05	17.2	4.2	3.9	506	8.6	0.05	7.9	0.005	37	1.7
G22	2370	13500	0.63	45.6	0.1	17.2	2.6	4.3	672	6.4	0.05	6.4	0.005	35.8	2
G23	1480	6860	0.25	17.2	0.05	10.2	1.8	2.2	261	4.1	0.05	4.7	0.005	12.8	2.61
G24	2050	9230	0.25	26.4	0.05	12.7	2.9	3.4	392	5.3	0.05	4.8	0.005	28.9	3.35
G25	2310	8690	0.25	14.1	0.05	16.4	3.1	2.6	381	7.5	0.05	7.3	0.005	33.3	0.17
Mean	2329	11410	0.26	24.6	0.05	16.9	2.9	3.1	298	6.7	0.05	6.8	0.005	24.0	0.43
Median	2010	11750	0.25	25.5	0.05	15.9	2.45	3	266	5.55	0.05	6.4	0.005	23.3	0.13
Min	1320	5910	0.25	7.56	0.05	10.2	1.4	2.2	92	3.9	0.05	4.2	0.005	12.8	0.07
Max	6170	15700	0.63	45.6	0.1	27.7	6.8	4.8	672	14	0.05	12.5	0.005	37	3.35

Analyte	TBT	TRH					PAH																				
		C6 – C9	C10 – C14	C15 – C28	C29 – C36	C10 -C36 (sum)	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b+j)fluoranthen	Benzo(k)fluoranthene	Benzo(e)pyrene	Benzo(a)pyrene	Perylene	Benzo(g.h.i)perylene	Dibenz(a.h)anthracene	Indeno(1.2.3.cd)pyrene	Coronene	Sum of PAHs
Unit	µgSn/kg	mg/kg					µg/kg																				
LOR	0.5	3	3	3	5	3	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4
G2	0.25	1.5	1.5	1.5	2.5	1.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2
G5	0.25	1.5	1.5	1.5	2.5	1.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2
G6	0.25	1.5	1.5	1.5	2.5	1.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2
G8	0.25	1.5	1.5	1.5	2.5	1.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2

Analyte	TBT	TRH					PAH																			
		C6 – C9	C10 – C14	C15 – C28	C29 – C36	C10 -C36 (sum)	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b+j)fluoranthen	Benzo(k)fluoranthene	Benzo(e)pyrene	Benzo(a)pyrene	Perylene	Benzo(g.h.i)perylene	Dibenz(a.h)anthracene	Indeno(1.2.3.cd)pyrene	Coronene	Sum of PAHs
G10	0.25	1.5	1.5	1.5	2.5	1.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2
G12	0.25	1.5	1.5	4	2.5	4	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2
G17	1.4	1.5	1.5	1.5	2.5	1.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2
G23	0.25	1.5	3	5	5	13	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2
Mean	0.4	1.5	1.7	2.3	2.8	3.3	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2
Median	0.25	1.5	1.5	1.5	2.5	1.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2
Min	0.25	1.5	1.5	1.5	2.5	1.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2
Max	1.4	1.5	3	5	5	13	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2

8 APPENDIX C – CORRELATION AND NORMALISATION OF METALS

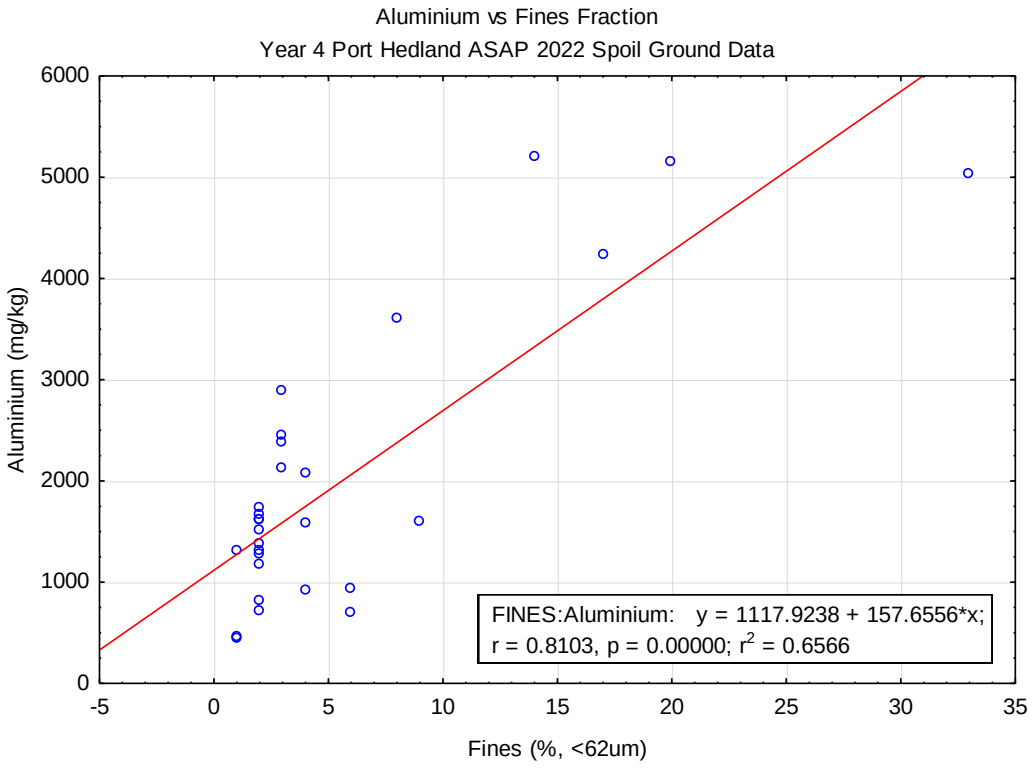
METALS AT SAMPLING SITES

Typically, the concentrations of metals in sediments are strongly affected by the binding capacity of the sediments. One determinant of that capacity is the surface area of sediment available: with small sediment fractions providing a relatively greater area for binding. Thus, the proportion of fines within sediment samples can offer a strong indication of its binding capacity for many metals. As much of the fine component of marine sediments is comprised of aluminosilicate clays, aluminium concentration can be used as a surrogate indicator of binding capacity. The greater the bound component of metals, the lower the bioavailability. Thus, an examination of the relationships of various metals with aluminium concentration and the fines component of sediments aids in interpreting the degree to which metal concentrations may impact marine life.

The fines fraction of sediment used routinely to indicate binding capacity is <62 µm. There was a strong correlation between the <62 µm grain size and the concentration of aluminium in sample collected within Zones A and B (r = 0.85) in the current survey. There was also a strong correlation between the <62 µm grain size and the concentration of aluminium in samples (n=29) obtained at spoil grounds 'I', 7B and 9A in in a recent 2022 survey of those areas (R=0.81) (MScience 2022a). The following calculations are based on the 29 data point from the spoil ground samples collected in the 2022 survey, where the fines component is represented by grain size <62 µm.

<u>Aluminium vs Fines</u>

Aluminium concentration was highly correlated with fines content of the sediments (r= 0.81, p<0) and thus all metals correlations below are tested against aluminium concentration.



Correlations of Metals with Aluminium

Correlation of metals with aluminium concentrations at spoil grounds showed five metals as highly positively correlated ($p < 0.05$) with aluminium and likely to be responding primarily to the surface area of sediment. Regression analysis of those metals (set in red type) provides a predictive equation (in red where $x = \beta*[Al] + \alpha$) for the spoil ground sampling sites.

Element	Correlation (Al)	Slope (β)	Intercept (α)
Chromium	0.84	0.0044	8.15
Nickel	0.96	0.0027	0.89
Arsenic	0.086	0.0007	23.43
Antimony	0.05	2.5597E-6	0.26
Cadmium	0.25	2.333E-6	0.05
Copper	0.94	0.0025	-1.42
Lead	0.94	0.0009	0.59
Manganese	0.45	0.0673	114.23
Silver	-	-	-
Zinc	0.97	0.0036	-1.54
Mercury	-	-	-

NORMALISATION

In comparing the concentrations of COPC with the background concentrations at the potential disposal sites, the NAGD states that this comparison should attempt to correct for differences in sediment characteristics at the test and background sites. This is known as normalisation. The normalisation process used here 'normalises' the background (reference) concentration to provide an estimate of the 80th percentile concentration that would occur at the background site were it to contain a sediment with similar metals binding capacity to that at the test site. As sediment characteristics differed between test sites, a normalised background value has been calculated for each test site.

The steps used in that normalisation were:

1) determine the relationship of the normalising element (here aluminium) and the COPC at the background site (the combined spoil grounds) – such that $[COPC] = \beta*[Al] + \alpha$;
2) input the mean aluminium value from each test sites into that relationship to provide a normalised mean estimate for the COPC at that site; then
3) calculate the 80%ile for the normalised COPC concentration (background concentration) for comparison against the mean reported COPC concentrations for each location at the Port of Port Hedland.

Examining the relationship for arsenic (that did not pass the initial screening test criteria) with aluminium from recent spoil ground data showed that arsenic did not show a significant correlation and could not be normalised.

9 APPENDIX D – LABORATORY CERTIFICATES OF ANALYSIS

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP2205852**	Page	: 1 of 28
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 Western Australia Australia 6065
Telephone	: ----	Telephone	: +61-8-9406 1301
Project	: MSA321 - PPA CEP SAP	Date Samples Received	: 13-May-2022 14:40
Order number	: ----	Date Analysis Commenced	: 18-May-2022
C-O-C number	: ----	Issue Date	: 07-Jun-2022 12:41
Sampler	: Matt Frapple		
Site	: ----		
Quote number	: EP/209/22 - Primary		
No. of samples received	: 39		
No. of samples analysed	: 39		

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, unless the sampling was conducted by ALS. 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*
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, Western Australia
David Viner	SENIOR LAB TECH	Perth Organics, Wangara, Western Australia
Sarah Ashworth	Laboratory Manager - Brisbane	Brisbane Organics, Stafford, QLD
Satishkumar Trivedi	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Vincent Emerton-Bell	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW

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 Contract 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.

- TOC and Organotins conducted by ALS Brisbane, NATA Site No. 818.
- PSD conducted by ALS Newcastle, NATA accreditation no. 825, site no 1656.
- EP080-SD: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP132B-SD: Poor matrix spike recovery due to possible matrix interferences.

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	C1-05	C1-1	G2-T1	G2-T2	G2-T3
			Sampling date / time	05-May-2022 00:00	05-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit	EP2205852-001	EP2205852-002	EP2205852-003	EP2205852-004	EP2205852-005
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	26.5	28.1	----	----	----
Moisture Content	----	1.0	%	----	----	21.6	21.5	22.1
EA150: Particle Sizing								
Clay (<4 µm)	----	1	%	7	6	6	7	6
Silt (4-62 µm)	----	1	%	<1	<1	<1	<1	1
Fine Sand (62-250 µm)	----	1	%	35	31	46	34	30
Medium Sand (250-500 µm)	----	1	%	38	33	34	38	37
Coarse Sand (500-2000 µm)	----	1	%	18	19	13	19	24
Gravel (2000-10000 µm)	----	1	%	2	11	1	2	2
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.56	2.59	2.64	2.62	2.62
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	1910	3700	1950	1890	2110
Iron	7439-89-6	50	mg/kg	8390	12800	9290	10600	10400
EG020-SD: Total Metals in Sediments by ICPMS								
Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic	7440-38-2	1.00	mg/kg	13.7	15.2	15.0	20.8	18.8
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	1.0	mg/kg	18.2	27.0	18.7	16.0	17.9
Copper	7440-50-8	1.0	mg/kg	2.9	6.4	2.5	2.1	2.7
Lead	7439-92-1	1.0	mg/kg	2.5	3.8	2.5	2.5	2.6
Manganese	7439-96-5	10	mg/kg	115	197	179	189	183
Nickel	7440-02-0	1.0	mg/kg	6.9	11.5	7.6	5.8	6.5
Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	1.0	mg/kg	6.9	12.5	7.6	6.8	7.9
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	0.13	0.15	0.10	0.14	0.12
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	----	3	mg/kg	----	----	<3	<3	<3
>C16 - C34 Fraction	----	3	mg/kg	----	----	3	<3	3
>C34 - C40 Fraction	----	5	mg/kg	----	----	<5	<5	<5
>C10 - C40 Fraction (sum)	----	3	mg/kg	----	----	3	<3	3

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	C1-05	C1-1	G2-T1	G2-T2	G2-T3
			Sampling date / time	05-May-2022 00:00	05-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit	EP2205852-001	EP2205852-002	EP2205852-003	EP2205852-004	EP2205852-005
				Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
>C10 - C16 Fraction minus Naphthalene (F2)	----	3	mg/kg	----	----	<3	<3	<3
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	3	mg/kg	----	----	<3	<3	<3
C10 - C14 Fraction	----	3	mg/kg	----	----	<3	<3	<3
C15 - C28 Fraction	----	3	mg/kg	----	----	<3	<3	<3
C29 - C36 Fraction	----	5	mg/kg	----	----	<5	<5	<5
^ C10 - C36 Fraction (sum)	----	3	mg/kg	----	----	<3	<3	<3
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons								
C6 - C10 Fraction	C6_C10	3	mg/kg	----	----	<3	<3	<3
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	3.0	mg/kg	----	----	<3.0	<3.0	<3.0
EP080-SD: BTEXN								
Benzene	71-43-2	0.2	mg/kg	----	----	<0.2	<0.2	<0.2
Toluene	108-88-3	0.2	mg/kg	----	----	<0.2	<0.2	<0.2
Ethylbenzene	100-41-4	0.2	mg/kg	----	----	<0.2	<0.2	<0.2
meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	----	----	<0.2	<0.2	<0.2
ortho-Xylene	95-47-6	0.2	mg/kg	----	----	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg	----	----	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg	----	----	<0.2	<0.2	<0.2
Naphthalene	91-20-3	0.2	mg/kg	----	----	<0.2	<0.2	<0.2
EP090: Organotin Compounds								
Monobutyltin	78763-54-9	1	µgSn/kg	----	----	<1	<1	<1
Dibutyltin	1002-53-5	1	µgSn/kg	----	----	<1	<1	<1
Tributyltin	56573-85-4	0.5	µgSn/kg	----	----	<0.5	<0.5	<0.5
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	5	µg/kg	----	----	<5	<5	<5
2-Methylnaphthalene	91-57-6	5	µg/kg	----	----	<5	<5	<5
Acenaphthylene	208-96-8	4	µg/kg	----	----	<4	<4	<4
Acenaphthene	83-32-9	4	µg/kg	----	----	<4	<4	<4
Fluorene	86-73-7	4	µg/kg	----	----	<4	<4	<4
Phenanthrene	85-01-8	4	µg/kg	----	----	<4	<4	<4
Anthracene	120-12-7	4	µg/kg	----	----	<4	<4	<4
Fluoranthene	206-44-0	4	µg/kg	----	----	<4	<4	<4

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Sample ID	C1-05	C1-1	G2-T1	G2-T2	G2-T3
				Sampling date / time	05-May-2022 00:00	05-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit		EP2205852-001	EP2205852-002	EP2205852-003	EP2205852-004	EP2205852-005
					Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Pyrene	129-00-0	4	µg/kg		----	----	<4	<4	<4
Benz(a)anthracene	56-55-3	4	µg/kg		----	----	<4	<4	<4
Chrysene	218-01-9	4	µg/kg		----	----	<4	<4	<4
Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg		----	----	<4	<4	<4
Benzo(k)fluoranthene	207-08-9	4	µg/kg		----	----	<4	<4	<4
Benzo(e)pyrene	192-97-2	4	µg/kg		----	----	<4	<4	<4
Benzo(a)pyrene	50-32-8	4	µg/kg		----	----	<4	<4	<4
Perylene	198-55-0	4	µg/kg		----	----	<4	<4	<4
Benzo(g.h.i)perylene	191-24-2	4	µg/kg		----	----	<4	<4	<4
Dibenz(a.h)anthracene	53-70-3	4	µg/kg		----	----	<4	<4	<4
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg		----	----	<4	<4	<4
Coronene	191-07-1	5	µg/kg		----	----	<5	<5	<5
^ Sum of PAHs	----	4	µg/kg		----	----	<4	<4	<4
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg		----	----	<4	<4	<4
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg		----	----	5	5	5
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg		----	----	10	10	10
EP080-SD: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		----	----	91.0	87.1	94.8
Toluene-D8	2037-26-5	0.2	%		----	----	96.4	91.2	96.2
4-Bromofluorobenzene	460-00-4	0.2	%		----	----	103	98.4	106
EP090S: Organotin Surrogate									
Tripropyltin	----	0.5	%		----	----	128	126	126
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	10	%		----	----	115	115	97.8
Anthracene-d10	1719-06-8	10	%		----	----	106	105	116
4-Terphenyl-d14	1718-51-0	10	%		----	----	117	114	113

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	C3-05	C3-1	C4-05	C4-1	G5-S1
			Sampling date / time	05-May-2022 00:00	05-May-2022 00:00	05-May-2022 00:00	05-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit	EP2205852-006	EP2205852-007	EP2205852-008	EP2205852-009	EP2205852-010
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	16.2	13.4	20.2	21.8	----
Moisture Content	----	1.0	%	----	----	----	----	20.8
EA150: Particle Sizing								
Clay (<4 µm)	----	1	%	7	12	9	23	4
Silt (4-62 µm)	----	1	%	3	4	4	16	1
Fine Sand (62-250 µm)	----	1	%	4	5	13	12	2
Medium Sand (250-500 µm)	----	1	%	13	12	15	11	14
Coarse Sand (500-2000 µm)	----	1	%	40	29	20	17	58
Gravel (2000-10000 µm)	----	1	%	33	38	39	21	21
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.63	2.63	2.63	2.54	2.63
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	1940	4000	1840	6170	1630
Iron	7439-89-6	50	mg/kg	12900	14000	10600	15700	11100
EG020-SD: Total Metals in Sediments by ICPMS								
Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic	7440-38-2	1.00	mg/kg	30.4	21.2	22.4	16.8	27.5
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	1.0	mg/kg	15.0	24.4	14.4	27.7	12.8
Copper	7440-50-8	1.0	mg/kg	2.0	5.3	2.0	6.8	1.6
Lead	7439-92-1	1.0	mg/kg	2.9	3.7	2.6	4.8	2.5
Manganese	7439-96-5	10	mg/kg	279	191	280	494	251
Nickel	7440-02-0	1.0	mg/kg	5.0	11.1	5.1	14.0	3.9
Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	1.0	mg/kg	5.1	7.3	6.4	10.4	5.2
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	0.08	0.08	0.14	0.08	0.10
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	----	3	mg/kg	----	----	----	----	<3
>C16 - C34 Fraction	----	3	mg/kg	----	----	----	----	<3
>C34 - C40 Fraction	----	5	mg/kg	----	----	----	----	<5
>C10 - C40 Fraction (sum)	----	3	mg/kg	----	----	----	----	<3

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	C3-05	C3-1	C4-05	C4-1	G5-S1
			Sampling date / time	05-May-2022 00:00	05-May-2022 00:00	05-May-2022 00:00	05-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit	EP2205852-006	EP2205852-007	EP2205852-008	EP2205852-009	EP2205852-010
				Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
>C10 - C16 Fraction minus Naphthalene (F2)	----	3	mg/kg	----	----	----	----	<3
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	3	mg/kg	----	----	----	----	<3
C10 - C14 Fraction	----	3	mg/kg	----	----	----	----	<3
C15 - C28 Fraction	----	3	mg/kg	----	----	----	----	<3
C29 - C36 Fraction	----	5	mg/kg	----	----	----	----	<5
^ C10 - C36 Fraction (sum)	----	3	mg/kg	----	----	----	----	<3
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons								
C6 - C10 Fraction	C6_C10	3	mg/kg	----	----	----	----	<3
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	3.0	mg/kg	----	----	----	----	<3.0
EP080-SD: BTEXN								
Benzene	71-43-2	0.2	mg/kg	----	----	----	----	<0.2
Toluene	108-88-3	0.2	mg/kg	----	----	----	----	<0.2
Ethylbenzene	100-41-4	0.2	mg/kg	----	----	----	----	<0.2
meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	----	----	----	----	<0.2
ortho-Xylene	95-47-6	0.2	mg/kg	----	----	----	----	<0.2
^ Total Xylenes	----	0.5	mg/kg	----	----	----	----	<0.5
^ Sum of BTEX	----	0.2	mg/kg	----	----	----	----	<0.2
Naphthalene	91-20-3	0.2	mg/kg	----	----	----	----	<0.2
EP090: Organotin Compounds								
Monobutyltin	78763-54-9	1	µgSn/kg	----	----	----	----	<1
Dibutyltin	1002-53-5	1	µgSn/kg	----	----	----	----	<1
Tributyltin	56573-85-4	0.5	µgSn/kg	----	----	----	----	<0.5
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	5	µg/kg	----	----	----	----	<5
2-Methylnaphthalene	91-57-6	5	µg/kg	----	----	----	----	<5
Acenaphthylene	208-96-8	4	µg/kg	----	----	----	----	<4
Acenaphthene	83-32-9	4	µg/kg	----	----	----	----	<4
Fluorene	86-73-7	4	µg/kg	----	----	----	----	<4
Phenanthrene	85-01-8	4	µg/kg	----	----	----	----	<4
Anthracene	120-12-7	4	µg/kg	----	----	----	----	<4
Fluoranthene	206-44-0	4	µg/kg	----	----	----	----	<4

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	C3-05	C3-1	C4-05	C4-1	G5-S1
			Sampling date / time	05-May-2022 00:00	05-May-2022 00:00	05-May-2022 00:00	05-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit	EP2205852-006	EP2205852-007	EP2205852-008	EP2205852-009	EP2205852-010
				Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued								
Pyrene	129-00-0	4	µg/kg	----	----	----	----	<4
Benz(a)anthracene	56-55-3	4	µg/kg	----	----	----	----	<4
Chrysene	218-01-9	4	µg/kg	----	----	----	----	<4
Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	----	----	----	----	<4
Benzo(k)fluoranthene	207-08-9	4	µg/kg	----	----	----	----	<4
Benzo(e)pyrene	192-97-2	4	µg/kg	----	----	----	----	<4
Benzo(a)pyrene	50-32-8	4	µg/kg	----	----	----	----	<4
Perylene	198-55-0	4	µg/kg	----	----	----	----	<4
Benzo(g.h.i)perylene	191-24-2	4	µg/kg	----	----	----	----	<4
Dibenz(a.h)anthracene	53-70-3	4	µg/kg	----	----	----	----	<4
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	----	----	----	----	<4
Coronene	191-07-1	5	µg/kg	----	----	----	----	<5
^ Sum of PAHs	----	4	µg/kg	----	----	----	----	<4
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg	----	----	----	----	<4
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg	----	----	----	----	5
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg	----	----	----	----	10
EP080-SD: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	----	----	----	----	92.6
Toluene-D8	2037-26-5	0.2	%	----	----	----	----	94.2
4-Bromofluorobenzene	460-00-4	0.2	%	----	----	----	----	105
EP090S: Organotin Surrogate								
Tripropyltin	----	0.5	%	----	----	----	----	124
EP132T: Base/Neutral Extractable Surrogates								
2-Fluorobiphenyl	321-60-8	10	%	----	----	----	----	93.7
Anthracene-d10	1719-06-8	10	%	----	----	----	----	120
4-Terphenyl-d14	1718-51-0	10	%	----	----	----	----	102

