Mardie Project

Sediment Quality Assessment Report

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O2 MARINE

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Executive Summary

Mardie Minerals Pty Ltd is proposing to develop a Salt and Potash marine export facility as part of a salt production project (The Mardie Project). The Mardie Project involves dredging up to 500,000 cubic metres of sediment and construction and operations of a trestle jetty extending 3.4 km into sub-tidal marine waters at Mardie in the Pilbara, WA. This document addresses requirements of the Environmental Scoping Document (ESD) developed for the Mardie Project to implement a baseline marine sediment quality investigation for the derivation of environmental quality criteria (EQC), to identify potential acid sulfate sediments that could be disturbed and for consideration of the *Environmental Protection (Sea dumping) Act 1981* and associated guidance during development of the Dredging and Spoil Disposal Management Plan (DSDMP).

Sediment sampling took place over three separate field campaigns in December 2018, January 2019 and March 2019. The marine project footprint was revised following the first two sampling events, with one further sampling event conducted following modification of the marine project design. Sediment samples were collected using a combination of vibro-coring, surface grab sampling and diver-coring from thirty-two (32) sites with 34 samples collected in total (excluding QA/QC samples). The vibro-corer experienced refusal at 0.5 m depth on hard substrate (i.e. gravel and/or limestone layers) at all locations except two (2) where samples were collected up to 1 m depth and subsamples were collected from two horizons; 0 m to 0.5 m and 0.5 m to 1 m. The sediment samples were analysed for physical properties (PSD), Metals and metalloids (Al, Ag, As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Sb, V and Zn), Organic compounds (TPH/TRH, BTEXN, PAHs, TBT), Nutrients (TN, TKN, NH4, NO2+NO3, TP, FRP), Pesticides, Potential acid sulfate soils (PASS) and Benthic infauna. The results are compared to relevant sediment quality guidelines (SQGs) where appropriate.

The samples collected within the nearshore proposed Development Envelope at Mardie are comprised of uncontaminated sediments and are considered suitable for onshore disposal. The background sediment quality at the site is considered to be representative of natural environmental conditions that are largely un-impacted by anthropogenic influences. However, some concentrations for metals and nutrients in sediments are naturally higher than recorded for marine sediment programs in other areas of the Pilbara, Western Australia, and revised site-specific EQC are recommended.

Physical Characteristics

The colour of the sediment samples varied from brown/grey, grey/red/, dark grey, red/brown, dark brown to brown. Sand and gravel size fractions dominated the particle size distribution (PSD) results from locations within the channel (C1-1 to C8) and the outer channel (OC1-OC3) of the original dredge footprint, and within the revised dredge footprint sample area (RF1-RF6).

Sites closer to shore within the turning basin (TB1-TB10), around the outfall (O1-O3) and the inner channel (C9-C11) of the original footprint sediment samples were comprised of a higher proportion of fines (i.e. silt and clay).

The total organic carbon (TOC) levels were typically low across the survey area, although notably lower proportions of TOC and moisture were found in samples collected closer to shore of the original dredge footprint, between the original proposed turning basin and revised dredge sample area.

Metals and Metalloids

The results for total metals in sediment from the Mardie Project area indicate the estimated natural background concentrations are typically higher than recorded across the Pilbara region. The 95% Upper Confidence Level (UCL) of the mean were calculated across all 32 sites. The 95% UCL was above the Interim Sediment Quality Guideline (ISQG) low value for arsenic and nickel. In addition, the 95% UCL is above the background SQG for Pilbara waters for aluminium, cobalt, iron and vanadium. Three samples exceed the low reliability guideline value for Manganese. All concentrations for all metals are below EIL and HIL screening levels. The standard deviation of the sample data is less than 50% of the relevant HILs across all metals and no single value exceeds 250% of the relevant HILs.

Normalisation tests conducted on the results for metals in sediment samples found a strong positive correlation between Aluminium and Iron, although weak correlations for comparison of these natural elements with the <63 µm PSD. The results indicate naturally high levels of trace metals occur in marine sediments in the Development Envelope, likely dependant on the geology and mineralogy of the area, although apparently not strongly correlated to PSD. This is contradictory to findings from other studies in the region where grain size was determined to be the principle factor controlling concentrations of most trace metals in whole sediments (O2 Marine 2018). However, the PSD results collected from the Development Envelope were highly variable. The results may be influenced by terrigenous input from the Fortescue River catchment, similar to DEC (2006) findings of higher natural concentrations in sediments from Ashburton River Mouth compared to levels measured at other locations along the Pilbara coast.