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	G5-S2	G6	C7-05	C7-1	G8
			Sampling date / time	07-May-2022 00:00	07-May-2022 00:00	05-May-2022 00:00	05-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit	EP2205852-011	EP2205852-012	EP2205852-013	EP2205852-014	EP2205852-015
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	----	----	24.9	19.1	----
Moisture Content	----	1.0	%	21.5	24.8	----	----	21.4
EA150: Particle Sizing								
Clay (<4 µm)	----	1	%	5	10	8	9	6
Silt (4-62 µm)	----	1	%	1	2	4	3	2
Fine Sand (62-250 µm)	----	1	%	2	22	13	11	2
Medium Sand (250-500 µm)	----	1	%	12	13	17	12	22
Coarse Sand (500-2000 µm)	----	1	%	52	31	33	24	52
Gravel (2000-10000 µm)	----	1	%	28	22	25	41	16
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.62	2.60	2.61	2.61	2.63
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	1900	3360	2240	3240	1730
Iron	7439-89-6	50	mg/kg	12300	14600	11700	12800	11300
EG020-SD: Total Metals in Sediments by ICPMS								
Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic	7440-38-2	1.00	mg/kg	30.2	26.0	26.5	21.7	28.1
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	1.0	mg/kg	15.7	23.3	18.1	21.8	13.9
Copper	7440-50-8	1.0	mg/kg	2.2	4.6	2.7	5.1	1.8
Lead	7439-92-1	1.0	mg/kg	3.3	3.7	3.0	3.5	2.8
Manganese	7439-96-5	10	mg/kg	322	249	271	241	371
Nickel	7440-02-0	1.0	mg/kg	4.7	9.6	6.8	9.0	4.7
Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	1.0	mg/kg	5.9	10.2	6.8	10.1	6.0
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	0.10	0.14	0.14	0.12	0.10
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	----	3	mg/kg	<3	<3	----	----	<3
>C16 - C34 Fraction	----	3	mg/kg	<3	<3	----	----	<3
>C34 - C40 Fraction	----	5	mg/kg	<5	<5	----	----	<5
>C10 - C40 Fraction (sum)	----	3	mg/kg	<3	<3	----	----	<3

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	G5-S2	G6	C7-05	C7-1	G8
			Sampling date / time	07-May-2022 00:00	07-May-2022 00:00	05-May-2022 00:00	05-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit	EP2205852-011	EP2205852-012	EP2205852-013	EP2205852-014	EP2205852-015
				Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
>C10 - C16 Fraction minus Naphthalene (F2)	----	3	mg/kg	<3	<3	----	----	<3
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	3	mg/kg	<3	<3	----	----	<3
C10 - C14 Fraction	----	3	mg/kg	<3	<3	----	----	<3
C15 - C28 Fraction	----	3	mg/kg	<3	<3	----	----	<3
C29 - C36 Fraction	----	5	mg/kg	<5	<5	----	----	<5
^ C10 - C36 Fraction (sum)	----	3	mg/kg	<3	<3	----	----	<3
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons								
C6 - C10 Fraction	C6_C10	3	mg/kg	<3	<3	----	----	<3
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	3.0	mg/kg	<3.0	<3.0	----	----	<3.0
EP080-SD: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	----	----	<0.2
Toluene	108-88-3	0.2	mg/kg	<0.2	<0.2	----	----	<0.2
Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	<0.2	----	----	<0.2
meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	<0.2	----	----	<0.2
ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	<0.2	----	----	<0.2
^ Total Xylenes	----	0.5	mg/kg	<0.5	<0.5	----	----	<0.5
^ Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	----	----	<0.2
Naphthalene	91-20-3	0.2	mg/kg	<0.2	<0.2	----	----	<0.2
EP090: Organotin Compounds								
Monobutyltin	78763-54-9	1	µgSn/kg	<1	<1	----	----	<1
Dibutyltin	1002-53-5	1	µgSn/kg	<1	<1	----	----	<1
Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	----	----	<0.5
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	5	µg/kg	<5	<5	----	----	<5
2-Methylnaphthalene	91-57-6	5	µg/kg	<5	<5	----	----	<5
Acenaphthylene	208-96-8	4	µg/kg	<4	<4	----	----	<4
Acenaphthene	83-32-9	4	µg/kg	<4	<4	----	----	<4
Fluorene	86-73-7	4	µg/kg	<4	<4	----	----	<4
Phenanthrene	85-01-8	4	µg/kg	<4	<4	----	----	<4
Anthracene	120-12-7	4	µg/kg	<4	<4	----	----	<4
Fluoranthene	206-44-0	4	µg/kg	<4	<4	----	----	<4

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	G5-S2	G6	C7-05	C7-1	G8
			Sampling date / time	07-May-2022 00:00	07-May-2022 00:00	05-May-2022 00:00	05-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit	EP2205852-011	EP2205852-012	EP2205852-013	EP2205852-014	EP2205852-015
				Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued								
Pyrene	129-00-0	4	µg/kg	<4	<4	----	----	<4
Benz(a)anthracene	56-55-3	4	µg/kg	<4	<4	----	----	<4
Chrysene	218-01-9	4	µg/kg	<4	<4	----	----	<4
Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	<4	<4	----	----	<4
Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	<4	----	----	<4
Benzo(e)pyrene	192-97-2	4	µg/kg	<4	<4	----	----	<4
Benzo(a)pyrene	50-32-8	4	µg/kg	<4	<4	----	----	<4
Perylene	198-55-0	4	µg/kg	<4	<4	----	----	<4
Benzo(g.h.i)perylene	191-24-2	4	µg/kg	<4	<4	----	----	<4
Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	<4	----	----	<4
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	----	----	<4
Coronene	191-07-1	5	µg/kg	<5	<5	----	----	<5
^ Sum of PAHs	----	4	µg/kg	<4	<4	----	----	<4
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg	<4	<4	----	----	<4
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg	**5**	**5**	----	----	**5**
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg	**10**	**10**	----	----	**10**
EP080-SD: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	**91.9**	**83.6**	----	----	**92.3**
Toluene-D8	2037-26-5	0.2	%	**92.1**	**95.5**	----	----	**92.1**
4-Bromofluorobenzene	460-00-4	0.2	%	**101**	**99.9**	----	----	**103**
EP090S: Organotin Surrogate								
Tripropyltin	----	0.5	%	**109**	**130**	----	----	**126**
EP132T: Base/Neutral Extractable Surrogates								
2-Fluorobiphenyl	321-60-8	10	%	**74.0**	**84.2**	----	----	**78.9**
Anthracene-d10	1719-06-8	10	%	**79.1**	**103**	----	----	**84.8**
4-Terphenyl-d14	1718-51-0	10	%	**85.2**	**93.0**	----	----	**81.5**

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	C9-05	C9-1	G10	G11	G12-T1
			Sampling date / time	05-May-2022 00:00	05-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit	EP2205852-016	EP2205852-017	EP2205852-018	EP2205852-019	EP2205852-020
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	22.4	24.3	----	24.5	----
Moisture Content	----	1.0	%	----	----	20.4	----	22.7
EA150: Particle Sizing								
Clay (<4 µm)	----	1	%	4	5	8	2	3
Silt (4-62 µm)	----	1	%	<1	<1	3	<1	<1
Fine Sand (62-250 µm)	----	1	%	1	<1	9	6	5
Medium Sand (250-500 µm)	----	1	%	4	3	15	32	21
Coarse Sand (500-2000 µm)	----	1	%	68	64	36	36	56
Gravel (2000-10000 µm)	----	1	%	23	28	29	24	15
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.63	2.64	2.61	2.63	2.62
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	2020	2000	3380	1320	1850
Iron	7439-89-6	50	mg/kg	14200	13400	12800	9490	8840
EG020-SD: Total Metals in Sediments by ICPMS								
Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic	7440-38-2	1.00	mg/kg	41.0	36.6	20.8	25.0	22.4
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	1.0	mg/kg	13.7	13.7	22.7	12.0	13.4
Copper	7440-50-8	1.0	mg/kg	2.6	2.3	4.8	1.4	2.3
Lead	7439-92-1	1.0	mg/kg	3.4	3.1	3.4	2.4	2.6
Manganese	7439-96-5	10	mg/kg	363	336	224	223	255
Nickel	7440-02-0	1.0	mg/kg	5.5	5.2	9.3	4.0	5.0
Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	1.0	mg/kg	5.8	6.0	10.7	4.9	5.6
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	0.08	0.11	0.16	0.10	0.15
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	----	3	mg/kg	----	----	<3	----	<3
>C16 - C34 Fraction	----	3	mg/kg	----	----	<3	----	<3
>C34 - C40 Fraction	----	5	mg/kg	----	----	<5	----	<5
>C10 - C40 Fraction (sum)	----	3	mg/kg	----	----	<3	----	<3

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	C9-05	C9-1	G10	G11	G12-T1
			Sampling date / time	05-May-2022 00:00	05-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit	EP2205852-016	EP2205852-017	EP2205852-018	EP2205852-019	EP2205852-020
				Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
>C10 - C16 Fraction minus Naphthalene (F2)	----	3	mg/kg	----	----	<3	----	<3
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	3	mg/kg	----	----	<3	----	<3
C10 - C14 Fraction	----	3	mg/kg	----	----	<3	----	<3
C15 - C28 Fraction	----	3	mg/kg	----	----	<3	----	<3
C29 - C36 Fraction	----	5	mg/kg	----	----	<5	----	<5
^ C10 - C36 Fraction (sum)	----	3	mg/kg	----	----	<3	----	<3
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons								
C6 - C10 Fraction	C6_C10	3	mg/kg	----	----	<3	----	<3
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	3.0	mg/kg	----	----	<3.0	----	<3.0
EP080-SD: BTEXN								
Benzene	71-43-2	0.2	mg/kg	----	----	<0.2	----	<0.2
Toluene	108-88-3	0.2	mg/kg	----	----	<0.2	----	<0.2
Ethylbenzene	100-41-4	0.2	mg/kg	----	----	<0.2	----	<0.2
meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	----	----	<0.2	----	<0.2
ortho-Xylene	95-47-6	0.2	mg/kg	----	----	<0.2	----	<0.2
^ Total Xylenes	----	0.5	mg/kg	----	----	<0.5	----	<0.5
^ Sum of BTEX	----	0.2	mg/kg	----	----	<0.2	----	<0.2
Naphthalene	91-20-3	0.2	mg/kg	----	----	<0.2	----	<0.2
EP090: Organotin Compounds								
Monobutyltin	78763-54-9	1	µgSn/kg	----	----	<1	----	<1
Dibutyltin	1002-53-5	1	µgSn/kg	----	----	<1	----	<1
Tributyltin	56573-85-4	0.5	µgSn/kg	----	----	<0.5	----	<0.5
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	5	µg/kg	----	----	<5	----	<5
2-Methylnaphthalene	91-57-6	5	µg/kg	----	----	<5	----	<5
Acenaphthylene	208-96-8	4	µg/kg	----	----	<4	----	<4
Acenaphthene	83-32-9	4	µg/kg	----	----	<4	----	<4
Fluorene	86-73-7	4	µg/kg	----	----	<4	----	<4
Phenanthrene	85-01-8	4	µg/kg	----	----	<4	----	<4
Anthracene	120-12-7	4	µg/kg	----	----	<4	----	<4
Fluoranthene	206-44-0	4	µg/kg	----	----	<4	----	<4

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	C9-05	C9-1	G10	G11	G12-T1
			Sampling date / time	05-May-2022 00:00	05-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit	EP2205852-016	EP2205852-017	EP2205852-018	EP2205852-019	EP2205852-020
				Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued								
Pyrene	129-00-0	4	µg/kg	----	----	<4	----	<4
Benz(a)anthracene	56-55-3	4	µg/kg	----	----	<4	----	<4
Chrysene	218-01-9	4	µg/kg	----	----	<4	----	<4
Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	----	----	<4	----	<4
Benzo(k)fluoranthene	207-08-9	4	µg/kg	----	----	<4	----	<4
Benzo(e)pyrene	192-97-2	4	µg/kg	----	----	<4	----	<4
Benzo(a)pyrene	50-32-8	4	µg/kg	----	----	<4	----	<4
Perylene	198-55-0	4	µg/kg	----	----	<4	----	<4
Benzo(g.h.i)perylene	191-24-2	4	µg/kg	----	----	<4	----	<4
Dibenz(a.h)anthracene	53-70-3	4	µg/kg	----	----	<4	----	<4
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	----	----	<4	----	<4
Coronene	191-07-1	5	µg/kg	----	----	<5	----	<5
^ Sum of PAHs	----	4	µg/kg	----	----	<4	----	<4
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg	----	----	<4	----	<4
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg	----	----	5	----	5
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg	----	----	10	----	10
EP080-SD: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	----	----	103	----	96.8
Toluene-D8	2037-26-5	0.2	%	----	----	102	----	101
4-Bromofluorobenzene	460-00-4	0.2	%	----	----	112	----	110
EP090S: Organotin Surrogate								
Tripropyltin	----	0.5	%	----	----	122	----	116
EP132T: Base/Neutral Extractable Surrogates								
2-Fluorobiphenyl	321-60-8	10	%	----	----	103	----	96.8
Anthracene-d10	1719-06-8	10	%	----	----	118	----	110
4-Terphenyl-d14	1718-51-0	10	%	----	----	105	----	114

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	G12-T2	G12-T3	G13	G14	G15
			Sampling date / time	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit	EP2205852-021	EP2205852-022	EP2205852-023	EP2205852-024	EP2205852-025
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	----	----	25.1	30.1	25.2
Moisture Content	----	1.0	%	17.4	22.6	----	----	----
EA150: Particle Sizing								
Clay (<4 µm)	----	1	%	4	6	4	7	5
Silt (4-62 µm)	----	1	%	2	1	<1	<1	<1
Fine Sand (62-250 µm)	----	1	%	2	3	8	12	7
Medium Sand (250-500 µm)	----	1	%	10	8	19	25	17
Coarse Sand (500-2000 µm)	----	1	%	38	34	38	45	37
Gravel (2000-10000 µm)	----	1	%	44	48	31	11	34
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.62	2.60	2.61	2.60	2.62
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	2210	2690	2200	2350	1620
Iron	7439-89-6	50	mg/kg	11600	10300	12700	11000	6910
EG020-SD: Total Metals in Sediments by ICPMS								
Antimony	7440-36-0	0.50	mg/kg	0.52	<0.50	<0.50	<0.50	<0.50
Arsenic	7440-38-2	1.00	mg/kg	32.8	22.4	33.9	22.1	13.4
Cadmium	7440-43-9	0.1	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	1.0	mg/kg	19.2	17.5	16.0	18.0	15.8
Copper	7440-50-8	1.0	mg/kg	2.9	3.8	2.4	2.8	2.0
Lead	7439-92-1	1.0	mg/kg	4.5	3.4	3.0	3.0	2.4
Manganese	7439-96-5	10	mg/kg	335	298	248	243	164
Nickel	7440-02-0	1.0	mg/kg	7.7	7.1	5.8	6.5	5.2
Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	1.0	mg/kg	6.7	8.2	6.4	7.6	4.7
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	0.17	0.18	0.12	0.19	0.10
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	----	3	mg/kg	<3	<3	----	----	----
>C16 - C34 Fraction	----	3	mg/kg	5	<3	----	----	----
>C34 - C40 Fraction	----	5	mg/kg	<5	<5	----	----	----
>C10 - C40 Fraction (sum)	----	3	mg/kg	5	<3	----	----	----

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	G12-T2	G12-T3	G13	G14	G15
			Sampling date / time	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit	EP2205852-021	EP2205852-022	EP2205852-023	EP2205852-024	EP2205852-025
				Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
>C10 - C16 Fraction minus Naphthalene (F2)	----	3	mg/kg	<3	<3	----	----	----
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	3	mg/kg	<3	<3	----	----	----
C10 - C14 Fraction	----	3	mg/kg	<3	<3	----	----	----
C15 - C28 Fraction	----	3	mg/kg	4	<3	----	----	----
C29 - C36 Fraction	----	5	mg/kg	<5	<5	----	----	----
^ C10 - C36 Fraction (sum)	----	3	mg/kg	4	<3	----	----	----
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons								
C6 - C10 Fraction	C6_C10	3	mg/kg	<3	<3	----	----	----
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	3.0	mg/kg	<3.0	<3.0	----	----	----
EP080-SD: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	----	----	----
Toluene	108-88-3	0.2	mg/kg	<0.2	<0.2	----	----	----
Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	<0.2	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	<0.2	----	----	----
ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	<0.2	----	----	----
^ Total Xylenes	----	0.5	mg/kg	<0.5	<0.5	----	----	----
^ Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	----	----	----
Naphthalene	91-20-3	0.2	mg/kg	<0.2	<0.2	----	----	----
EP090: Organotin Compounds								
Monobutyltin	78763-54-9	1	µgSn/kg	<1	<1	----	----	----
Dibutyltin	1002-53-5	1	µgSn/kg	<1	<1	----	----	----
Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	----	----	----
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	5	µg/kg	<5	<5	----	----	----
2-Methylnaphthalene	91-57-6	5	µg/kg	<5	<5	----	----	----
Acenaphthylene	208-96-8	4	µg/kg	<4	<4	----	----	----
Acenaphthene	83-32-9	4	µg/kg	<4	<4	----	----	----
Fluorene	86-73-7	4	µg/kg	<4	<4	----	----	----
Phenanthrene	85-01-8	4	µg/kg	<4	<4	----	----	----
Anthracene	120-12-7	4	µg/kg	<4	<4	----	----	----
Fluoranthene	206-44-0	4	µg/kg	<4	<4	----	----	----

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	G12-T2	G12-T3	G13	G14	G15
			Sampling date / time	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit	EP2205852-021	EP2205852-022	EP2205852-023	EP2205852-024	EP2205852-025
				Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued								
Pyrene	129-00-0	4	µg/kg	<4	<4	----	----	----
Benz(a)anthracene	56-55-3	4	µg/kg	<4	<4	----	----	----
Chrysene	218-01-9	4	µg/kg	<4	<4	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	<4	<4	----	----	----
Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	<4	----	----	----
Benzo(e)pyrene	192-97-2	4	µg/kg	<4	<4	----	----	----
Benzo(a)pyrene	50-32-8	4	µg/kg	<4	<4	----	----	----
Perylene	198-55-0	4	µg/kg	<4	<4	----	----	----
Benzo(g.h.i)perylene	191-24-2	4	µg/kg	<4	<4	----	----	----
Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	<4	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	----	----	----
Coronene	191-07-1	5	µg/kg	<5	<5	----	----	----
^ Sum of PAHs	----	4	µg/kg	<4	<4	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg	<4	<4	----	----	----
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg	**5**	**5**	----	----	----
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg	**10**	**10**	----	----	----
EP080-SD: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	**97.9**	**98.6**	----	----	----
Toluene-D8	2037-26-5	0.2	%	**101**	**101**	----	----	----
4-Bromofluorobenzene	460-00-4	0.2	%	**112**	**109**	----	----	----
EP090S: Organotin Surrogate								
Tripropyltin	----	0.5	%	**108**	**122**	----	----	----
EP132T: Base/Neutral Extractable Surrogates								
2-Fluorobiphenyl	321-60-8	10	%	**106**	**95.0**	----	----	----
Anthracene-d10	1719-06-8	10	%	**89.7**	**105**	----	----	----
4-Terphenyl-d14	1718-51-0	10	%	**124**	**88.8**	----	----	----

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	G16	G17-S1	G17-S2	G18	G19
			Sampling date / time	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit	EP2205852-026	EP2205852-027	EP2205852-028	EP2205852-029	EP2205852-030
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	29.1	----	----	23.5	23.1
Moisture Content	----	1.0	%	----	21.2	21.8	----	----
EA150: Particle Sizing								
Clay (<4 µm)	----	1	%	5	5	3	3	4
Silt (4-62 µm)	----	1	%	<1	1	<1	<1	<1
Fine Sand (62-250 µm)	----	1	%	5	4	3	16	26
Medium Sand (250-500 µm)	----	1	%	25	10	8	14	27
Coarse Sand (500-2000 µm)	----	1	%	48	35	35	36	30
Gravel (2000-10000 µm)	----	1	%	17	45	51	31	13
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.59	2.62	2.63	2.61	2.62
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	2150	1820	2040	1620	1330
Iron	7439-89-6	50	mg/kg	12800	11800	14200	10800	5910
EG020-SD: Total Metals in Sediments by ICPMS								
Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic	7440-38-2	1.00	mg/kg	31.8	29.3	36.6	26.6	7.56
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	1.0	mg/kg	15.1	12.4	14.3	14.2	18.0
Copper	7440-50-8	1.0	mg/kg	2.2	1.8	1.9	1.7	2.0
Lead	7439-92-1	1.0	mg/kg	3.3	2.8	3.3	2.5	2.3
Manganese	7439-96-5	10	mg/kg	342	354	398	402	92
Nickel	7440-02-0	1.0	mg/kg	5.6	4.7	5.2	5.3	5.5
Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	1.0	mg/kg	7.0	5.8	6.5	5.2	4.2
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	0.18	0.13	0.17	0.12	0.07
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	----	3	mg/kg	----	<3	<3	----	----
>C16 - C34 Fraction	----	3	mg/kg	----	5	<3	----	----
>C34 - C40 Fraction	----	5	mg/kg	----	<5	<5	----	----
>C10 - C40 Fraction (sum)	----	3	mg/kg	----	5	<3	----	----

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	G16	G17-S1	G17-S2	G18	G19
			Sampling date / time	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit	EP2205852-026	EP2205852-027	EP2205852-028	EP2205852-029	EP2205852-030
				Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
>C10 - C16 Fraction minus Naphthalene (F2)	----	3	mg/kg	----	<3	<3	----	----
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	3	mg/kg	----	<3	<3	----	----
C10 - C14 Fraction	----	3	mg/kg	----	<3	<3	----	----
C15 - C28 Fraction	----	3	mg/kg	----	<3	<3	----	----
C29 - C36 Fraction	----	5	mg/kg	----	<5	<5	----	----
^ C10 - C36 Fraction (sum)	----	3	mg/kg	----	<3	<3	----	----
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons								
C6 - C10 Fraction	C6_C10	3	mg/kg	----	<3	<3	----	----
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	3.0	mg/kg	----	<3.0	<3.0	----	----
EP080-SD: BTEXN								
Benzene	71-43-2	0.2	mg/kg	----	<0.2	<0.2	----	----
Toluene	108-88-3	0.2	mg/kg	----	<0.2	<0.2	----	----
Ethylbenzene	100-41-4	0.2	mg/kg	----	<0.2	<0.2	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	----	<0.2	<0.2	----	----
ortho-Xylene	95-47-6	0.2	mg/kg	----	<0.2	<0.2	----	----
^ Total Xylenes	----	0.5	mg/kg	----	<0.5	<0.5	----	----
^ Sum of BTEX	----	0.2	mg/kg	----	<0.2	<0.2	----	----
Naphthalene	91-20-3	0.2	mg/kg	----	<0.2	<0.2	----	----
EP090: Organotin Compounds								
Monobutyltin	78763-54-9	1	µgSn/kg	----	<1	<1	----	----
Dibutyltin	1002-53-5	1	µgSn/kg	----	**3**	<1	----	----
Tributyltin	56573-85-4	0.5	µgSn/kg	----	**2.6**	<0.5	----	----
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	5	µg/kg	----	<5	<5	----	----
2-Methylnaphthalene	91-57-6	5	µg/kg	----	<5	<5	----	----
Acenaphthylene	208-96-8	4	µg/kg	----	<4	<4	----	----
Acenaphthene	83-32-9	4	µg/kg	----	<4	<4	----	----
Fluorene	86-73-7	4	µg/kg	----	<4	<4	----	----
Phenanthrene	85-01-8	4	µg/kg	----	<4	<4	----	----
Anthracene	120-12-7	4	µg/kg	----	<4	<4	----	----
Fluoranthene	206-44-0	4	µg/kg	----	<4	<4	----	----

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Sample ID	G16	G17-S1	G17-S2	G18	G19
				Sampling date / time	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit		EP2205852-026	EP2205852-027	EP2205852-028	EP2205852-029	EP2205852-030
					Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Pyrene	129-00-0	4	µg/kg		----	<4	<4	----	----
Benz(a)anthracene	56-55-3	4	µg/kg		----	<4	<4	----	----
Chrysene	218-01-9	4	µg/kg		----	<4	<4	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg		----	<4	<4	----	----
Benzo(k)fluoranthene	207-08-9	4	µg/kg		----	<4	<4	----	----
Benzo(e)pyrene	192-97-2	4	µg/kg		----	<4	<4	----	----
Benzo(a)pyrene	50-32-8	4	µg/kg		----	<4	<4	----	----
Perylene	198-55-0	4	µg/kg		----	<4	<4	----	----
Benzo(g.h.i)perylene	191-24-2	4	µg/kg		----	<4	<4	----	----
Dibenz(a.h)anthracene	53-70-3	4	µg/kg		----	<4	<4	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg		----	<4	<4	----	----
Coronene	191-07-1	5	µg/kg		----	<5	<5	----	----
^ Sum of PAHs	----	4	µg/kg		----	<4	<4	----	----
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg		----	<4	<4	----	----
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg		----	5	5	----	----
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg		----	10	10	----	----
EP080-SD: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		----	105	98.0	----	----
Toluene-D8	2037-26-5	0.2	%		----	109	102	----	----
4-Bromofluorobenzene	460-00-4	0.2	%		----	117	108	----	----
EP090S: Organotin Surrogate									
Tripropyltin	----	0.5	%		----	124	126	----	----
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	10	%		----	100	91.4	----	----
Anthracene-d10	1719-06-8	10	%		----	89.4	88.6	----	----
4-Terphenyl-d14	1718-51-0	10	%		----	97.0	94.4	----	----

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	G20	G21	G22	G23-T1	G23-T2
			Sampling date / time	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit	EP2205852-031	EP2205852-032	EP2205852-033	EP2205852-034	EP2205852-035
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	21.7	37.0	35.8	----	----
Moisture Content	----	1.0	%	----	----	----	12.8	29.1
EA150: Particle Sizing								
Clay (<4 µm)	----	1	%	2	5	6	5	7
Silt (4-62 µm)	----	1	%	<1	1	<1	<1	<1
Fine Sand (62-250 µm)	----	1	%	1	5	7	11	11
Medium Sand (250-500 µm)	----	1	%	13	5	23	16	15
Coarse Sand (500-2000 µm)	----	1	%	66	33	60	56	59
Gravel (2000-10000 µm)	----	1	%	18	51	4	12	8
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.65	2.60	2.65	2.59	2.55
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	1770	2530	2370	1480	2560
Iron	7439-89-6	50	mg/kg	12500	15700	13500	6860	8900
EG020-SD: Total Metals in Sediments by ICPMS								
Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	0.63	<0.50	<0.50
Arsenic	7440-38-2	1.00	mg/kg	32.5	28.7	45.6	17.2	16.9
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.1	<0.1	<0.1
Chromium	7440-47-3	1.0	mg/kg	12.8	17.2	17.2	10.2	16.0
Copper	7440-50-8	1.0	mg/kg	1.8	4.2	2.6	1.8	3.2
Lead	7439-92-1	1.0	mg/kg	3.1	3.9	4.3	2.2	3.0
Manganese	7439-96-5	10	mg/kg	363	506	672	261	286
Nickel	7440-02-0	1.0	mg/kg	5.0	8.6	6.4	4.1	6.6
Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	1.0	mg/kg	4.8	7.9	6.4	4.7	7.1
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	0.11	1.70	2.00	2.61	2.81
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	----	3	mg/kg	----	----	----	<3	<3
>C16 - C34 Fraction	----	3	mg/kg	----	----	----	<3	<3
>C34 - C40 Fraction	----	5	mg/kg	----	----	----	<5	<5
>C10 - C40 Fraction (sum)	----	3	mg/kg	----	----	----	<3	<3

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Sample ID	G20	G21	G22	G23-T1	G23-T2
				Sampling date / time	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit		EP2205852-031	EP2205852-032	EP2205852-033	EP2205852-034	EP2205852-035
					Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued									
>C10 - C16 Fraction minus Naphthalene (F2)	----	3	mg/kg		----	----	----	<3	<3
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	3	mg/kg		----	----	----	<3	<3
C10 - C14 Fraction	----	3	mg/kg		----	----	----	<3	<3
C15 - C28 Fraction	----	3	mg/kg		----	----	----	<3	<3
C29 - C36 Fraction	----	5	mg/kg		----	----	----	<5	<5
^ C10 - C36 Fraction (sum)	----	3	mg/kg		----	----	----	<3	<3
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons									
C6 - C10 Fraction	C6_C10	3	mg/kg		----	----	----	<3	<3
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	3.0	mg/kg		----	----	----	<3.0	<3.0
EP080-SD: BTEXN									
Benzene	71-43-2	0.2	mg/kg		----	----	----	<0.2	<0.2
Toluene	108-88-3	0.2	mg/kg		----	----	----	<0.2	<0.2
Ethylbenzene	100-41-4	0.2	mg/kg		----	----	----	<0.2	<0.2
meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg		----	----	----	<0.2	<0.2
ortho-Xylene	95-47-6	0.2	mg/kg		----	----	----	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg		----	----	----	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg		----	----	----	<0.2	<0.2
Naphthalene	91-20-3	0.2	mg/kg		----	----	----	<0.2	<0.2
EP090: Organotin Compounds									
Monobutyltin	78763-54-9	1	µgSn/kg		----	----	----	<1	<1
Dibutyltin	1002-53-5	1	µgSn/kg		----	----	----	<1	<1
Tributyltin	56573-85-4	0.5	µgSn/kg		----	----	----	<0.5	<0.5
EP132B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	5	µg/kg		----	----	----	<5	<5
2-Methylnaphthalene	91-57-6	5	µg/kg		----	----	----	<5	<5
Acenaphthylene	208-96-8	4	µg/kg		----	----	----	<4	<4
Acenaphthene	83-32-9	4	µg/kg		----	----	----	<4	<4
Fluorene	86-73-7	4	µg/kg		----	----	----	<4	<4
Phenanthrene	85-01-8	4	µg/kg		----	----	----	<4	<4
Anthracene	120-12-7	4	µg/kg		----	----	----	<4	<4
Fluoranthene	206-44-0	4	µg/kg		----	----	----	<4	<4

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Sample ID	G20	G21	G22	G23-T1	G23-T2
				Sampling date / time	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00
Compound	CAS Number	LOR	Unit		EP2205852-031	EP2205852-032	EP2205852-033	EP2205852-034	EP2205852-035
					Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Pyrene	129-00-0	4	µg/kg		----	----	----	<4	<4
Benz(a)anthracene	56-55-3	4	µg/kg		----	----	----	<4	<4
Chrysene	218-01-9	4	µg/kg		----	----	----	<4	<4
Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg		----	----	----	<4	<4
Benzo(k)fluoranthene	207-08-9	4	µg/kg		----	----	----	<4	<4
Benzo(e)pyrene	192-97-2	4	µg/kg		----	----	----	<4	<4
Benzo(a)pyrene	50-32-8	4	µg/kg		----	----	----	<4	<4
Perylene	198-55-0	4	µg/kg		----	----	----	<4	<4
Benzo(g.h.i)perylene	191-24-2	4	µg/kg		----	----	----	<4	<4
Dibenz(a.h)anthracene	53-70-3	4	µg/kg		----	----	----	<4	<4
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg		----	----	----	<4	<4
Coronene	191-07-1	5	µg/kg		----	----	----	<5	<5
^ Sum of PAHs	----	4	µg/kg		----	----	----	<4	<4
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg		----	----	----	<4	<4
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg		----	----	----	5	5
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg		----	----	----	10	10
EP080-SD: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		----	----	----	93.6	90.2
Toluene-D8	2037-26-5	0.2	%		----	----	----	99.7	98.6
4-Bromofluorobenzene	460-00-4	0.2	%		----	----	----	106	103
EP090S: Organotin Surrogate									
Tripropyltin	----	0.5	%		----	----	----	123	114
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	10	%		----	----	----	74.4	76.9
Anthracene-d10	1719-06-8	10	%		----	----	----	76.3	79.4
4-Terphenyl-d14	1718-51-0	10	%		----	----	----	71.0	75.9

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	G23-T3	G24	G25	----	----
			Sampling date / time	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	----	----
Compound	CAS Number	LOR	Unit	EP2205852-036	EP2205852-037	EP2205852-038	--------	--------
				Result	Result	Result	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	----	28.9	33.3	----	----
Moisture Content	----	1.0	%	25.8	----	----	----	----
EA150: Particle Sizing								
Clay (<4 µm)	----	1	%	8	3	7	----	----
Silt (4-62 µm)	----	1	%	<1	1	<1	----	----
Fine Sand (62-250 µm)	----	1	%	10	1	40	----	----
Medium Sand (250-500 µm)	----	1	%	13	5	34	----	----
Coarse Sand (500-2000 µm)	----	1	%	52	43	17	----	----
Gravel (2000-10000 µm)	----	1	%	17	47	2	----	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.56	2.60	2.58	----	----
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	2230	2050	2310	----	----
Iron	7439-89-6	50	mg/kg	9340	9230	8690	----	----
EG020-SD: Total Metals in Sediments by ICPMS								
Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	<0.50	----	----
Arsenic	7440-38-2	1.00	mg/kg	22.9	26.4	14.1	----	----
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	----	----
Chromium	7440-47-3	1.0	mg/kg	14.5	12.7	16.4	----	----
Copper	7440-50-8	1.0	mg/kg	2.8	2.9	3.1	----	----
Lead	7439-92-1	1.0	mg/kg	3.0	3.4	2.6	----	----
Manganese	7439-96-5	10	mg/kg	381	392	381	----	----
Nickel	7440-02-0	1.0	mg/kg	5.7	5.3	7.5	----	----
Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	<0.1	----	----
Zinc	7440-66-6	1.0	mg/kg	6.2	4.8	7.3	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	<0.01	----	----
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	1.59	3.35	0.17	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	----	3	mg/kg	<3	----	----	----	----
>C16 - C34 Fraction	----	3	mg/kg	8	----	----	----	----
>C34 - C40 Fraction	----	5	mg/kg	<5	----	----	----	----
>C10 - C40 Fraction (sum)	----	3	mg/kg	8	----	----	----	----

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	G23-T3	G24	G25	----	----
			Sampling date / time	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	----	----
Compound	CAS Number	LOR	Unit	EP2205852-036	EP2205852-037	EP2205852-038	--------	--------
				Result	Result	Result	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
>C10 - C16 Fraction minus Naphthalene (F2)	----	3	mg/kg	<3	----	----	----	----
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	3	mg/kg	<3	----	----	----	----
C10 - C14 Fraction	----	3	mg/kg	**3**	----	----	----	----
C15 - C28 Fraction	----	3	mg/kg	**5**	----	----	----	----
C29 - C36 Fraction	----	5	mg/kg	**5**	----	----	----	----
^ **C10 - C36 Fraction (sum)**	----	3	mg/kg	**13**	----	----	----	----
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons								
C6 - C10 Fraction	C6_C10	3	mg/kg	<3	----	----	----	----
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	3.0	mg/kg	<3.0	----	----	----	----
EP080-SD: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	----	----	----	----
Toluene	108-88-3	0.2	mg/kg	<0.2	----	----	----	----
Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	----	----	----	----
ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	----	----	----	----
^ **Total Xylenes**	----	0.5	mg/kg	<0.5	----	----	----	----
^ **Sum of BTEX**	----	0.2	mg/kg	<0.2	----	----	----	----
Naphthalene	91-20-3	0.2	mg/kg	<0.2	----	----	----	----
EP090: Organotin Compounds								
Monobutyltin	78763-54-9	1	µgSn/kg	<1	----	----	----	----
Dibutyltin	1002-53-5	1	µgSn/kg	<1	----	----	----	----
Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	----	----	----	----
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	5	µg/kg	<5	----	----	----	----
2-Methylnaphthalene	91-57-6	5	µg/kg	<5	----	----	----	----
Acenaphthylene	208-96-8	4	µg/kg	<4	----	----	----	----
Acenaphthene	83-32-9	4	µg/kg	<4	----	----	----	----
Fluorene	86-73-7	4	µg/kg	<4	----	----	----	----
Phenanthrene	85-01-8	4	µg/kg	<4	----	----	----	----
Anthracene	120-12-7	4	µg/kg	<4	----	----	----	----
Fluoranthene	206-44-0	4	µg/kg	<4	----	----	----	----

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Sample ID	G23-T3	G24	G25	----	----
				Sampling date / time	07-May-2022 00:00	07-May-2022 00:00	07-May-2022 00:00	----	----
Compound	CAS Number	LOR	Unit		EP2205852-036	EP2205852-037	EP2205852-038	--------	--------
					Result	Result	Result	----	----
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Pyrene	129-00-0	4	µg/kg		<4	----	----	----	----
Benz(a)anthracene	56-55-3	4	µg/kg		<4	----	----	----	----
Chrysene	218-01-9	4	µg/kg		<4	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg		<4	----	----	----	----
Benzo(k)fluoranthene	207-08-9	4	µg/kg		<4	----	----	----	----
Benzo(e)pyrene	192-97-2	4	µg/kg		<4	----	----	----	----
Benzo(a)pyrene	50-32-8	4	µg/kg		<4	----	----	----	----
Perylene	198-55-0	4	µg/kg		<4	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	4	µg/kg		<4	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	4	µg/kg		<4	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg		<4	----	----	----	----
Coronene	191-07-1	5	µg/kg		<5	----	----	----	----
^ Sum of PAHs	----	4	µg/kg		<4	----	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg		<4	----	----	----	----
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg		**5**	----	----	----	----
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg		**10**	----	----	----	----
EP080-SD: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		**98.3**	----	----	----	----
Toluene-D8	2037-26-5	0.2	%		**99.8**	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.2	%		**109**	----	----	----	----
EP090S: Organotin Surrogate									
Tripropyltin	----	0.5	%		**124**	----	----	----	----
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	10	%		**97.0**	----	----	----	----
Anthracene-d10	1719-06-8	10	%		**88.0**	----	----	----	----
4-Terphenyl-d14	1718-51-0	10	%		**89.0**	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	TB1	----	----	----	----
				Sampling date / time	05-May-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EP2205852-039	--------	--------	--------	--------
					Result	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	0.1	%		**17.1**	----	----	----	----
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	3	mg/kg		<3	----	----	----	----
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons									
C6 - C10 Fraction	C6_C10	3	mg/kg		<3	----	----	----	----
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	3.0	mg/kg		<3.0	----	----	----	----
EP080-SD: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	----	----	----	----
Toluene	108-88-3	0.2	mg/kg		<0.2	----	----	----	----
Ethylbenzene	100-41-4	0.2	mg/kg		<0.2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg		<0.2	----	----	----	----
ortho-Xylene	95-47-6	0.2	mg/kg		<0.2	----	----	----	----
^ **Total Xylenes**	----	0.5	mg/kg		<0.5	----	----	----	----
^ **Sum of BTEX**	----	0.2	mg/kg		<0.2	----	----	----	----
Naphthalene	91-20-3	0.2	mg/kg		<0.2	----	----	----	----
EP080-SD: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		**96.6**	----	----	----	----
Toluene-D8	2037-26-5	0.2	%		**104**	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.2	%		**111**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **SEDIMENT**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP080-SD: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	70	130
Toluene-D8	2037-26-5	70	130
4-Bromofluorobenzene	460-00-4	70	130
EP090S: Organotin Surrogate			
Tripropyltin	----	35	130
EP132T: Base/Neutral Extractable Surrogates			
2-Fluorobiphenyl	321-60-8	70	130
Anthracene-d10	1719-06-8	70	130
4-Terphenyl-d14	1718-51-0	70	130

Sub-Matrix: **SOIL**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP080-SD: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	70	130
Toluene-D8	2037-26-5	70	130
4-Bromofluorobenzene	460-00-4	70	130

Inter-Laboratory Testing

Analysis conducted by ALS Brisbane, NATA accreditation no. 825, site no. 818 (Chemistry) 18958 (Biology).

(SOIL) EP003: Total Organic Carbon (TOC) in Soil

(SOIL) EP090: Organotin Compounds

(SOIL) EP090S: Organotin Surrogate

Analysis conducted by ALS Newcastle, NATA accreditation no. 825, site no. 1656 (Chemistry) 9854 (Biology).

(SOIL) EA152: Soil Particle Density

(SOIL) EA150: Particle Sizing

Certificate of Analysis

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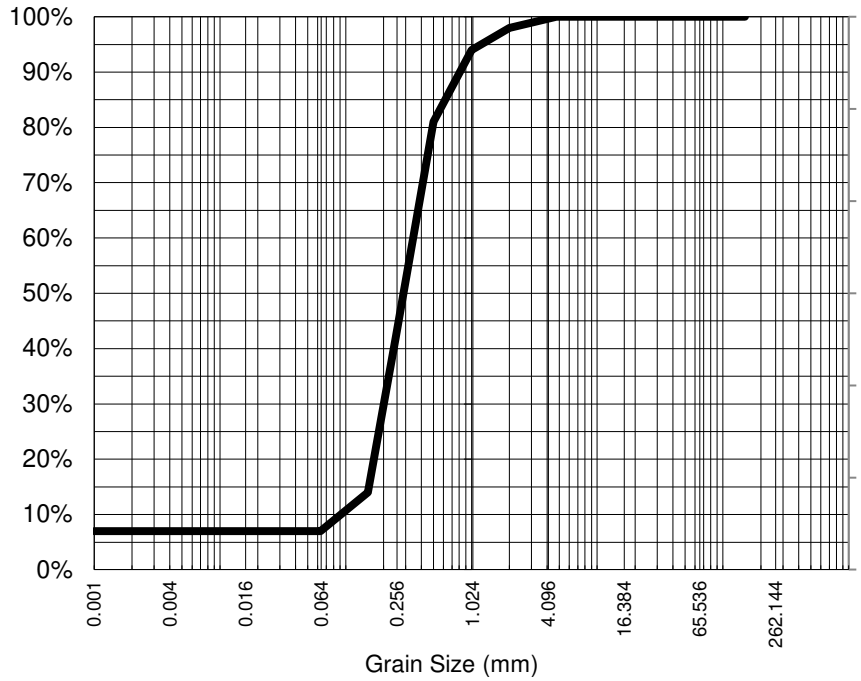
ALS Environmental

Newcastle, NSW

CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-001 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	C1-05

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.00	98%
1.000	94%
0.500	81%
0.250	42%
0.150	14%
0.063	7%
Particle Size (microns)	
38	7%
27	7%
19	7%
13	7%
10	7%
7	7%
5	7%
3	7%
1	7%

Median Particle Size (mm)*	0.301

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:**	26-May-22
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)	2.56		

NATA Accreditation: 825 Site: Newcastle
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WORLD RECOGNISED ACCREDITATION

Vincent Emerton-Bell
Laboratory Analyst
Authorised Signatory

Certificate of Analysis

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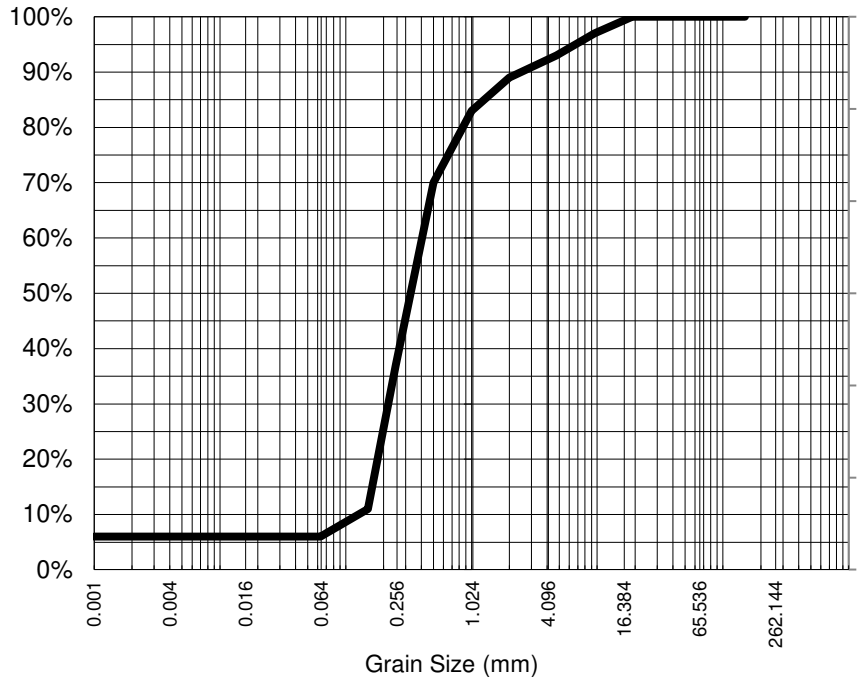
ALS Environmental