The data for metal contaminants that recorded elevated concentrations (Arsenic, Nickel, Vanadium, Cobalt and Manganese) were graphed against the Aluminium normaliser concentration. A strong positive correlation with Nickel, Cobalt, and Vanadium suggests these metals are lithogenically derived and of natural origin. The normalised results for Nickel are below the ISQG-low value of 21 mg/L, although values for Cobalt and Vanadium remain above the SQG for Pilbara waters. Weak linear correlations are observed between Aluminium and Arsenic or Manganese, therefore normalisation was not undertaken on these metals. DEC (2006) concluded that the ISQG-low value for Arsenic may not be suitable for use across much of the marine environment of the Pilbara region and that alternative guidelines based on local data should be derived. In addition, the Manganese low reliability guideline value was derived from The Ontario Ministry of the Environment and therefore natural exceedance of this value is unlikely to indicate a Contaminant of Potential Concern.

Site-specific EQC have been derived for metals in sediment for the Mardie Project area in accordance with DEC (2006) and EPA (2016).

Organic Compounds

Organic compounds tested included TPH, TRH, BTEXN, PAHs and organotins. All contaminant concentrations are below ANZECC/ARMCANZ (2000) ISQG-low, ESL and HSL values, and the vast majority of organic analytes are below the laboratory LoR. The only organic compounds recorded above the LoR are TPH/TRH concentrations in the larger carbon fractions at seven sites.

EQC for these organic compounds will use values derived in ISQG or the guideline may be no detectable concentration.

Pesticides

All 14 tested Phenoxyacetic Acid Herbicide analytes returned concentrations below the LoR. Herbicides were identified early as a CoPC due to historical use on Mardie Station. This SAP found no evidence of Herbicides in marine sediments.

EQC for these herbicide analytes will use values derived in ISQG or the guideline may be no detectable concentration.

Nutrients

Inorganic forms of nutrients in sediments (NO_2, NO_3, NH_4, FRP) are either below the laboratory LoR, or are recorded at very low concentrations. Results for TKN/TN and TP are therefore likely to be predominantly organically bound and representative of the typically low organic concentrations of sediments of the Pilbara, which must be broken down into inorganic forms to be available for uptake by plants. Concentrations of TKN/TN range from 110 to 500 mg/kg and TP from 179 to 468 mg/kg. However, these concentrations are notably higher than organic material reported in sediments near Onslow which ranged from 30 to 360 mg/kg and 43 to 293 mg/kg, respectively (O2 Marine 2018).

Site-specific EQC have been derived for nutrients in sediment for the Mardie Project area in accordance with DEC (2006) and EPA (2016).

PASS Screening

Values across all sites for pH_F in deionised water range from 7.4 to 9.3, reflecting seawater influence (pH 8.2) and possibly dissolved carbonates typical of sediments in marine systems. The maximum change in pH_F and pH_{FOX} values was 1.7. The reaction to hydrogen peroxide was recorded as “Extreme” in 10 samples. Whilst “Extreme” reactions were recorded in a reasonable number of samples from the site, results from the other two combining factors to identify a ‘positive field sulphide identification’ were not triggered and it is therefore considered PASS are not detected. The reactions observed were possibly caused from organic material within the sample.

Benthic Infauna

The distribution and abundance of benthic infauna taxa across the survey area is heterogeneous, and there was no significant difference in species richness, diversity or composition identified across sites. The results suggest that it would be difficult to develop EQC for detecting anthropogenic impacts based on the variability of benthic infauna observed within samples. The genus of foraminifera *Quinqueloculina* spp., which is found in relatively high abundance within these sediments, may be considered a good bioindicator for disturbance. These foraminifera have been shown to be sensitive taxa and the faunal composition and morphology respond to human-induced environmental perturbations and extreme responses to natural variations in coastal marine areas. However, further targeted investigation would be required to develop specific biomonitoring EQC.