Newcastle, NSW

CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-002 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	C1-1

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	97%
4.75	93%
2.00	89%
1.000	83%
0.500	70%
0.250	37%
0.150	11%
0.063	6%
Particle Size (microns)	
38	6%
27	6%
19	6%
13	6%
10	6%
7	6%
5	6%
3	6%
1	6%

Median Particle Size (mm)*	0.348

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.59		

NATA Accreditation: 825 Site: Newcastle
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Certificate of Analysis

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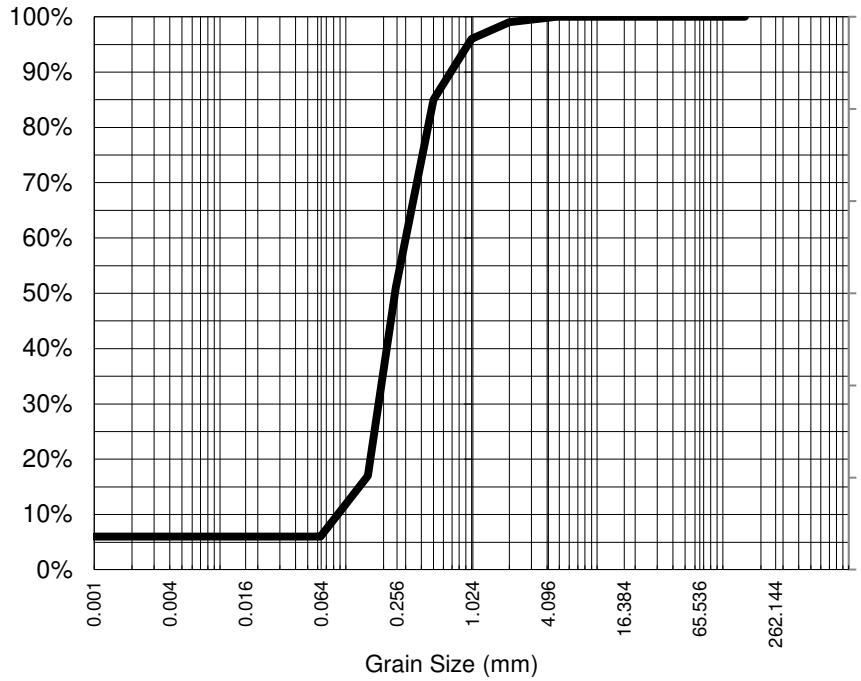
ALS Environmental

Newcastle, NSW

CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-003 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G2-T1

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.00	99%
1.000	96%
0.500	85%
0.250	51%
0.150	17%
0.063	6%
Particle Size (microns)	
37	6%
26	6%
19	6%
13	6%
10	6%
7	6%
5	6%
3	6%
1	6%

Median Particle Size (mm)*	0.247

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:**	26-May-22
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)	2.64		

NATA Accreditation: 825 Site: Newcastle
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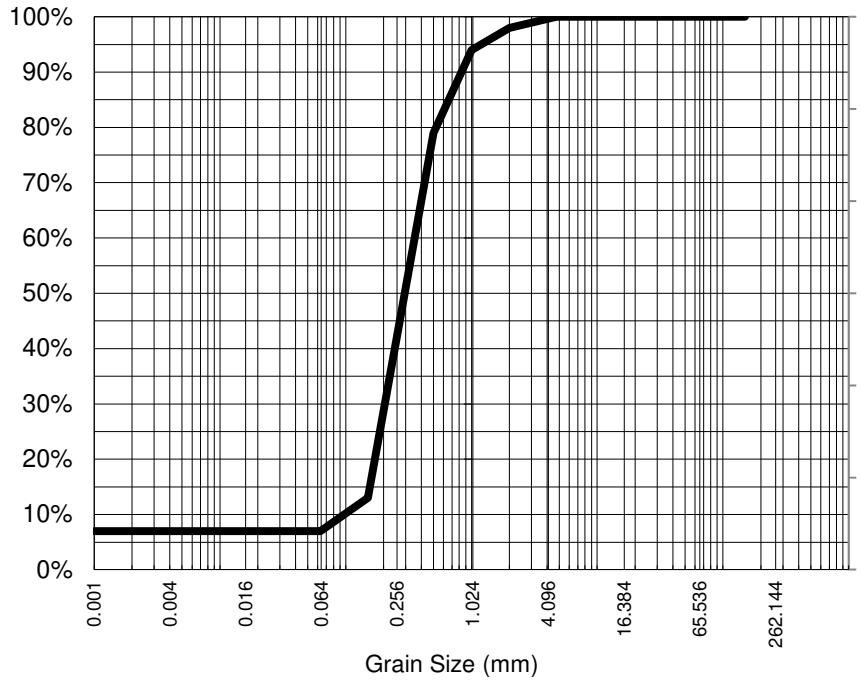
ALS Environmental

Newcastle, NSW

CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-004 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G2-T2

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.00	98%
1.000	94%
0.500	79%
0.250	41%
0.150	13%
0.063	7%
Particle Size (microns)	
37	7%
26	7%
19	7%
13	7%
10	7%
7	7%
5	7%
3	7%
1	7%

Median Particle Size (mm)*	0.309

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:**	26-May-22
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)	2.62		

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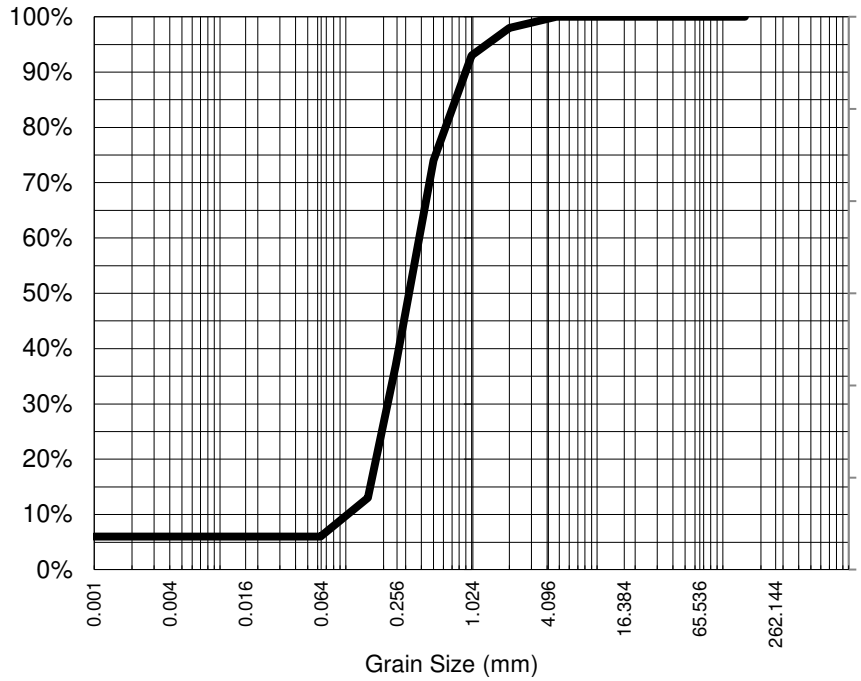
ALS Environmental

Newcastle, NSW

CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-005 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G2-T3

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.00	98%
1.000	93%
0.500	74%
0.250	37%
0.150	13%
0.063	6%
Particle Size (microns)	
37	6%
26	6%
19	6%
13	6%
10	6%
7	6%
5	6%
3	6%
1	6%

Median Particle Size (mm)*	0.338

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:**	26-May-22
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)	2.62		

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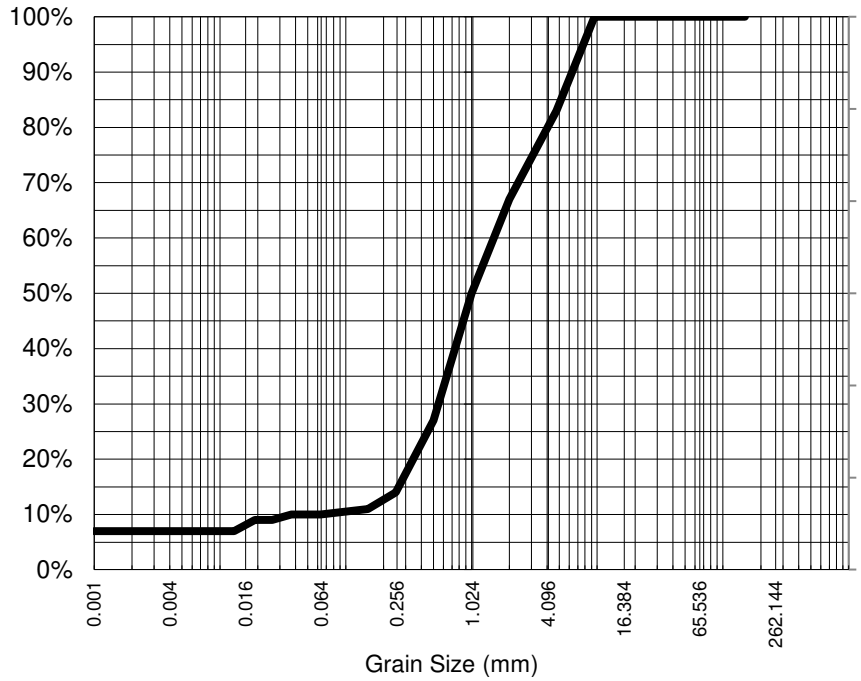
CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-006 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	C3-05

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	83%
2.00	67%
1.000	50%
0.500	27%
0.250	14%
0.150	11%
0.063	10%
Particle Size (microns)	
37	10%
26	9%
19	9%
13	7%
10	7%
7	7%
5	7%
3	7%
1	7%

Median Particle Size (mm)*	1.000

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

Analysis Notes

Samples analysed as received.

Sample Comments:

Analysed: 26-May-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, SHELL, FINES

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.00mm) 2.63

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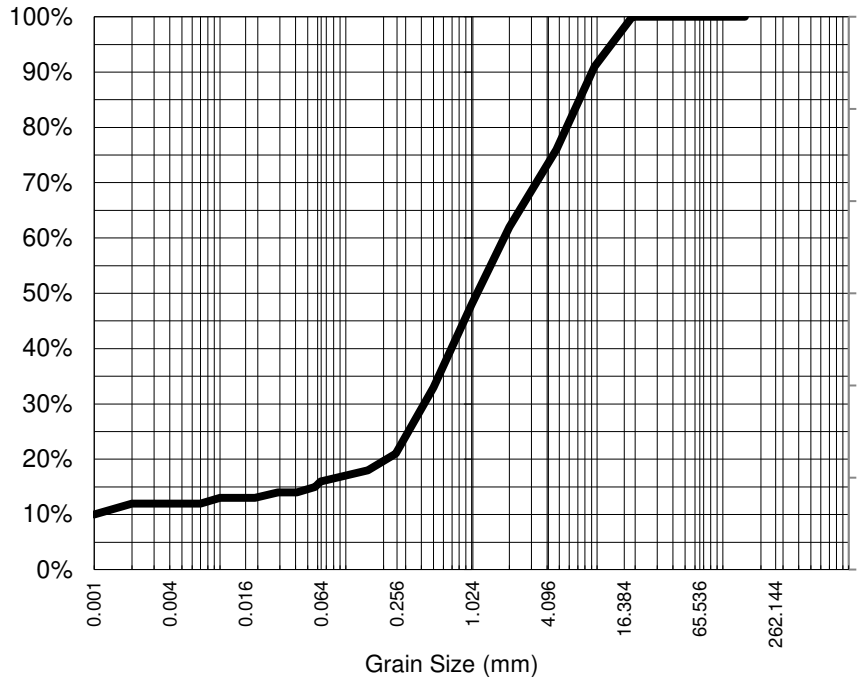
CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-007 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	C3-1

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	91%
4.75	76%
2.00	62%
1.000	48%
0.500	33%
0.250	21%
0.150	18%
0.063	16%
Particle Size (microns)	
41	14%
29	14%
19	13%
13	13%
10	13%
7	12%
5	12%
3	12%
1	10%

Median Particle Size (mm)*	1.143

Analysis Notes

Samples analysed as received.

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

Sample Comments:

Analysed: 26-May-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, SHELL, FINES

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.00mm) 2.63

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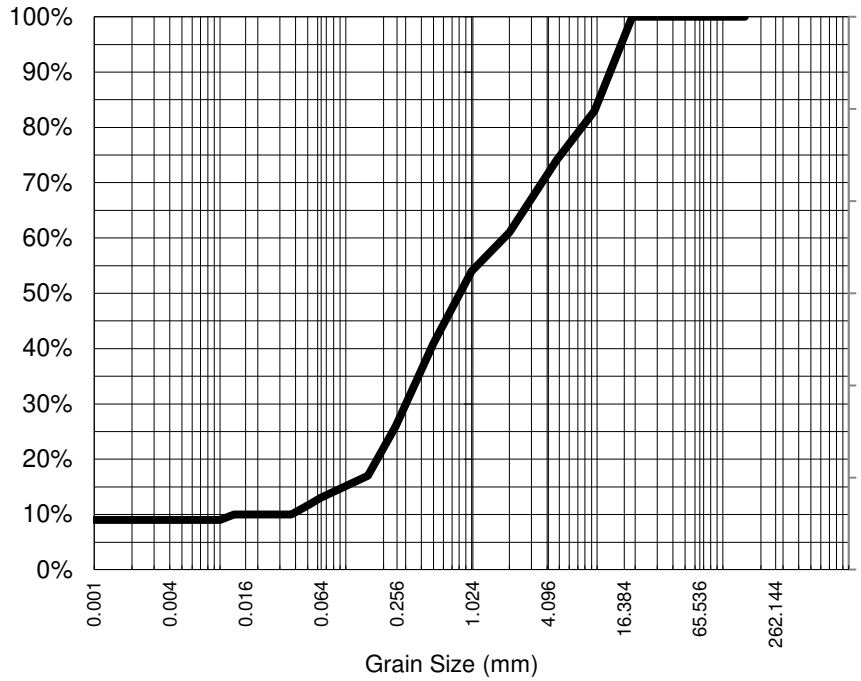
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-008 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	C4-05

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	83%
4.75	74%
2.00	61%
1.000	54%
0.500	41%
0.250	26%
0.150	17%
0.063	13%
Particle Size (microns)	
37	10%
26	10%
19	10%
13	10%
10	9%
7	9%
5	9%
3	9%
1	9%

Median Particle Size (mm)*	0.846

Analysis Notes

Samples analysed as received.

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

Sample Comments:

Analysed: 26-May-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, SHELL, FINES

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.00mm) 2.63

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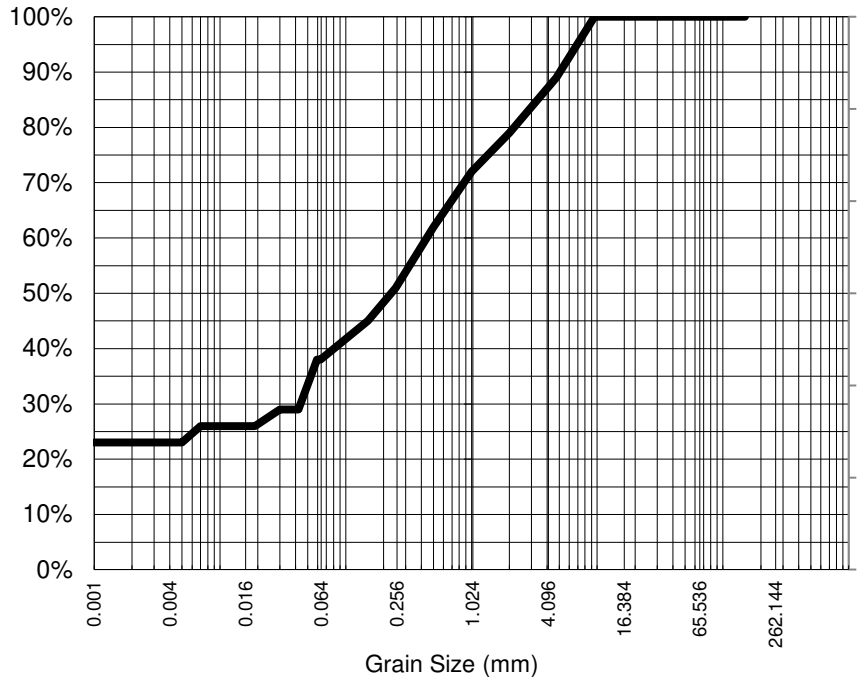
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-009 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	C4-1

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	89%
2.00	79%
1.000	72%
0.500	62%
0.250	51%
0.150	45%
0.063	38%
Particle Size (microns)	
42	29%
30	29%
19	26%
14	26%
10	26%
7	26%
5	23%
4	23%
1	23%

Median Particle Size (mm)*	0.233

Analysis Notes

Samples analysed as received.

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

Sample Comments:

Analysed: 26-May-22

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) 2.54

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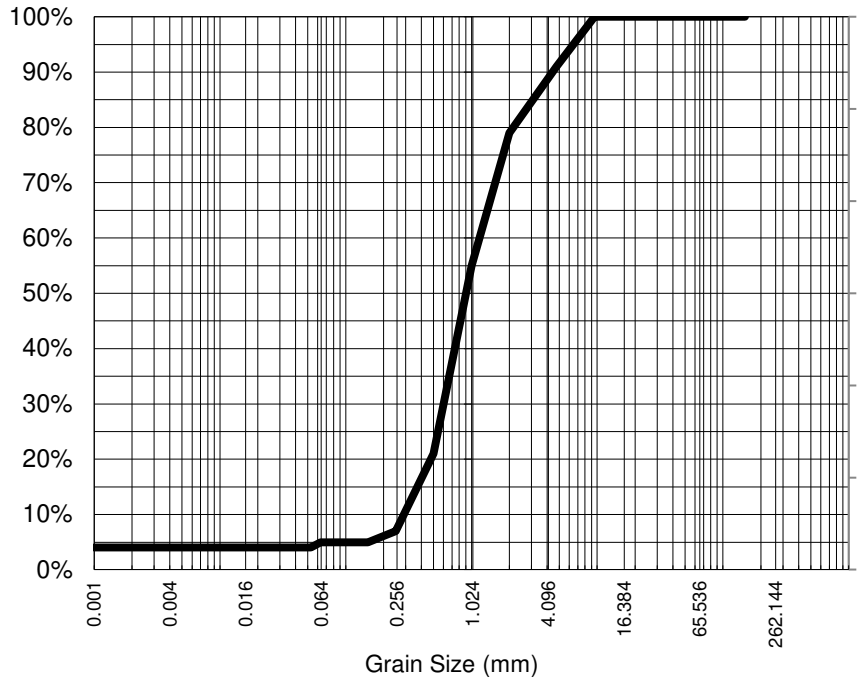
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-010 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G5-S1

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	91%
2.00	79%
1.000	55%
0.500	21%
0.250	7%
0.150	5%
0.063	5%
Particle Size (microns)	
37	4%
26	4%
19	4%
13	4%
10	4%
7	4%
5	4%
3	4%
1	4%

Median Particle Size (mm)*	0.926

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.63		

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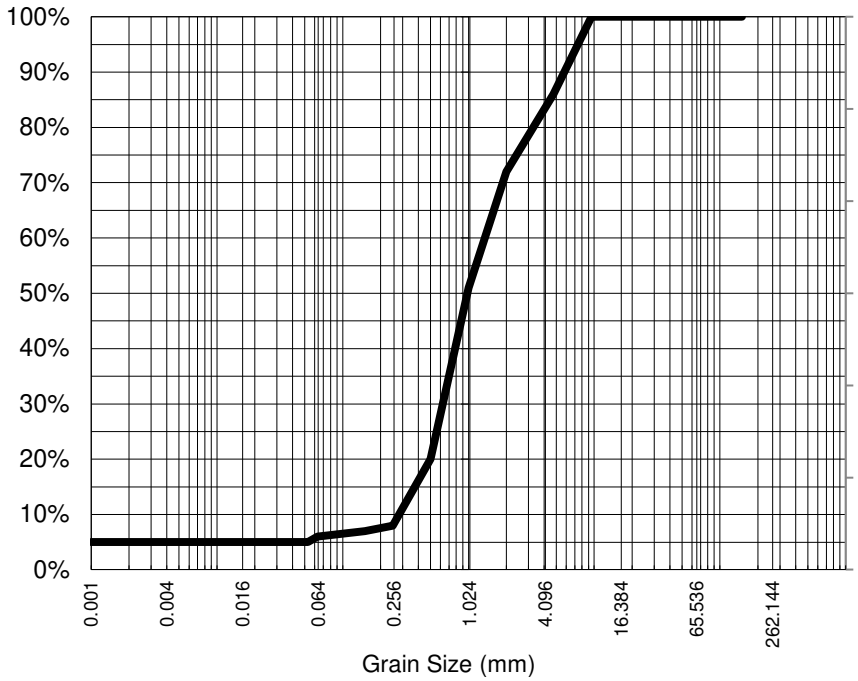
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-011 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G5-S2

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	86%
2.00	72%
1.000	51%
0.500	20%
0.250	8%
0.150	7%
0.063	6%
Particle Size (microns)	
37	5%
26	5%
19	5%
13	5%
10	5%
7	5%
5	5%
3	5%
1	5%

Median Particle Size (mm)*	0.984

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.62		

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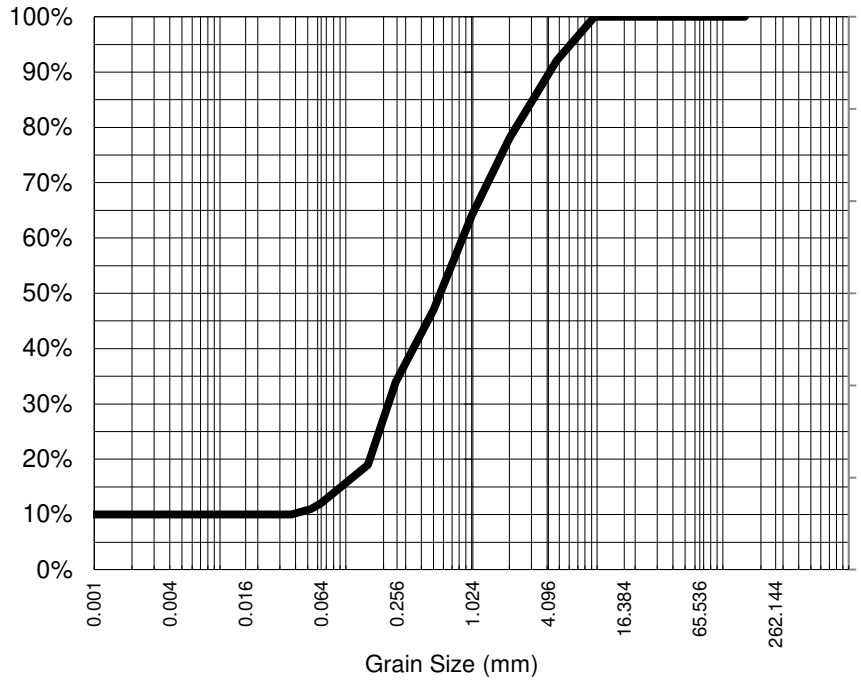
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-012 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G6

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	92%
2.00	78%
1.000	64%
0.500	47%
0.250	34%
0.150	19%
0.063	12%
Particle Size (microns)	
37	10%
26	10%
19	10%
13	10%
10	10%
7	10%
5	10%
3	10%
1	10%

Median Particle Size (mm)*	0.588

Analysis Notes

Samples analysed as received.