Acronyms and Abbreviations

Acronyms/Abbreviation	Description
ADAS	Australian Diver Accreditation Scheme
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BTEXN	Benzene, Toluene, Ethylbenzene, Xylenes and Naphthalene
COPC	Contaminants of Potential Concern
DEC	Department of Environment and Conservation
DGV	Default Guideline Values
DoTEE	Department of the Environment and Energy
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
EQC	Environmental Quality Criteria
ESD	Environmental Scoping Document
ISQG	Interim Sediment Quality Guideline
LoR	Limit of Reporting
NAGD	National Assessment Guidelines for Dredging
NEPM	National Environment Protection Measures
NWS	North-West Shelf
OC	Organochlorine (pesticides)
PAHs	Polycyclic Aromatic Hydrocarbons
PCB	polychlorinated biphenyl
PQLs	Practical Quantitation Limits
PSD	Particle size distribution
QAQC	Quality Assurance/Quality Control
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SAP	Sampling and Analysis Plan
SOP	sulphate of potash
SQG	Sediment Quality Guidelines
SRM	Standard Reference Material
TBT	Tributyltin
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
UCL95	Upper confidence limits of 95%
WA	Western Australia

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1. Introduction

1.1. Project Description

1.1.1. Short Summary of the Proposal

Table 1 Short Summary of the Proposal

Proposal Title	Mardie Project
Proponent Name	Mardie Minerals Pty Ltd
Short Description	Mardie Minerals Pty Ltd is seeking to develop a greenfields high quality salt and sulphate of potash (SOP) project and associated export facility at Mardie, approximately 80 km south west of Karratha, in the Pilbara region of WA. The proposal will utilise seawater to produce a high purity salt product, SOP and other products derived from sea water. The proposal includes the development of a seawater intake, concentrator and crystalliser ponds, processing facilities and stockpile areas, bitterns disposal pipeline and diffuser, trestle jetty export facility, transhipment channel, drainage channels, access / haul roads, desalination (reverse osmosis) plant, borrow pits, pipelines, and associated infrastructure (power supply, communications equipment, offices, workshops, accommodation village, laydown areas, sewage treatment plant, landfill facility, etc.).

1.1.2. Proposal Description

Mardie Minerals Pty Ltd (Mardie Minerals) seeks to develop the Mardie Project (the proposal), a greenfields high-quality salt and sulphate of potash project in the Pilbara region of Western Australia (Figure 1). Mardie Minerals is a wholly-owned subsidiary of BCI Minerals Limited.

The proposal is a solar salt project that utilises seawater and evaporation to produce raw salts as a feedstock for dedicated processing facilities that will produce a high purity salt, industrial grade fertiliser products, and other commercial by-products. Production rates of 4.0 Million tonnes per annum (Mtpa) of salt (NaCl), 100 kilo tonnes per annum (ktpa) of Sulphate of Potash (SoP), and up to 300 ktpa of other salt products are being targeted, sourced from a 150 Gigalitre per annum (GLpa) seawater intake. To meet this production, the following infrastructure will be developed:

- Seawater intake, pump station and pipeline;
- Concentrator ponds;
- Drainage channels;
- Crystalliser ponds;
- Trestle jetty and transhipment berth/channel;
- Bitterns disposal pipeline and diffuser;
- Processing facilities and stockpiles;
- Administration buildings;
- Accommodation village,
- Access / haul roads;

- Desalination plant for freshwater production, with brine discharged to the evaporation ponds; and
- Associated infrastructure such as power supply, communications, workshop, laydown, landfill facility, sewage treatment plant, etc.

Seawater for the process will be pumped from a large tidal creek into the concentrator ponds. All pumps will be triple-screened and operated accordingly to minimise entrapment of marine fauna and any reductions in water levels in the tidal creek.

Concentrator and crystalliser ponds will be developed behind low permeability walls engineered from local clays and soils and rock armoured to protect against erosion. The height of the walls varies across the project and is matched to the flood risk for the area.

Potable water will be required for the production plants and the village. The water supply will be sourced from a desalination plant which will provide the water required to support the Project. The high salinity output from the plant will be directed to a concentrator pond with the corresponding salinity.

A trestle jetty will be constructed to convey salt (NaCl) from the salt production stockpile to the transhipment berth pocket. The jetty will traverse the intertidal zone for approximately 3.6 km before extending into the ocean for a further 3.4 km. The jetty will not impede coastal water or sediment movement, thus ensuring coastal processes are maintained.