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

Sample Comments:

Analysed: 26-May-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, SHELL, FINES

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.00mm) 2.6

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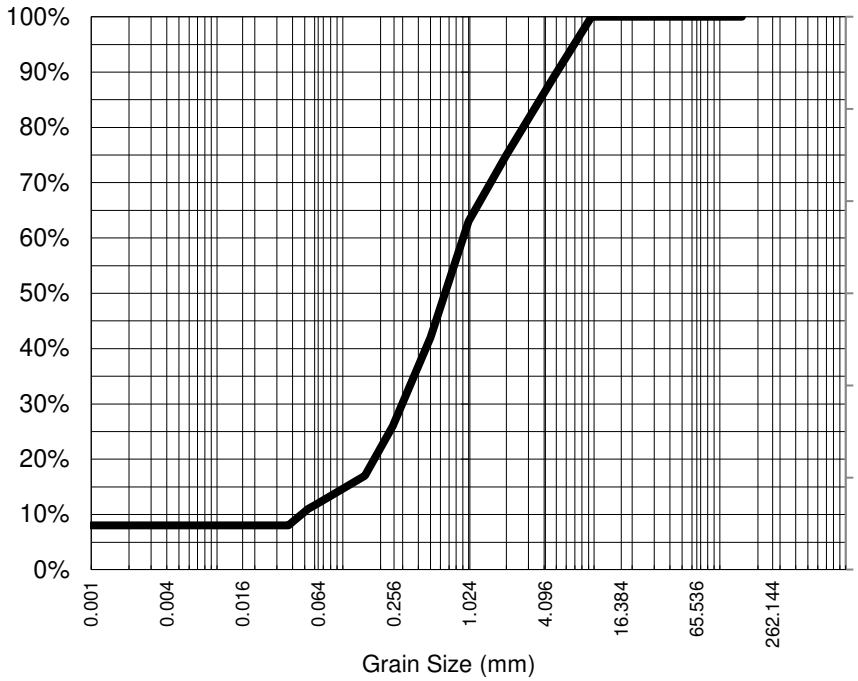
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-013 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	C7-05

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	89%
2.00	75%
1.000	63%
0.500	42%
0.250	26%
0.150	17%
0.063	12%
Particle Size (microns)	
37	8%
26	8%
19	8%
13	8%
10	8%
7	8%
5	8%
3	8%
1	8%

Median Particle Size (mm)*	0.690

Analysis Notes

Samples analysed as received.

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

Sample Comments:

Analysed: 26-May-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, SHELL, FINES

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.00mm) 2.61

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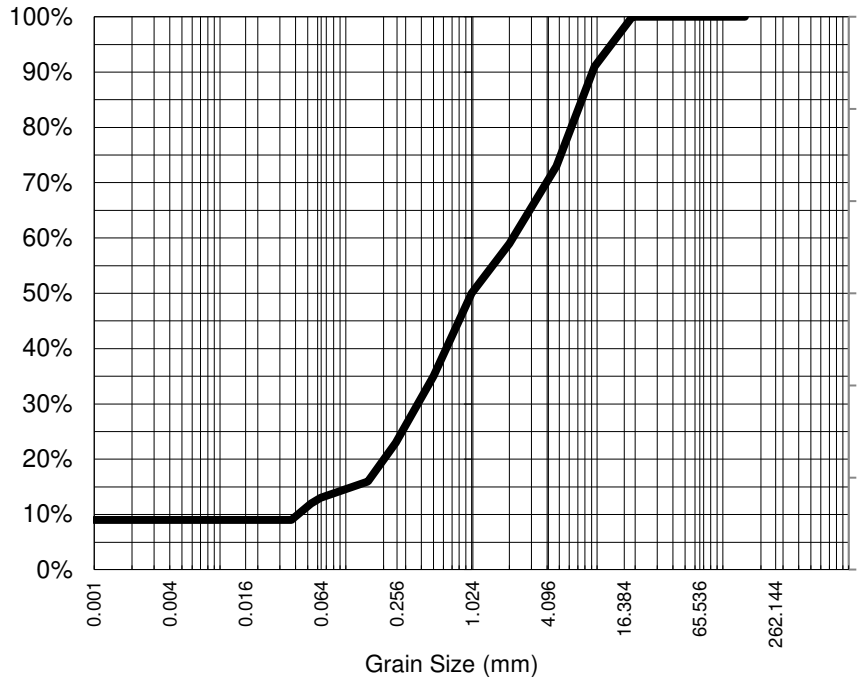
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-014 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	C7-1

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	91%
4.75	73%
2.00	59%
1.000	50%
0.500	35%
0.250	23%
0.150	16%
0.063	13%
Particle Size (microns)	
37	9%
26	9%
19	9%
13	9%
10	9%
7	9%
5	9%
3	9%
1	9%

Median Particle Size (mm)*	1.000

Analysis Notes

Samples analysed as received.

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

Sample Comments:

Analysed: 26-May-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, SHELL, FINES

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.00mm) 2.61

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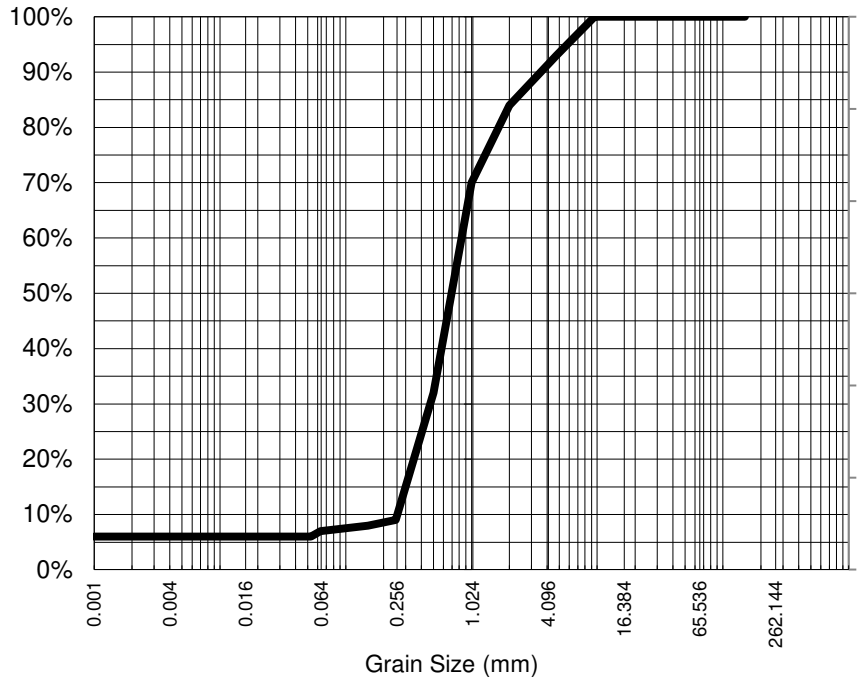
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-015 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G8

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	93%
2.00	84%
1.000	70%
0.500	32%
0.250	9%
0.150	8%
0.063	7%
Particle Size (microns)	
37	6%
26	6%
19	6%
13	6%
10	6%
7	6%
5	6%
3	6%
1	6%

Median Particle Size (mm)*	0.737

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.63		

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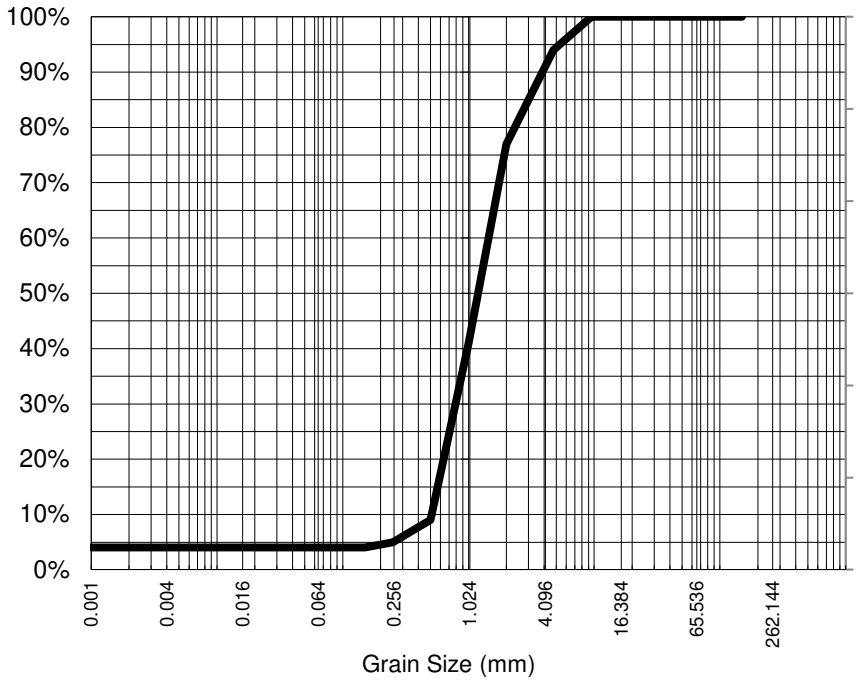
CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-016 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	C9-05

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	94%
2.00	77%
1.000	41%
0.500	9%
0.250	5%
0.150	4%
0.063	4%
Particle Size (microns)	
37	4%
26	4%
19	4%
13	4%
10	4%
7	4%
5	4%
3	4%
1	4%

Median Particle Size (mm)*	1.250

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.63		

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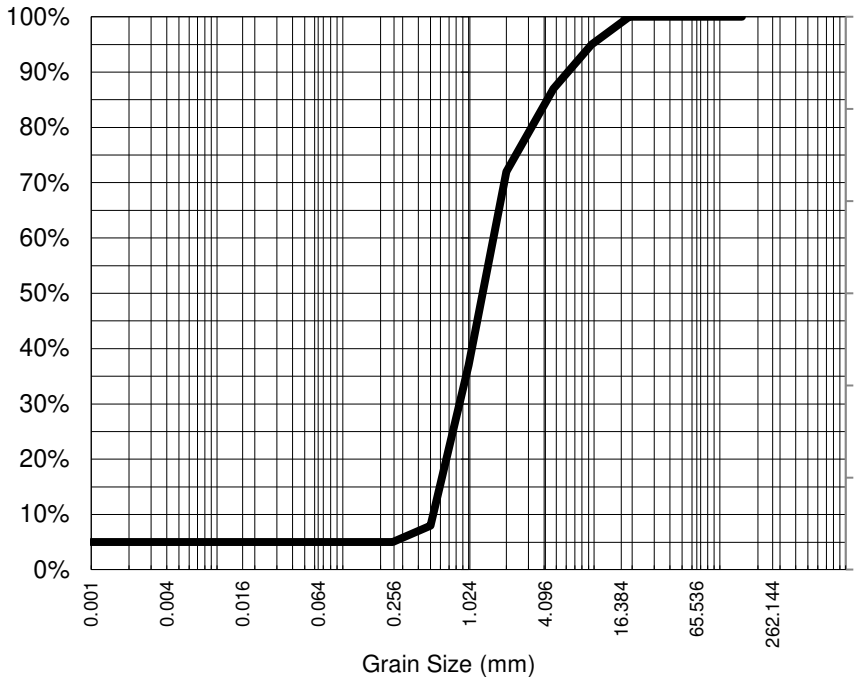
ALS Environmental

Newcastle, NSW

CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-017 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	C9-1

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	95%
4.75	87%
2.00	72%
1.000	37%
0.500	8%
0.250	5%
0.150	5%
0.063	5%
Particle Size (microns)	
37	5%
26	5%
19	5%
13	5%
10	5%
7	5%
5	5%
3	5%
1	5%

Median Particle Size (mm)*	1.371

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.64		

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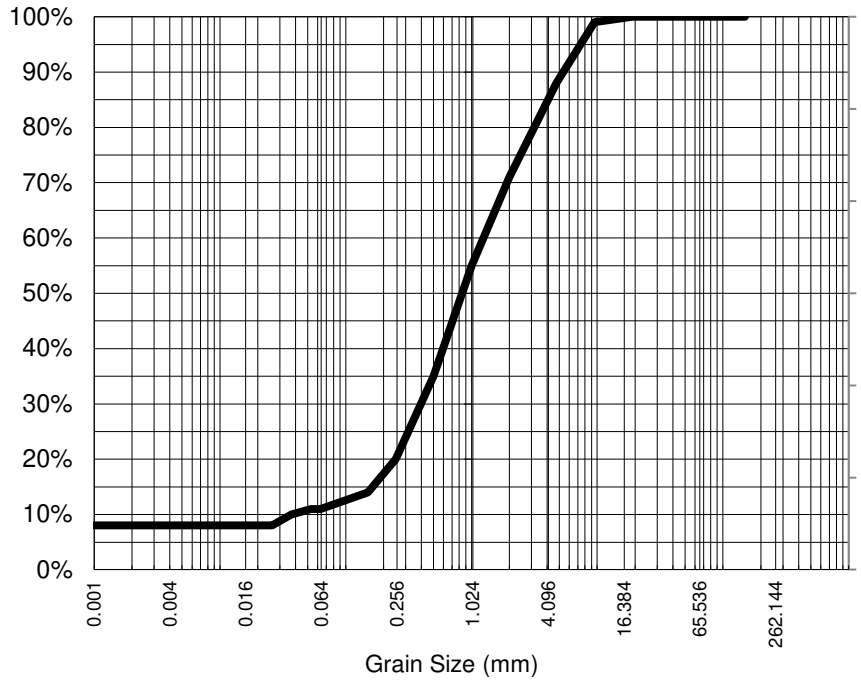
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-018 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G10

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	99%
4.75	88%
2.00	71%
1.000	55%
0.500	35%
0.250	20%
0.150	14%
0.063	11%
Particle Size (microns)	
37	10%
26	8%
19	8%
13	8%
10	8%
7	8%
5	8%
3	8%
1	8%

Median Particle Size (mm)*	0.875

Analysis Notes

Samples analysed as received.

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

Sample Comments:

Analysed: 26-May-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, SHELL, FINES

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.00mm) 2.61

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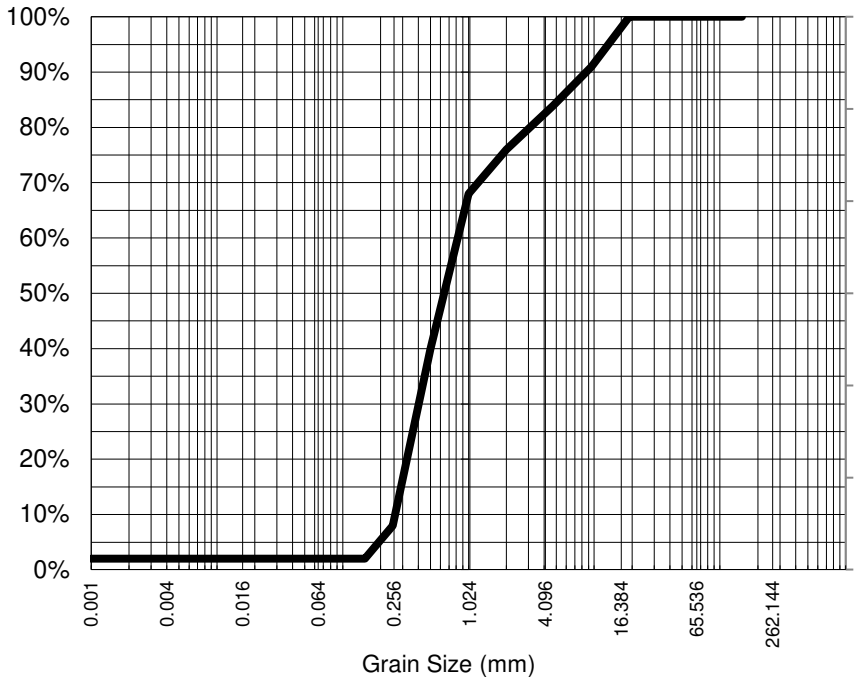
CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-019 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G11

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	91%
4.75	84%
2.00	76%
1.000	68%
0.500	40%
0.250	8%
0.150	2%
0.063	2%
Particle Size (microns)	
37	2%
26	2%
19	2%
13	2%
10	2%
7	2%
5	2%
3	2%
1	2%

Median Particle Size (mm)*	0.679

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.63		

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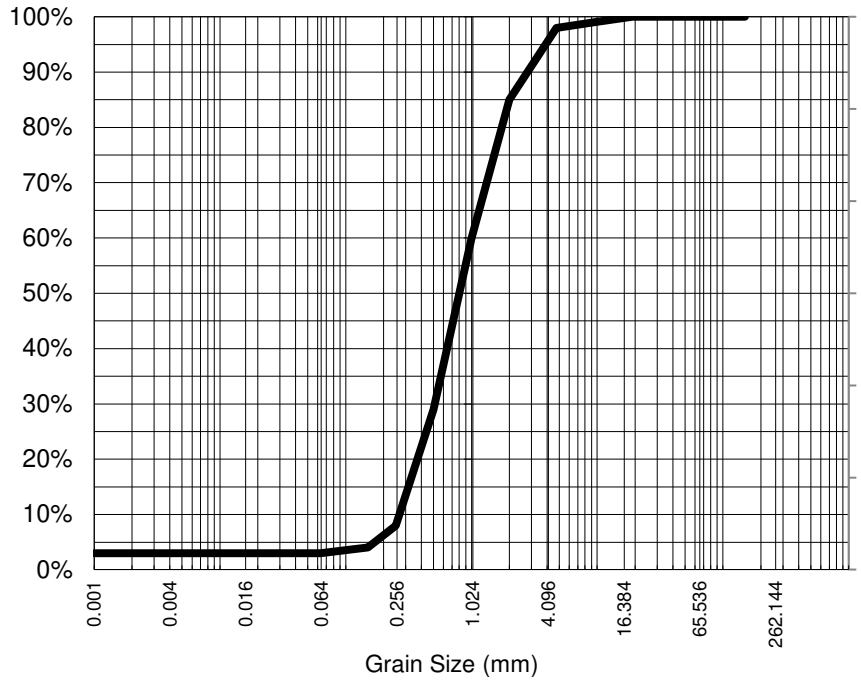
CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-020 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G12-T1

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	99%
4.75	98%
2.00	85%
1.000	60%
0.500	29%
0.250	8%
0.150	4%
0.063	3%
Particle Size (microns)	
37	3%
26	3%
19	3%
13	3%
10	3%
7	3%
5	3%
3	3%
1	3%

Median Particle Size (mm)*	0.839

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.62		

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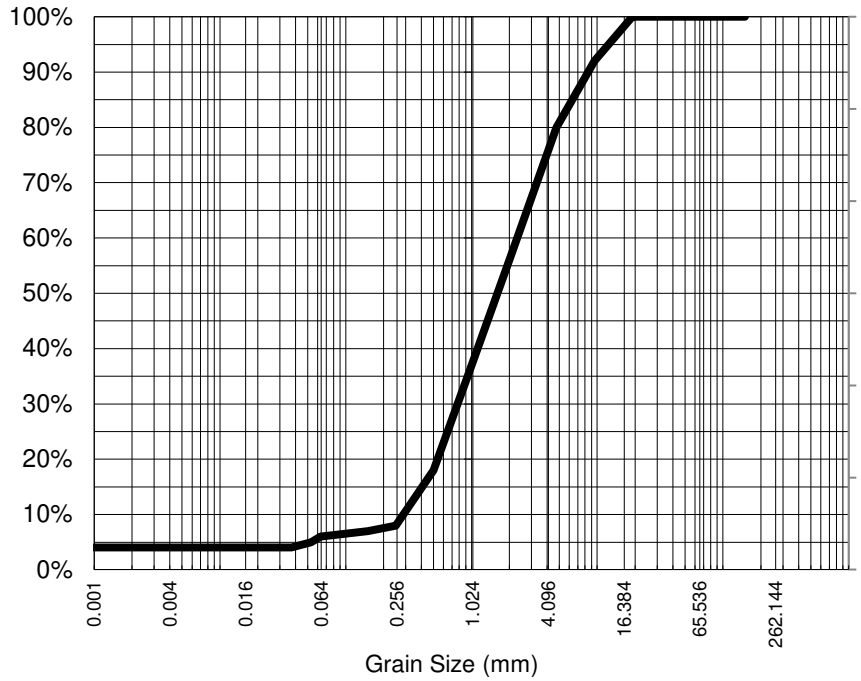
CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-021 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G12-T2

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	92%
4.75	80%
2.00	56%
1.000	37%
0.500	18%
0.250	8%
0.150	7%
0.063	6%
Particle Size (microns)	
37	4%
26	4%
19	4%
13	4%
10	4%
7	4%
5	4%
3	4%
1	4%

Median Particle Size (mm)*	1.684

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.62		

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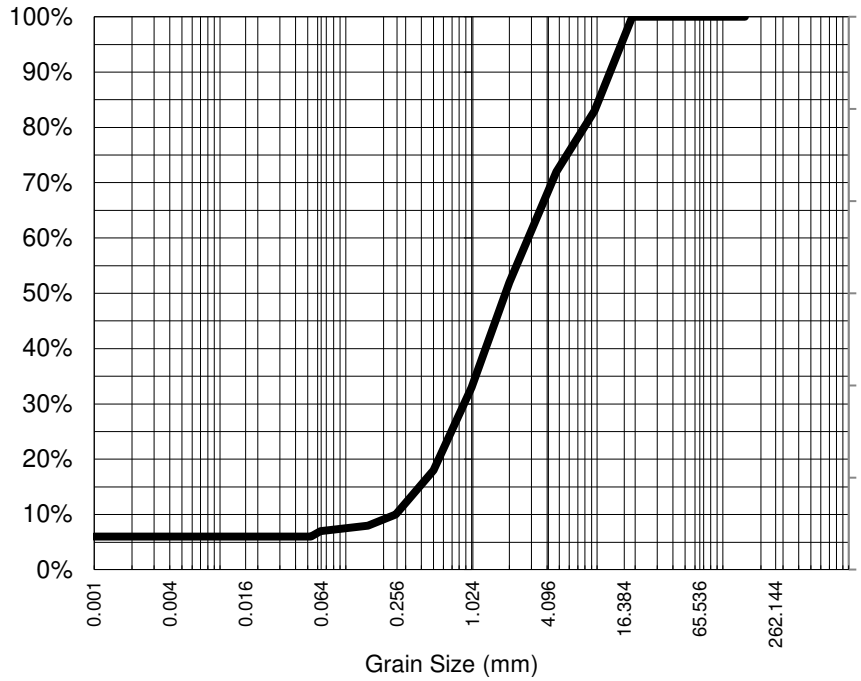
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-022 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G12-T3

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	83%
4.75	72%
2.00	52%
1.000	33%
0.500	18%
0.250	10%
0.150	8%
0.063	7%
Particle Size (microns)	
37	6%
26	6%
19	6%
13	6%
10	6%
7	6%
5	6%
3	6%
1	6%

Median Particle Size (mm)*	1.895

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SHELL, SAND, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.6		

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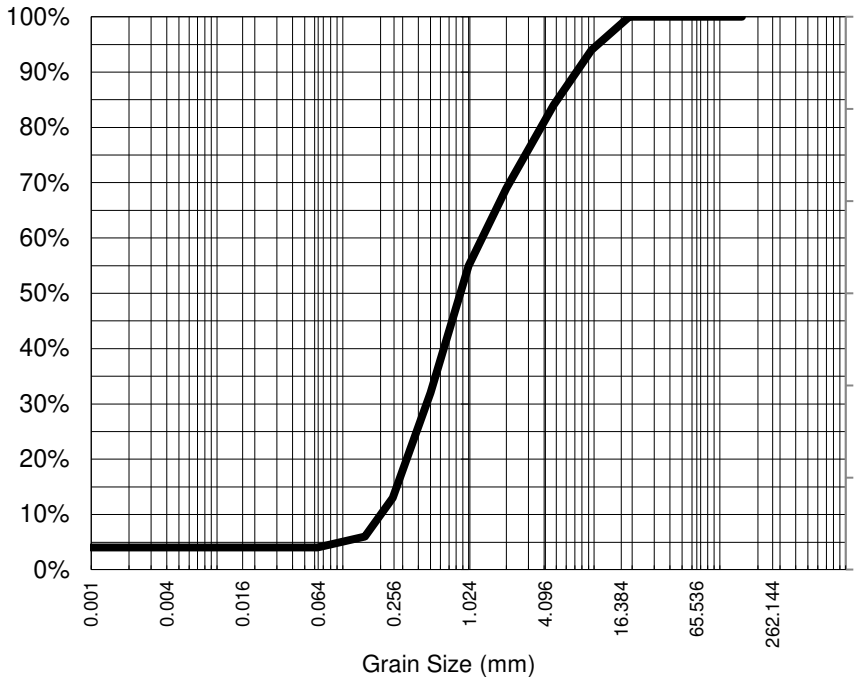
CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-023 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G13

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	94%
4.75	84%
2.00	69%
1.000	55%
0.500	32%
0.250	13%
0.150	6%
0.063	4%
Particle Size (microns)	
37	4%
26	4%
19	4%
13	4%
10	4%
7	4%
5	4%
3	4%
1	4%

Median Particle Size (mm)*	0.891

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.61		

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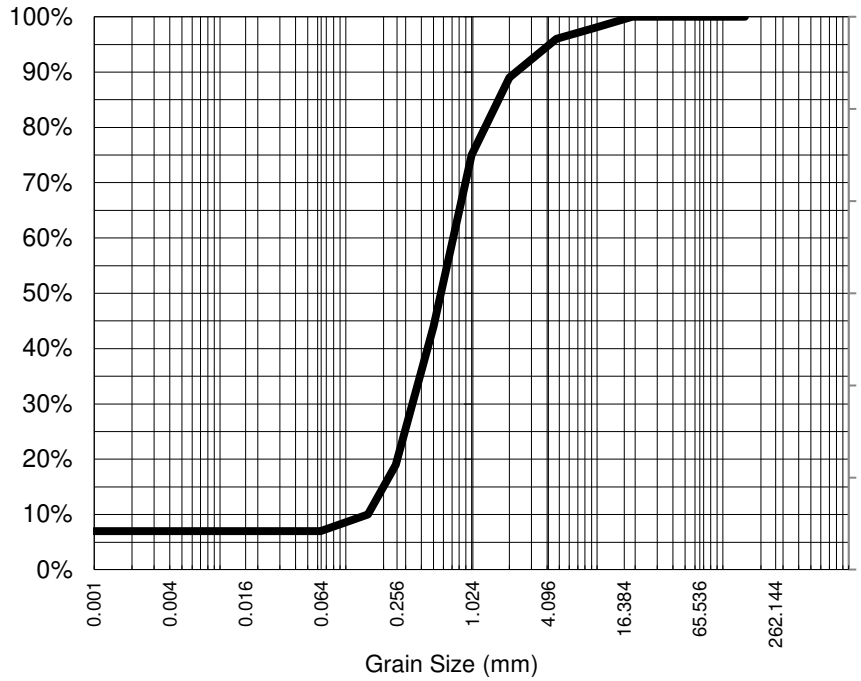
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-024 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G14

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	98%
4.75	96%
2.00	89%
1.000	75%
0.500	44%
0.250	19%
0.150	10%
0.063	7%
Particle Size (microns)	
37	7%
26	7%
19	7%
13	7%
10	7%
7	7%
5	7%
3	7%
1	7%

Median Particle Size (mm)*	0.597

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.6		

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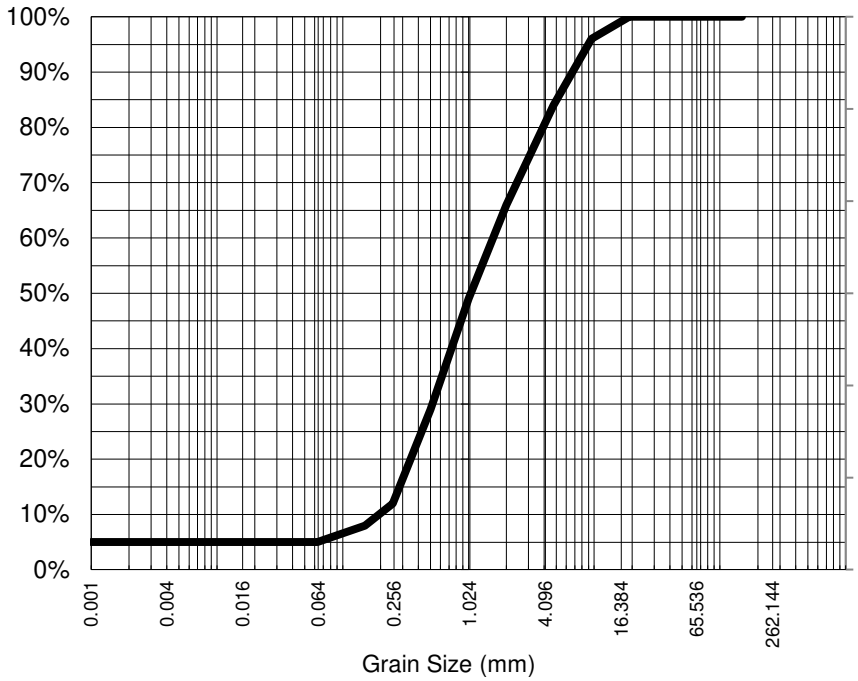
CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-025 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G15

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	96%
4.75	84%
2.00	66%
1.000	49%
0.500	29%
0.250	12%
0.150	8%
0.063	5%
Particle Size (microns)	
37	5%
26	5%
19	5%
13	5%
10	5%
7	5%
5	5%
3	5%
1	5%

Median Particle Size (mm)*	1.059

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.62		

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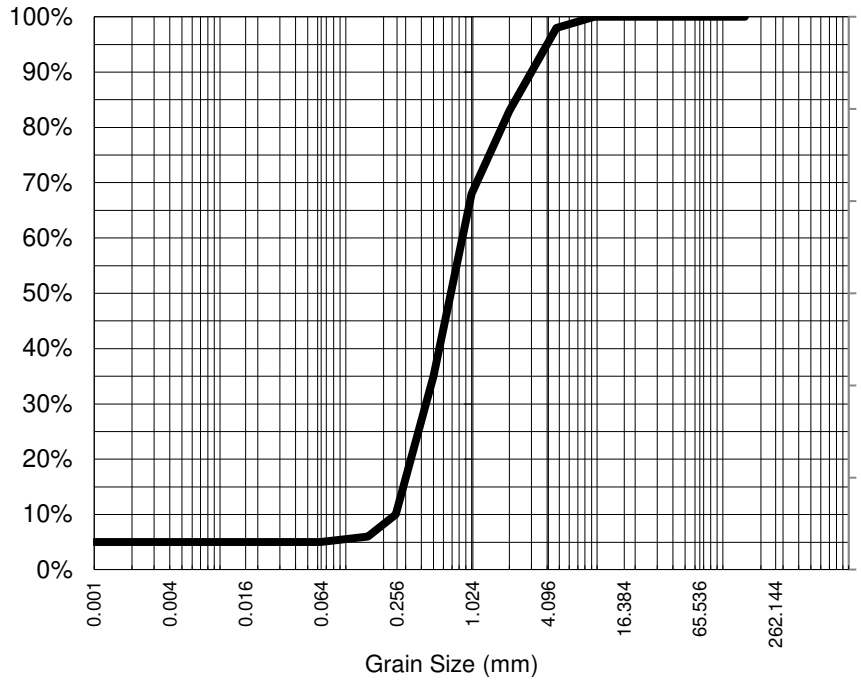
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-026 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G16

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	98%
2.00	83%
1.000	68%
0.500	35%
0.250	10%
0.150	6%
0.063	5%
Particle Size (microns)	
38	5%
27	5%
19	5%
13	5%
10	5%
7	5%
5	5%
3	5%
1	5%

Median Particle Size (mm)*	0.727

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.59		

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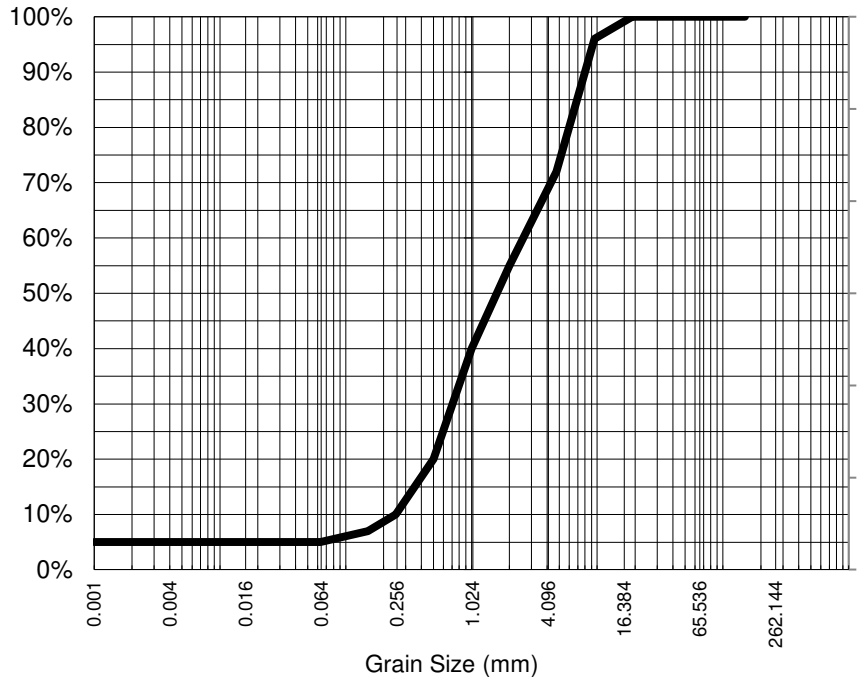
CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-027 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G17-S1

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	96%
4.75	72%
2.00	55%
1.000	40%
0.500	20%
0.250	10%
0.150	7%
0.063	5%
Particle Size (microns)	
37	5%
26	5%
19	5%
13	5%
10	5%
7	5%
5	5%
3	5%
1	5%

Median Particle Size (mm)*	1.667

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.62		

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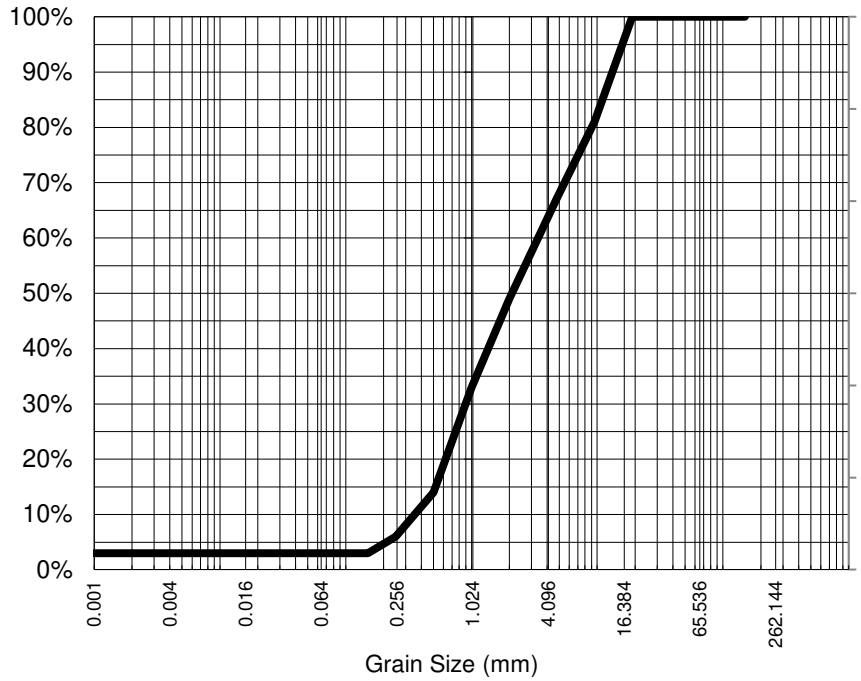
ALS Environmental

Newcastle, NSW

CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-028 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G17-S2

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	81%
4.75	67%
2.00	49%
1.000	33%
0.500	14%
0.250	6%
0.150	3%
0.063	3%
Particle Size (microns)	
37	3%
26	3%
19	3%
13	3%
10	3%
7	3%
5	3%
3	3%
1	3%

Median Particle Size (mm)*	2.153

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SHELL, SAND, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.63		

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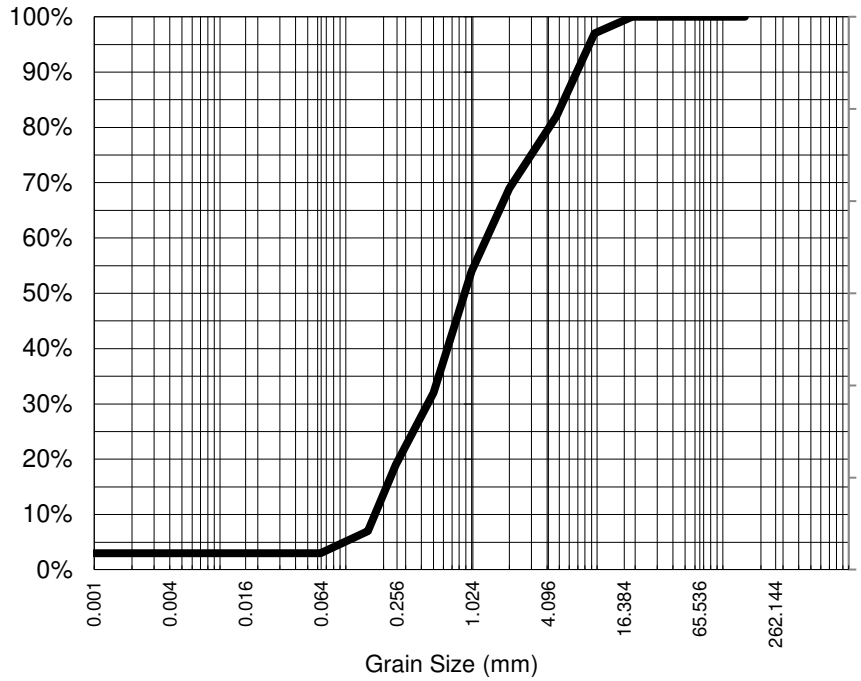
CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-029 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G18

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	97%
4.75	82%
2.00	69%
1.000	54%
0.500	32%
0.250	19%
0.150	7%
0.063	3%
Particle Size (microns)	
37	3%
26	3%
19	3%
13	3%
10	3%
7	3%
5	3%
3	3%
1	3%

Median Particle Size (mm)*	0.909

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.61		

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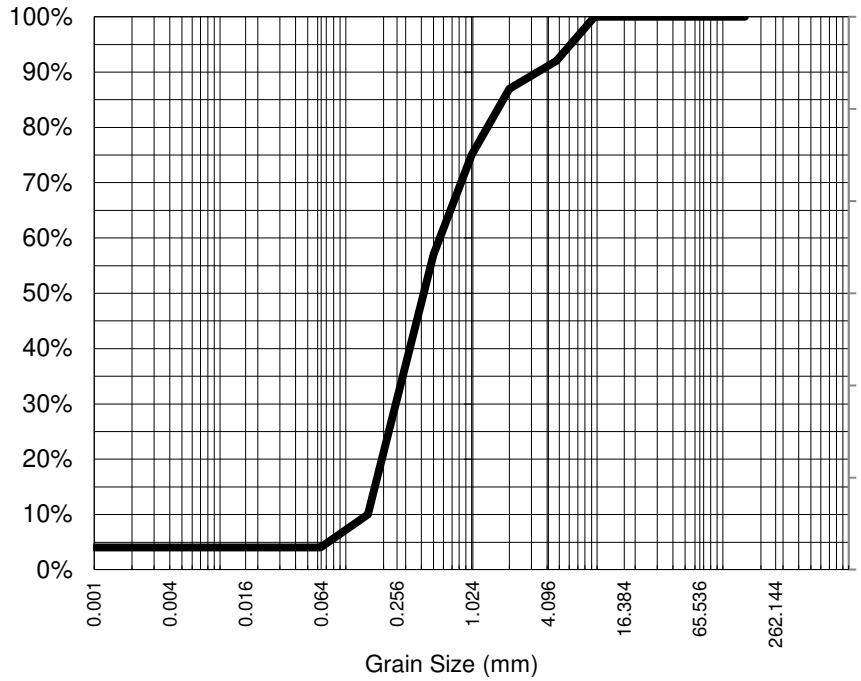
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-030 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G19

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	92%
2.00	87%
1.000	75%
0.500	57%
0.250	30%
0.150	10%
0.063	4%
Particle Size (microns)	
37	4%
26	4%
19	4%
13	4%
10	4%
7	4%
5	4%
3	4%
1	4%

Median Particle Size (mm)*	0.435

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.62		

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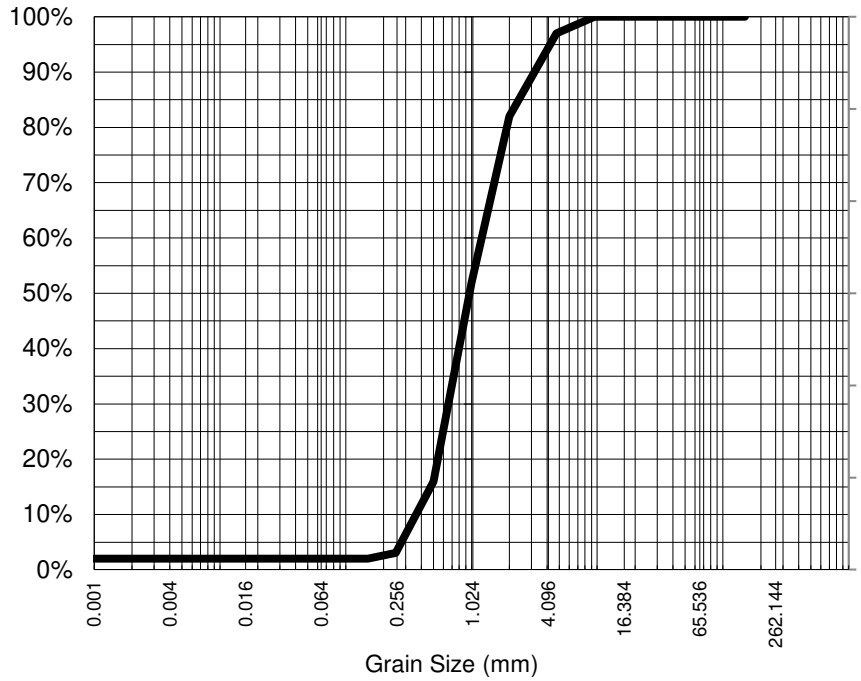
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-031 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G20

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	97%
2.00	82%
1.000	52%
0.500	16%
0.250	3%
0.150	2%
0.063	2%
Particle Size (microns)	
37	2%
26	2%
18	2%
13	2%
9	2%
7	2%
5	2%
3	2%
1	2%