Dredging of up to 500,000 m^3 will be required to ensure sufficient depth for the transhipper berth pocket at the end of the trestle jetty, as well as along a 4 km long channel out to deeper water. The average depth of dredging is approximately 1 m below the current sea floor. The dredge spoil is inert and will be transported to shore for use within the development.

The production process will produce a high-salinity bittern that, prior to its discharge through a diffuser at the far end of the trestle jetty, will be diluted with seawater to bring its salinity closer to that of the receiving environment.

Access to the project from North West Coastal Highway will be based on an existing public road alignment that services the Mardie Station homestead and will require upgrading (i.e. widening and sealing).

The majority of the power required for the project (i.e. approximately 95%) is provided by the sun and the wind, which drives the evaporation and crystallisation processes. In addition, the Project will require diesel and gas to provide additional energy for infrastructure, support services and processing plant requirements.

The proposal will be developed within three separate development envelopes. The boundaries of these development envelopes are shown in Figure 2 and described in Table 2.

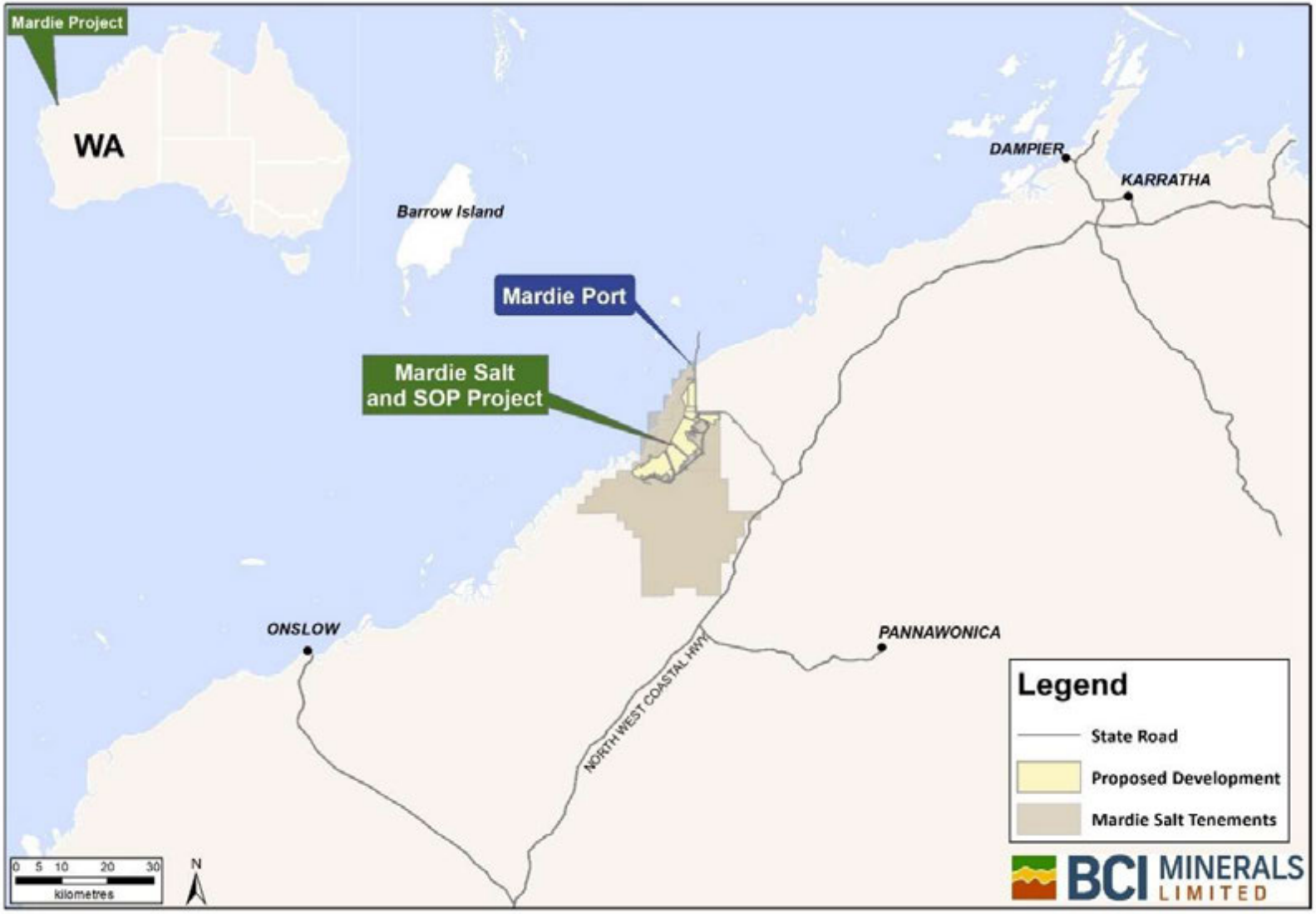


Figure 1 **Mardie Project Regional Location**

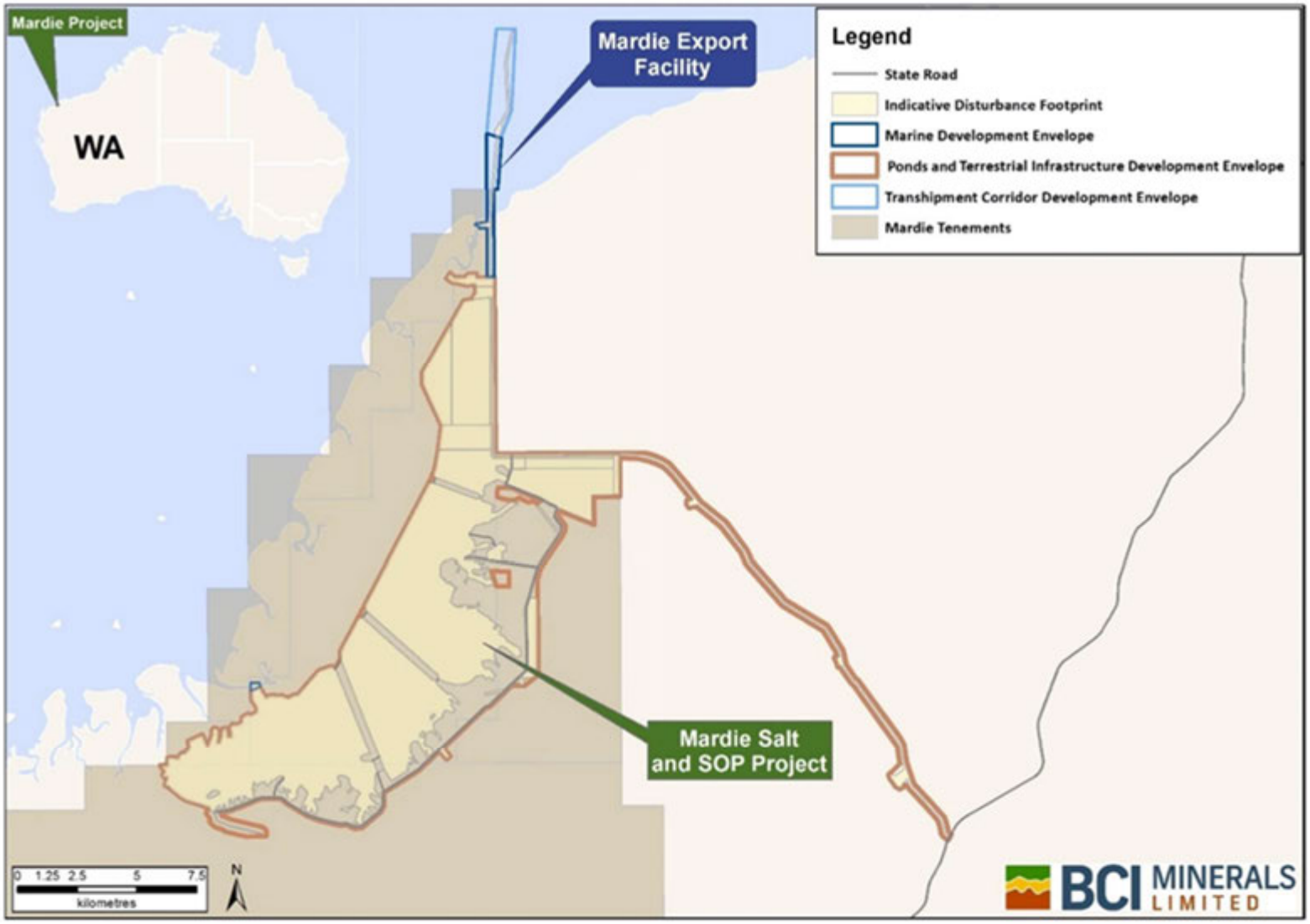


Figure 2 **Mardie Project Development Envelopes: Marine, Ponds and Terrestrial Infrastructure and Transhipment Corridor**

1.2. Scope and Objectives

The scope of this report is to address the relevant work requirements outlined by in the Mardie Project - Environmental Scoping Document (ESD) (Preston 2018). Table 3 outlines the specific requirements from the ESD that are required to be addressed in this Sediment Quality Assessment report.