Median Particle Size (mm)*	0.972

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.65		

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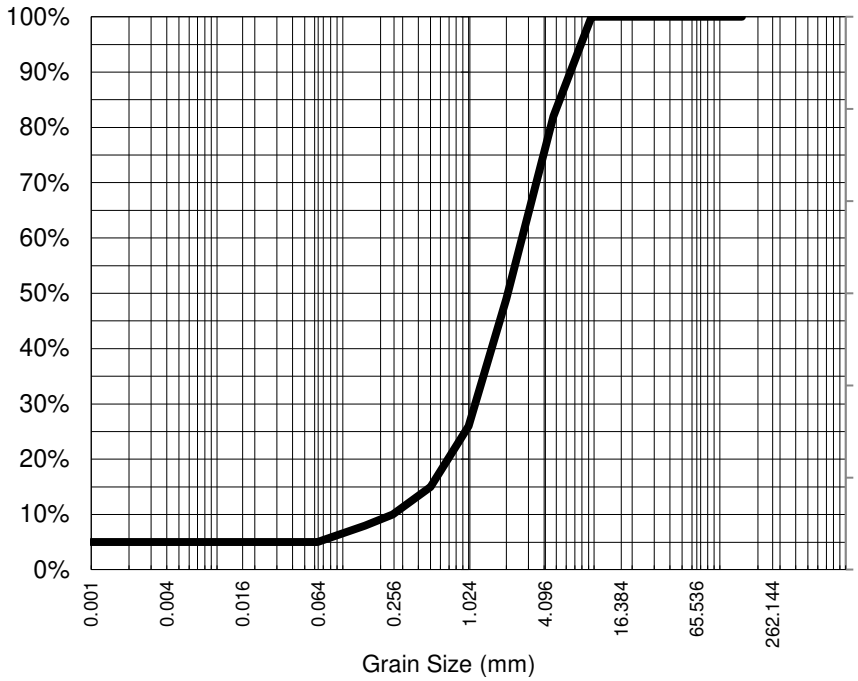
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-032 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G21

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	82%
2.00	49%
1.000	26%
0.500	15%
0.250	10%
0.150	8%
0.063	5%
Particle Size (microns)	
37	5%
26	5%
19	5%
13	5%
10	5%
7	5%
5	5%
3	5%
1	5%

Median Particle Size (mm)*	2.083

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.6		

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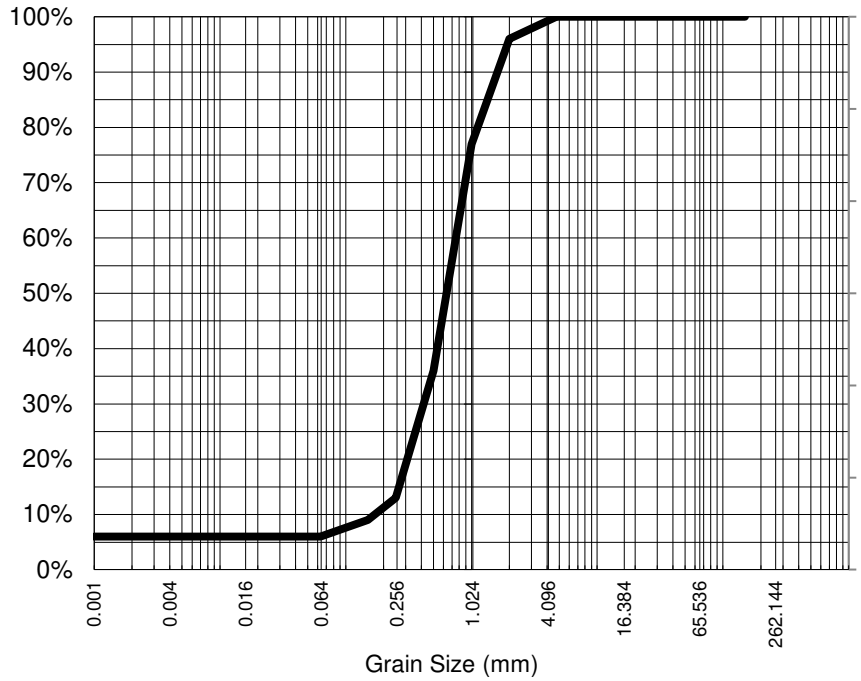
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-033 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G22

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.00	96%
1.000	77%
0.500	36%
0.250	13%
0.150	9%
0.063	6%
Particle Size (microns)	
37	6%
26	6%
18	6%
13	6%
9	6%
7	6%
5	6%
3	6%
1	6%

Median Particle Size (mm)*	0.671

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.65		

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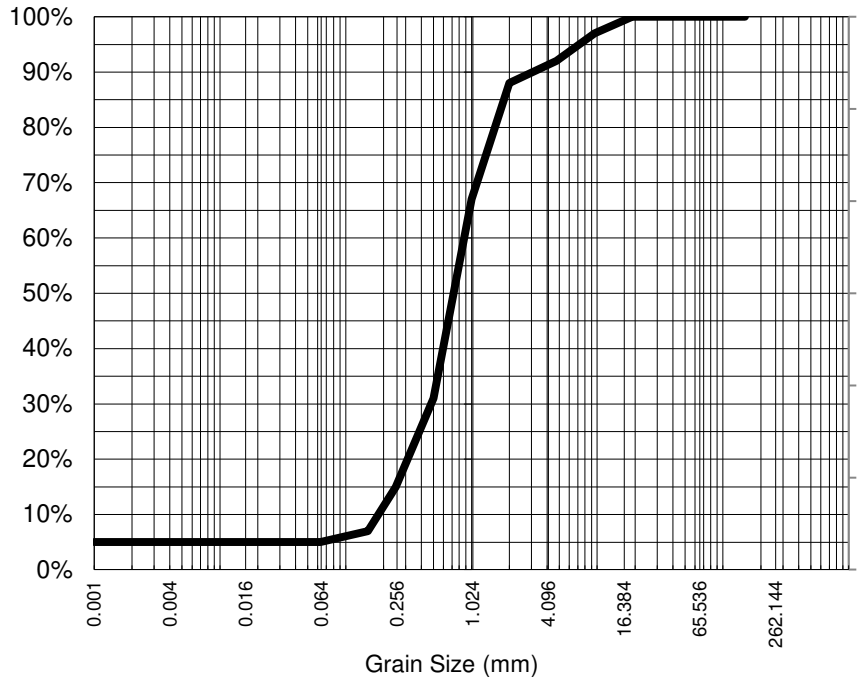
CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-034 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G23-T1

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	97%
4.75	92%
2.00	88%
1.000	67%
0.500	31%
0.250	15%
0.150	7%
0.063	5%
Particle Size (microns)	
38	5%
27	5%
19	5%
13	5%
10	5%
7	5%
5	5%
3	5%
1	5%

Median Particle Size (mm)*	0.764

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.59		

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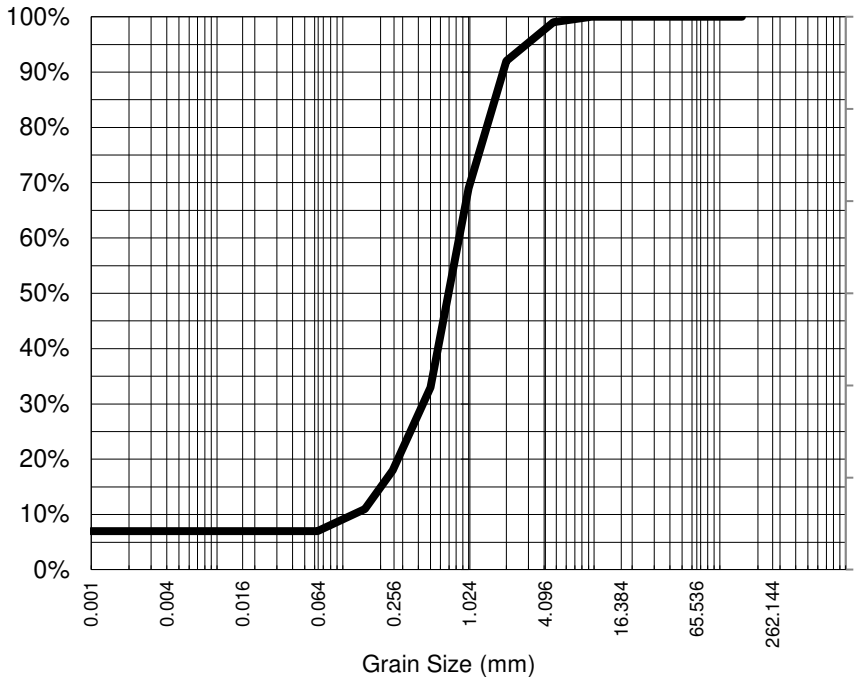
CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-035 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G23-T2

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	99%
2.00	92%
1.000	69%
0.500	33%
0.250	18%
0.150	11%
0.063	7%
Particle Size (microns)	
38	7%
27	7%
19	7%
13	7%
10	7%
7	7%
5	7%
3	7%
1	7%

Median Particle Size (mm)*	0.736

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.55		

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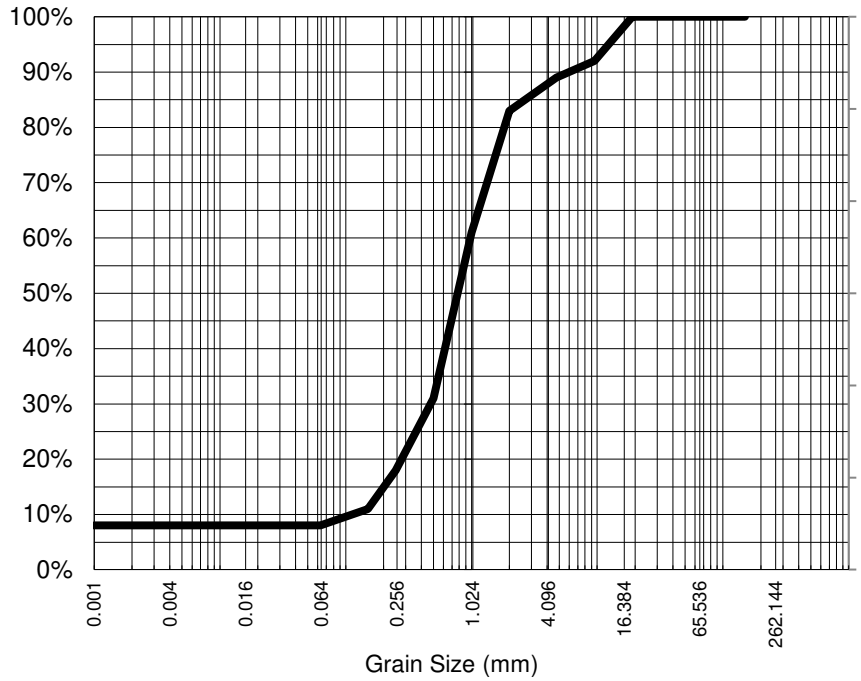
CLIENT:	Iain Posnett	**DATE REPORTED:**	1-Jun-2022
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-036 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G23-T3

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	92%
4.75	89%
2.00	83%
1.000	61%
0.500	31%
0.250	18%
0.150	11%
0.063	8%
Particle Size (microns)	
38	8%
27	8%
19	8%
13	8%
10	8%
7	8%
5	8%
3	8%
1	8%

Median Particle Size (mm)*	0.817

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.56		

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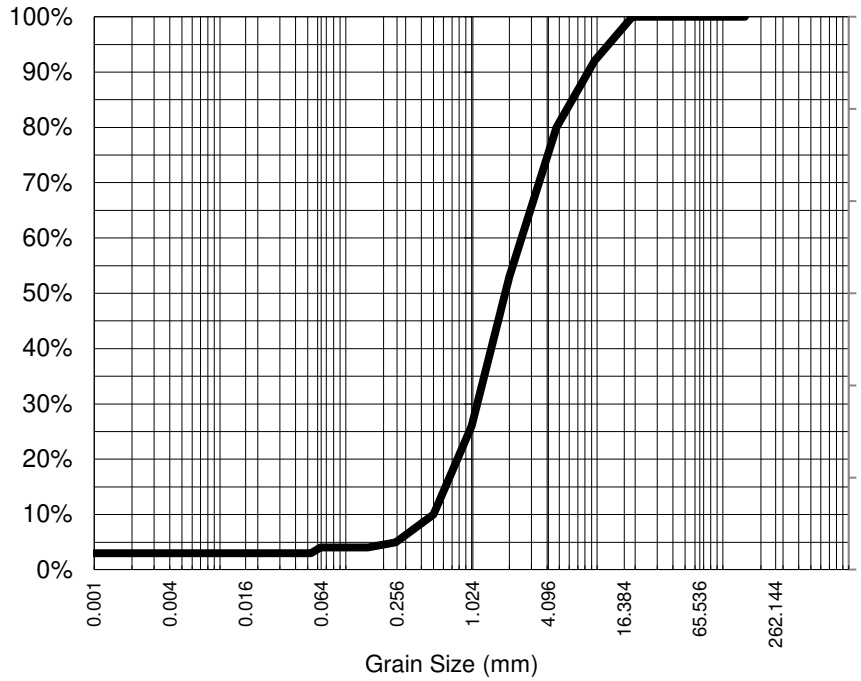
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-037 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G24

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	92%
4.75	80%
2.00	53%
1.000	26%
0.500	10%
0.250	5%
0.150	4%
0.063	4%
Particle Size (microns)	
37	3%
26	3%
19	3%
13	3%
10	3%
7	3%
5	3%
3	3%
1	3%

Median Particle Size (mm)*	1.889

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.6		

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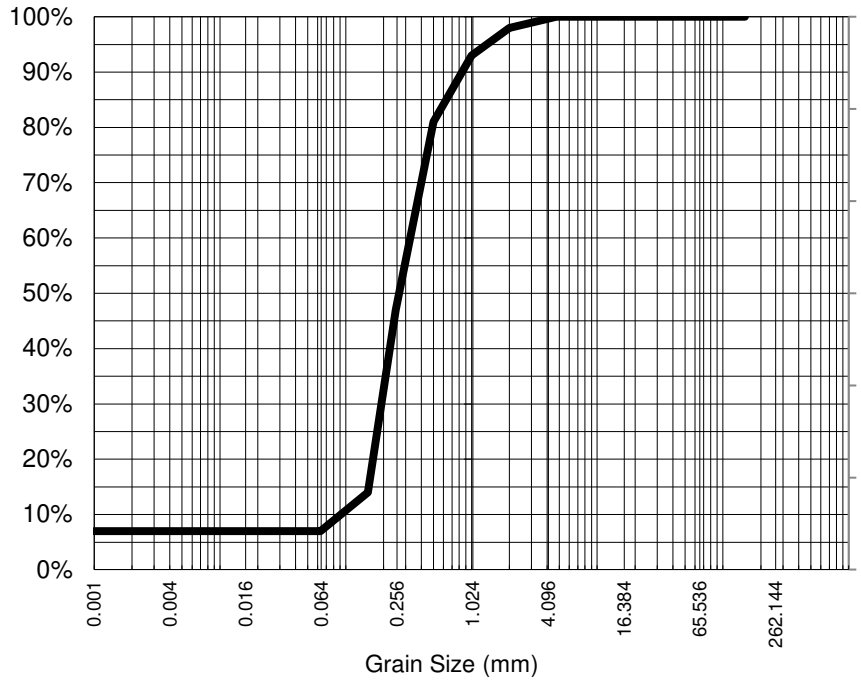
COMPANY:	MSCIENCE PTY LTD	**DATE RECEIVED:**	13-May-2022
ADDRESS:	322 Lord St	**REPORT NO:**	EP2205852-038 / PSD
PROJECT:	WA Esperance MSA321 - PPA CEP SAP	**SAMPLE ID:**	G25

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.00	98%
1.000	93%
0.500	81%
0.250	47%
0.150	14%
0.063	7%
Particle Size (microns)	
38	7%
27	7%
19	7%
13	7%
10	7%
7	7%
5	7%
3	7%
1	7%

Median Particle Size (mm)*	0.272

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:**	26-May-22
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, SHELL, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.00mm)	2.58		

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CERTIFICATE OF ANALYSIS 281708

Client Details

Client	Eurofins ARL Pty Ltd
Attention	Jessica Turner
Address	46-48 Banksia Road, Welshpool, WA, 6106

Sample Details

Your Reference	**888584**
Number of Samples	2 Soil
Date samples received	16/05/2022
Date completed instructions received	16/05/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	25/05/2022
Date of Issue	20/05/2022

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Results Approved By
Travis Carey, Organics - Team Leader

Authorised By

Michael Kubiak, Laboratory Manager

Organotin Compounds in Soil			
Our Reference		281708-1	281708-2
Sample ID	UNITS	888584 22-My0035328	888584 22-My0035329
Your Reference		G5-S3	G17-S3
Type of sample		Sediment	Sediment
Date extracted	-	18/05/2022	18/05/2022
Date analysed	-	20/05/2022	20/05/2022
Monobutyltin as Sn	µg Sn/kg	<0.5	<0.5
Dibutyltin as Sn	µg Sn/kg	<0.5	<0.5
Tributyltin as Sn	µg Sn/kg	<0.5	<0.5
Surrogate Triphenyltin	%	92	99

Moisture			
Our Reference		281708-1	281708-2
Sample ID	UNITS	888584 22-My0035328	888584 22-My0035329
Your Reference		G5-S3	G17-S3
Type of sample		Sediment	Sediment
Date prepared	-	18/05/2022	18/05/2022
Date analysed	-	20/05/2022	20/05/2022
Moisture	%	23	25

Method ID	Methodology Summary
INORG-008	Moisture content determined by heating at 105 deg C for a minimum of 12 hours.
Org-025/026	Water extracts are derivatised and extracted. Soils are extracted with a mix of water and methanolic KOH solution, neutralised and then derivatised and further extracted. The extracts are analysed by GC-MSMS. Alternatively, analyse directly by HS-GC-MSMS. Note - air volume measurements are not covered by Envirolab's NATA accreditation.

QUALITY CONTROL: Organotin Compounds in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	281708-2
Date extracted	-			18/05/2022	1	18/05/2022	18/05/2022		18/05/2022	18/05/2022
Date analysed	-			20/05/2022	1	20/05/2022	20/05/2022		20/05/2022	20/05/2022
Monobutyltin as Sn	µg Sn/kg	0.5	Org-025/026	<0.5	1	<0.5	<0.5	0	120	125
Dibutyltin as Sn	µg Sn/kg	0.5	Org-025/026	<0.5	1	<0.5	<0.5	0	122	115
Tributyltin as Sn	µg Sn/kg	0.5	Org-025/026	<0.5	1	<0.5	<0.5	0	107	107
Surrogate Triphenyltin	%		Org-025/026	99	1	92	110	18	91	98

QUALITY CONTROL: Moisture					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			18/05/2022	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Date analysed	-			20/05/2022	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Moisture	%	0.1	INORG-008	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

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NATA Accredited
Accreditation Number 2377
Site Number 2370

Accredited for compliance with ISO/IEC 17025 – Testing
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Attention: **Iain Posnett**

Report **888584-S**
Project name MSA321 - Port Hedland CEP
Received Date May 13, 2022

Client Sample ID			**G5-S3**	**G17-S3**
Sample Matrix			**Sediment**	**Sediment**
Eurofins Sample No.			**L22-My0035328**	**L22-My0035329**
Date Sampled			**Jun 07, 2022**	**Jun 07, 2022**
Test/Reference	LOR	Unit		
Polycyclic Aromatic Hydrocarbons (NAGD)				
2-Methylnapthalene	0.005	mg/kg	< 0.005	< 0.005
Acenaphthene	0.005	mg/kg	< 0.005	< 0.005
Acenaphthylene	0.005	mg/kg	< 0.005	< 0.005
Anthracene	0.005	mg/kg	< 0.005	< 0.005
Benz(a)anthracene	0.005	mg/kg	< 0.005	< 0.005
Benzo(a)pyrene	0.005	mg/kg	< 0.005	< 0.005
Benzo(b&j)fluoranthene	0.005	mg/kg	< 0.005	< 0.005
Benzo(e)pyrene	0.005	mg/kg	< 0.005	< 0.005
Benzo(g.h.i)perylene	0.005	mg/kg	< 0.005	< 0.005
Benzo(k)fluoranthene	0.005	mg/kg	< 0.005	< 0.005
Chrysene	0.005	mg/kg	< 0.005	< 0.005
Coronene	0.005	mg/kg	< 0.005	< 0.005
Dibenz(a.h)anthracene	0.005	mg/kg	< 0.005	< 0.005
Fluoranthene	0.005	mg/kg	< 0.005	< 0.005
Fluorene	0.005	mg/kg	< 0.005	< 0.005
Indeno(1.2.3-cd)pyrene	0.005	mg/kg	< 0.005	< 0.005
Naphthalene	0.005	mg/kg	< 0.005	< 0.005
Perylene	0.005	mg/kg	< 0.005	< 0.005
Phenanthrene	0.005	mg/kg	< 0.005	< 0.005
Pyrene	0.005	mg/kg	< 0.005	< 0.005
Total PAH*	0.005	mg/kg	< 0.005	< 0.005
2-Fluorobiphenyl (surr.)	1	%	69	56
p-Terphenyl-d14 (surr.)	1	%	74	65
TRH in Soil/Sediment				
TRH C6-9	0.2	mg/kg	< 0.2	< 0.2
TRH C10-14	0.2	mg/kg	< 0.2	< 0.2
TRH C15-28	0.4	mg/kg	< 0.4	< 0.4
TRH C29-36	0.4	mg/kg	< 0.4	< 0.4
TRH C>36	0.4	mg/kg	< 0.4	< 0.4
TOC	0.1	%	0.1	0.2
Aluminium	1	mg/kg	2300	3000
Antimony	2	mg/kg	< 2	< 2
Arsenic	5	mg/kg	43	47
Cadmium	0.1	mg/kg	< 0.1	< 0.1
Chromium	1	mg/kg	16	17

Client Sample ID			G5-S3	G17-S3
Sample Matrix			Sediment	Sediment
Eurofins Sample No.			L22-My0035328	L22-My0035329
Date Sampled			Jun 07, 2022	Jun 07, 2022
Test/Reference	LOR	Unit		
Copper	1	mg/kg	5.0	7.4
Iron	1	mg/kg	15000	16000
Lead	1	mg/kg	3.4	3.9
Manganese	1	mg/kg	350	500
Mercury	0.02	mg/kg	< 0.02	< 0.02
Nickel	1	mg/kg	6.3	7.7
Silver	1	mg/kg	< 1	< 1
Zinc	1	mg/kg	7.7	8.0
% Moisture	1	%	23	23
Particle Size Distribution			See attached	See attached

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Polycyclic Aromatic Hydrocarbons (NAGD)	Melbourne	May 19, 2022	14 Days
- Method: LTM-ORG-2130 PAH and Phenols in Soil and Water			
TRH in Soil/Sediment	Welshpool	May 15, 2022	14 Days
- Method: ARL010 - Total Petroleum Hydrocarbons (TPH) in Soil			
TOC	Welshpool	May 16, 2022	28 Days
- Method: ARL No. 064 - Total Organic Carbon in Sediment			
Aluminium	Welshpool	May 15, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Antimony	Welshpool	May 15, 2022	180 Day
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Arsenic	Welshpool	May 15, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Cadmium	Welshpool	May 15, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Chromium	Welshpool	May 15, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Copper	Welshpool	May 15, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Iron	Welshpool	May 15, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Lead	Welshpool	May 15, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Manganese	Welshpool	May 15, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Mercury	Welshpool	May 15, 2022	28 Days
- Method: ARL No. 406 - Mercury by Cold Vapour Atomic Absorption Spectrophotometry			
Nickel	Welshpool	May 15, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
Silver	Welshpool	May 15, 2022	180 Days
- Method: ARL030 - Metals in Soil and Sediment by AAS			
Zinc	Welshpool	May 15, 2022	180 Days
- Method: ARL401/403 - Metals in Soil and Sediment by ICPOES/MS			
% Moisture	Welshpool	May 15, 2022	14 Days
- Method: ARL135 Moisture in Solids			

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

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 SRA.

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.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
µg/L: micrograms per litre
ppm: parts per million
ppb: parts per billion
%: Percentage
org/100 mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100 mL: Most Probable Number of organisms per 100 millilitres

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
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.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

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%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

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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. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Polycyclic Aromatic Hydrocarbons (NAGD)							
2-Methylnapthalene	mg/kg	< 0.005			0.005	Pass	
Acenaphthene	mg/kg	< 0.005			0.005	Pass	
Acenaphthylene	mg/kg	< 0.005			0.005	Pass	
Anthracene	mg/kg	< 0.005			0.005	Pass	
Benz(a)anthracene	mg/kg	< 0.005			0.005	Pass	
Benzo(a)pyrene	mg/kg	< 0.005			0.005	Pass	
Benzo(b&j)fluoranthene	mg/kg	< 0.005			0.005	Pass	
Benzo(e)pyrene	mg/kg	< 0.005			0.005	Pass	
Benzo(g.h.i)perylene	mg/kg	< 0.005			0.005	Pass	
Benzo(k)fluoranthene	mg/kg	< 0.005			0.005	Pass	
Chrysene	mg/kg	< 0.005			0.005	Pass	
Coronene	mg/kg	< 0.005			0.005	Pass	
Dibenz(a.h)anthracene	mg/kg	< 0.005			0.005	Pass	
Fluoranthene	mg/kg	< 0.005			0.005	Pass	
Fluorene	mg/kg	< 0.005			0.005	Pass	
Indeno(1.2.3-cd)pyrene	mg/kg	< 0.005			0.005	Pass	
Naphthalene	mg/kg	< 0.005			0.005	Pass	
Perylene	mg/kg	< 0.005			0.005	Pass	
Phenanthrene	mg/kg	< 0.005			0.005	Pass	
Pyrene	mg/kg	< 0.005			0.005	Pass	
Method Blank							
TRH in Soil/Sediment							
TRH C6-9	mg/kg	< 0.2			0.2	Pass	
TRH C10-14	mg/kg	< 0.2			0.2	Pass	
TRH C15-28	mg/kg	< 0.4			0.4	Pass	
TRH C29-36	mg/kg	< 0.4			0.4	Pass	
TRH C>36	mg/kg	< 0.4			0.4	Pass	
Method Blank							
Aluminium	mg/kg	< 1			1	Pass	
Antimony	mg/kg	< 2			2	Pass	
Arsenic	mg/kg	< 5			5	Pass	
Cadmium	mg/kg	< 0.1			0.1	Pass	
Chromium	mg/kg	< 1			1	Pass	
Copper	mg/kg	< 1			1	Pass	
Lead	mg/kg	< 1			1	Pass	
Manganese	mg/kg	< 1			1	Pass	
Mercury	mg/kg	< 0.02			0.02	Pass	
Nickel	mg/kg	< 1			1	Pass	
Silver	mg/kg	< 1			1	Pass	
Zinc	mg/kg	< 1			1	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons (NAGD)							
Acenaphthene	%	113			70-130	Pass	
Acenaphthylene	%	117			70-130	Pass	
Anthracene	%	103			70-130	Pass	
Benz(a)anthracene	%	92			70-130	Pass	
Benzo(a)pyrene	%	90			70-130	Pass	
Benzo(b&j)fluoranthene	%	117			70-130	Pass	
Benzo(g.h.i)perylene	%	109			70-130	Pass	
Benzo(k)fluoranthene	%	113			70-130	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Chrysene	%	125			70-130	Pass	
Dibenz(a.h)anthracene	%	104			70-130	Pass	
Fluoranthene	%	119			70-130	Pass	
Fluorene	%	123			70-130	Pass	
Indeno(1.2.3-cd)pyrene	%	109			70-130	Pass	
Naphthalene	%	101			70-130	Pass	
Phenanthrene	%	105			70-130	Pass	
Pyrene	%	112			70-130	Pass	
LCS - % Recovery							
Aluminium	%	85			80-120	Pass	
Antimony	%	86			80-120	Pass	
Arsenic	%	108			80-120	Pass	
Cadmium	%	101			80-120	Pass	
Chromium	%	99			80-120	Pass	
Copper	%	112			80-120	Pass	
Iron	%	89			80-120	Pass	
Lead	%	113			80-120	Pass	
Manganese	%	109			80-120	Pass	
Mercury	%	89			60-120	Pass	
Nickel	%	109			80-120	Pass	
Silver	%	86			80-120	Pass	
Zinc	%	115			80-120	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
				Result 1					
Arsenic	L22-My0026127	NCP	%	102			80-120	Pass	
Cadmium	L22-My0035330	NCP	%	111			80-120	Pass	
Manganese	L22-My0033258	NCP	%	86			80-120	Pass	
Mercury	L22-My0035330	NCP	%	103			80-120	Pass	
Nickel	L22-My0026127	NCP	%	106			80-120	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Aluminium	L22-My0035332	NCP	mg/kg	5400	4600	15	20%	Pass	
Antimony	L22-My0035332	NCP	mg/kg	< 2	< 2	<1	20%	Pass	
Arsenic	L22-My0035332	NCP	mg/kg	19	15	28	20%	Fail	Q15
Chromium	L22-My0035332	NCP	mg/kg	33	32	2.0	20%	Pass	
Copper	L22-My0035332	NCP	mg/kg	11	9.4	19	20%	Pass	
Iron	L22-My0035332	NCP	mg/kg	17000	16000	9.0	20%	Pass	
Manganese	L22-My0035332	NCP	mg/kg	460	360	25	20%	Fail	Q15
Mercury	L22-My0048246	NCP	mg/kg	< 0.02	< 0.02	<1	30%	Pass	
Nickel	L22-My0035332	NCP	mg/kg	12	9.9	15	20%	Pass	
Silver	L22-My0026124	NCP	mg/kg	< 1	< 1	<1	20%	Pass	
Zinc	L22-My0035332	NCP	mg/kg	18	18	2.0	20%	Pass	
% Moisture	L22-My0035331	NCP	%	43	44	3.0	30%	Pass	

Comments

Analysis of PSD has been completed by Microanalysis, report reference 22_0736
Analysis of organotins has been completed by MPL, NATA Accreditation Number 2901, report reference 281708 (See attached)
Analysis of TOC has been completed by Eurofins | APAL, report reference 95620. This is not covered by NATA accreditation.

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	N/A
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
Q15	The RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.

Authorised by:

Douglas Todd	Analytical Services Manager
Sean Sangster	Senior Analyst-Metal
Sean Sangster	Senior Analyst-Sample Properties
Joseph Edouard	Senior Analyst-Organic
Edward Lee	Senior Analyst-Organic
Paul Nottle	Senior Analyst-Organic

Kim Rodgers
Business Unit Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request

10 APPENDIX E – QA/QC REPORTS FROM THE LABORATORY ANALYSIS

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP2205852**	Page	: 1 of 14
Client	: **MSCIENCE PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: Iain Posnett	Telephone	: +61-8-9406 1301
Project	: MSA321 - PPA CEP SAP	Date Samples Received	: 13-May-2022
Site	: ----	Issue Date	: 07-Jun-2022
Sampler	: Matt Frapple	No. of samples received	: 39
Order number	: ----	No. of samples analysed	: 39

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

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EP132B: Polynuclear Aromatic Hydrocarbons	EP2205852--004	G2-T2	**Naphthalene**	91-20-3	66.9 %	70.0-130%	**Recovery less than lower data quality objective**
EP132B: Polynuclear Aromatic Hydrocarbons	EP2205852--004	G2-T2	**Acenaphthylene**	208-96-8	53.6 %	70.0-130%	**Recovery less than lower data quality objective**
EP132B: Polynuclear Aromatic Hydrocarbons	EP2205852--004	G2-T2	**Acenaphthene**	83-32-9	51.3 %	70.0-130%	**Recovery less than lower data quality objective**
EP132B: Polynuclear Aromatic Hydrocarbons	EP2205852--004	G2-T2	**Fluorene**	86-73-7	61.7 %	70.0-130%	**Recovery less than lower data quality objective**
EP132B: Polynuclear Aromatic Hydrocarbons	EP2205852--004	G2-T2	**Benz(a)anthracene**	56-55-3	65.0 %	70.0-130%	**Recovery less than lower data quality objective**
EP132B: Polynuclear Aromatic Hydrocarbons	EP2205852--004	G2-T2	**Chrysene**	218-01-9	50.6 %	70.0-130%	**Recovery less than lower data quality objective**
EP132B: Polynuclear Aromatic Hydrocarbons	EP2205852--004	G2-T2	**Benzo(k)fluoranthene**	207-08-9	56.9 %	70.0-130%	**Recovery less than lower data quality objective**
EP132B: Polynuclear Aromatic Hydrocarbons	EP2205852--004	G2-T2	**Benzo(a)pyrene**	50-32-8	63.6 %	70.0-130%	**Recovery less than lower data quality objective**
EP132B: Polynuclear Aromatic Hydrocarbons	EP2205852--004	G2-T2	**Benzo(g.h.i)perylene**	191-24-2	45.0 %	70.0-130%	**Recovery less than lower data quality objective**
EP132B: Polynuclear Aromatic Hydrocarbons	EP2205852--004	G2-T2	**Dibenz(a.h)anthracene**	53-70-3	38.4 %	70.0-130%	**Recovery less than lower data quality objective**
EP132B: Polynuclear Aromatic Hydrocarbons	EP2205852--004	G2-T2	**Indeno(1.2.3.cd)pyrene**	193-39-5	50.8 %	70.0-130%	**Recovery less than lower data quality objective**

Outliers : Frequency of Quality Control Samples

Matrix: **SOIL**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Matrix Spikes (MS)					
Total Fe and Al in Sediments by ICPAES	0	38	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

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

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

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

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

Matrix: **SOIL**

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

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)							
C1-05, C1-1, C3-05, C3-1, C4-05, C4-1, C7-05, C7-1, C9-05, C9-1, TB1	**05-May-2022**	**----**	----	----	**18-May-2022**	19-May-2022	✓
Soil Glass Jar - Unpreserved (EA055)							
G2-T1, G2-T2, G2-T3, G5-S1, G5-S2, G6, G8, G10, G11, G12-T1, G12-T2, G12-T3, G13, G14, G15, G16, G17-S1, G17-S2, G18, G19, G20, G21, G22, G23-T1, G23-T2, G23-T3, G24, G25	**07-May-2022**	**----**	----	----	**18-May-2022**	21-May-2022	✓

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
EA150: Particle Sizing							
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H)							
C1-05, C1-1, C3-05, C3-1, C4-05, C4-1, C7-05, C7-1, C9-05, C9-1	**05-May-2022**	**----**	----	----	**01-Jun-2022**	01-Nov-2022	✓
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H)							
G2-T1, G2-T2, G2-T3, G5-S1, G5-S2, G6, G8, G10, G11, G12-T1, G12-T2, G12-T3, G13, G14, G15, G16, G17-S1, G17-S2, G18, G19, G20, G21, G22, G23-T1, G23-T2, G23-T3, G24, G25	**07-May-2022**	**----**	----	----	**01-Jun-2022**	03-Nov-2022	✓

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
EA152: Soil Particle Density								
Snap Lock Bag - Friable Asbestos/PSD Bag (EA152)								
C1-05,	C1-1,	**05-May-2022**	**----**	----	----	**01-Jun-2022**	01-Nov-2022	✓
C3-05,	C3-1,							
C4-05,	C4-1,							
C7-05,	C7-1,							
C9-05,	C9-1							
Snap Lock Bag - Friable Asbestos/PSD Bag (EA152)								
G2-T1,	G2-T2,	**07-May-2022**	**----**	----	----	**01-Jun-2022**	03-Nov-2022	✓
G2-T3,	G5-S1,							
G5-S2,	G6,							
G8,	G10,							
G11,	G12-T1,							
G12-T2,	G12-T3,							
G13,	G14,							
G15,	G16,							
G17-S1,	G17-S2,							
G18,	G19,							
G20,	G21,							
G22,	G23-T1,							
G23-T2,	G23-T3,							
G24,	G25							

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
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES							
Soil Glass Jar - Unpreserved (EG005-SD)							
C1-05, C1-1, C3-05, C3-1, C4-05, C4-1, C7-05, C7-1, C9-05, C9-1	**05-May-2022**	**18-May-2022**	01-Nov-2022	✓	**19-May-2022**	01-Nov-2022	✓
Soil Glass Jar - Unpreserved (EG005-SD)							
G2-T1, G2-T2, G2-T3, G5-S1, G5-S2, G6, G8, G10, G11, G12-T1, G12-T2, G12-T3, G13, G14, G15, G16, G17-S1, G17-S2, G18, G19, G20, G21, G22, G23-T1, G23-T2, G23-T3, G24, G25	**07-May-2022**	**18-May-2022**	03-Nov-2022	✓	**19-May-2022**	03-Nov-2022	✓

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
EG020-SD: Total Metals in Sediments by ICPMS							
Soil Glass Jar - Unpreserved (EG020-SD)							
C1-05, C1-1, C3-05, C3-1, C4-05, C4-1, C7-05, C7-1, C9-05, C9-1	**05-May-2022**	**18-May-2022**	01-Nov-2022	✓	**19-May-2022**	01-Nov-2022	✓
Soil Glass Jar - Unpreserved (EG020-SD)							
G2-T1, G2-T2, G2-T3, G5-S1, G5-S2, G6, G8, G10, G11, G12-T1, G12-T2, G12-T3, G13, G14, G15, G16, G17-S1, G17-S2, G18, G19, G20, G21, G22, G23-T1, G23-T2, G23-T3, G24, G25	**07-May-2022**	**18-May-2022**	03-Nov-2022	✓	**19-May-2022**	03-Nov-2022	✓

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-LL)							
C1-05, C1-1, C3-05, C3-1, C4-05, C4-1, C7-05, C7-1, C9-05, C9-1	**05-May-2022**	**18-May-2022**	02-Jun-2022	✓	**19-May-2022**	02-Jun-2022	✓
Soil Glass Jar - Unpreserved (EG035T-LL)							
G2-T1, G2-T2, G2-T3, G5-S1, G5-S2, G6, G8, G10, G11, G12-T1, G12-T2, G12-T3, G13, G14, G15, G16, G17-S1, G17-S2, G18, G19, G20, G21, G22, G23-T1, G23-T2, G23-T3, G24, G25	**07-May-2022**	**18-May-2022**	04-Jun-2022	✓	**19-May-2022**	04-Jun-2022	✓

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
EP003: Total Organic Carbon (TOC) in Soil							
Snap Lock Bag (EP003)							
C1-05, C1-1, C3-05, C3-1, C4-05, C4-1, C7-05, C7-1, C9-05, C9-1	**05-May-2022**	**01-Jun-2022**	02-Jun-2022	✓	**01-Jun-2022**	02-Jun-2022	✓
Snap Lock Bag (EP003)							
G2-T1, G2-T2, G2-T3, G5-S1, G5-S2, G6, G8, G10, G11, G12-T1, G12-T2, G12-T3, G13, G14, G15, G16, G17-S1, G17-S2, G18, G19, G20, G21, G22, G23-T1, G23-T2, G23-T3, G24, G25	**07-May-2022**	**01-Jun-2022**	04-Jun-2022	✓	**01-Jun-2022**	04-Jun-2022	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Soil Glass Jar - Unpreserved (EP071-SD)							
G2-T1, G2-T2, G2-T3, G5-S1, G5-S2, G6, G8, G10, G12-T1, G12-T2, G12-T3, G17-S1, G17-S2, G23-T1, G23-T2, G23-T3	**07-May-2022**	**18-May-2022**	21-May-2022	✓	**25-May-2022**	27-Jun-2022	✓

Matrix: **SOIL**

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

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons							
Soil Glass Jar - Unpreserved (EP080-SD)							
TB1	**05-May-2022**	**18-May-2022**	19-May-2022	✓	**19-May-2022**	19-May-2022	✓
Soil Glass Jar - Unpreserved (EP080-SD)							
G2-T1, G2-T2, G2-T3, G5-S1, G5-S2, G6, G8, G10, G12-T1, G12-T2, G12-T3, G17-S1, G17-S2, G23-T1, G23-T2, G23-T3	**07-May-2022**	**18-May-2022**	21-May-2022	✓	**19-May-2022**	21-May-2022	✓
Soil Glass Jar - Unpreserved (EP071-SD)							
G2-T1, G2-T2, G2-T3, G5-S1, G5-S2, G6, G8, G10, G12-T1, G12-T2, G12-T3, G17-S1, G17-S2, G23-T1, G23-T2, G23-T3	**07-May-2022**	**18-May-2022**	21-May-2022	✓	**25-May-2022**	27-Jun-2022	✓
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons							
Soil Glass Jar - Unpreserved (EP080-SD)							
TB1	**05-May-2022**	**18-May-2022**	19-May-2022	✓	**19-May-2022**	19-May-2022	✓
Soil Glass Jar - Unpreserved (EP080-SD)							
G2-T1, G2-T2, G2-T3, G5-S1, G5-S2, G6, G8, G10, G12-T1, G12-T2, G12-T3, G17-S1, G17-S2, G23-T1, G23-T2, G23-T3	**07-May-2022**	**18-May-2022**	21-May-2022	✓	**19-May-2022**	21-May-2022	✓

Matrix: **SOIL**

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

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080-SD: BTEXN							
Soil Glass Jar - Unpreserved (EP080-SD)							
TB1	**05-May-2022**	**18-May-2022**	19-May-2022	✓	**19-May-2022**	19-May-2022	✓
Soil Glass Jar - Unpreserved (EP080-SD)							
G2-T1, G2-T2, G2-T3, G5-S1, G5-S2, G6, G8, G10, G12-T1, G12-T2, G12-T3, G17-S1, G17-S2, G23-T1, G23-T2, G23-T3	**07-May-2022**	**18-May-2022**	21-May-2022	✓	**19-May-2022**	21-May-2022	✓
EP090: Organotin Compounds							
Soil Glass Jar - Frozen (EP090)							
G2-T1, G2-T2, G2-T3, G5-S1, G5-S2, G6, G8, G10, G12-T1, G12-T2, G12-T3, G17-S1, G17-S2, G23-T1, G23-T2, G23-T3	**07-May-2022**	**30-May-2022**	02-Jul-2022	✓	**03-Jun-2022**	09-Jul-2022	✓
EP132B: Polynuclear Aromatic Hydrocarbons							
Soil Glass Jar - Unpreserved (EP132B-SD)							
G2-T1, G2-T2, G2-T3, G5-S1, G5-S2, G6, G8, G10, G12-T1, G12-T2, G12-T3, G17-S1, G17-S2, G23-T1, G23-T2, G23-T3	**07-May-2022**	**18-May-2022**	21-May-2022	✓	**25-May-2022**	27-Jun-2022	✓

Quality Control Parameter Frequency Compliance

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

Matrix: **SOIL**

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

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Moisture Content	EA055	4	39	**10.26**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	4	38	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	4	38	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	4	38	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	4	38	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatile Fraction	EP071-SD	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX in Sediments	EP080-SD	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Organotin Analysis	EP090	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	2	38	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	2	38	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	3	38	**7.89**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	4	38	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatile Fraction	EP071-SD	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX in Sediments	EP080-SD	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Organotin Analysis	EP090	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	2	38	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	2	38	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	2	38	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	2	38	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatile Fraction	EP071-SD	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX in Sediments	EP080-SD	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Organotin Analysis	EP090	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	0	38	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	2	38	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	2	38	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatile Fraction	EP071-SD	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX in Sediments	EP080-SD	1	17	**5.88**	**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 Fe and Al in Sediments by ICPAES	EG005-SD	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). LORs per NODG
Total Metals in Sediments by ICPMS	EG020-SD	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector. Analyte list and LORs per NODG.
Total Mercury by FIMS (Low Level)	EG035T-LL	SOIL	In house: Referenced to 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)
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.
TPH - Semivolatile Fraction	EP071-SD	SOIL	In house: Referenced to USEPA SW 846 - 8270. Extracts are analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
TRH Volatiles/BTEX in Sediments	EP080-SD	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.
Organotin Analysis	EP090	SOIL	In house: Referenced to USEPA SW 846 - 8270 Prepared sample extracts are analysed by GC/MS coupled with high volume injection, and quanitified against an established calibration curve.
PAHs in Sediments by GCMS(SIM)	EP132B-SD	SOIL	In house: Referenced to USEPA 8270 GCMS Capillary column, SIM mode using large volume programmed temperature vaporisation injection.

Preparation Methods	Method	Matrix	Method Descriptions
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).
Dry and Pulverise (up to 100g)	GEO30	SOIL	#

Preparation Methods	Method	Matrix	Method Descriptions
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 (Option A - Concentrating)	ORG17A	SOIL	In house: Mechanical agitation (tumbler). 20g of sample, Na2SO4 and surrogate are extracted with 150mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.
Tumbler Extraction of Solids for LVI (Non-concentrating)	ORG17D	SOIL	In house: 10g of sample, Na2SO4 and surrogate are extracted with 50mL 1:1 DCM/Acetone by end over end tumbling. An aliquot is concentrated by nitrogen blowdown to a reduced volume for analysis if required.
Organotin Sample Preparation	ORG35	SOIL	In house: 20g sample is spiked with surrogate and leached in a methanol:acetic acid:UHP water mix and vacuum filtered. Reagents and solvents are added to the sample and the mixture tumbled. The butyltin compounds are simultaneously derivatised and extracted. The extract is further extracted with petroleum ether. The resultant extracts are combined and concentrated for analysis.