The objectives of this report are to:

- Describe the implementation of the sediment quality assessment;
- Analyse the sediment results for a range of physical and chemical properties;
- Compare chemical concentrations against the ANZECC/ARMCANZ (2000) Interim Sediment Quality Guideline (ISQG) values; and
- Inform dredge plume modelling and determine baseline sediment quality.

Table 3 Sediment Quality Assessment Objectives from the Environmental Scoping Document – Mardie Project 2018

ESD Item	Requirement
Item 8	Develop a Dredging and Spoil Disposal Management Plan (DSDMP). The DSDMP will be prepared in accordance with 'Instructions on how to prepare Environmental Protection Act Part IV Environmental Management Plans' (EPA, 2018a) and Environmental Management Plan Guidelines (Cth DotE, 2014a, DoEE, 2018a). Consideration should also be given to the requirements of the Environment Protection (Sea dumping) Act 1981 and associated guidance. The plan will consider the results of dredge plume modelling, sediment quality investigation baseline water quality and BCH surveys to inform monitoring and management. The plan will include: a. Presentation of model outputs and potential impacts in an impact zonation scheme including both Environmental Protection Outcomes (EPOs) and management targets; b. 'Most likely best case' and 'most likely worst case' impacts and losses of BCH for each of the dredge timing scenarios (e.g. accounting for seasonal variation in BCH or current patterns); c. Monitoring / management feedback loops and triggers to achieve the EPOs (focussing on the Zone of Moderate Impact / Zone of Influence Boundary) and management targets; d. Selection of indicators for management triggers to be used to assess achievement of EPOs and management triggers based on pressure response pathways and proposed adaptive management actions; e. Monitoring program including site locations and methods to provide data to allow assessment against the management triggers; f. Contingency management strategies to be employed if triggers are reached; and g. Performance criteria and method for demonstrating during and immediately following dredging that the impact predictions have been achieved, focusing on the Zone of Moderate Impact / Zone of Influence Boundary.
Item 30	Undertake a baseline sediment quality assessment at the outfall location including physical (i.e. particle size) and chemical (metals, tributyltin, hydrocarbons);
Item 35	Collect adequate baseline water and sediment quality data to document background marine environmental quality (including spatial and temporal variation) within the receiving marine environment. Baseline data acquisition will be adequate for the derivation of environmental quality criteria for indicators relevant to the discharge(s) e.g. water, sediment and/or infauna quality indicators;
Item 38	Undertake a study to identify any acid sulphate soils or sediment that could potentially be disturbed by the Proposal;

2. Existing Environment

2.1. Site Identification, History and Use

The Mardie Project is located on the Mardie Coastline in the Pilbara between Dampier and Onslow. The majority of the Mardie Project area is located on Mardie Station. The area is isolated and undeveloped with the exception of a magnetite export facility located at Cape Preston, approximately 50 km north of the Mardie Project area.

Mardie Station is a 225,000 ha pastoral lease, sheep then cattle station which was established in 1866 near the mouth of Fortescue River. Mardie Station operates under a Vacant Crown Land reserve now held by Citic Pacific Mining.

2.2. Environmental Setting

The offshore components of the Mardie Project Development Envelope occur within shallow (<6 m) nearshore areas, north of the Robe River and southwest from the Fortescue River mouth. The seafloor in this area is generally comprised of unconsolidated silt, sand and gravel. Benthic habitat surveys have determined the presence of patches of coral and macroalgae, seagrass, sponges, and ascidians which may occur within, or immediately adjacent to, the Mardie Project Development Envelope (O2 Marine 2019a).

2.2.1. Previous Sediment Investigations

Sediment quality has not previously been assessed within or adjacent to the Project Area. Only one previous study in the Pilbara region is considered relevant to inform the identification of contaminants of potential concern.

Background Quality of Pilbara Coast Sediments (DEC 2006)

The Department of Environment and Conservation (DEC) undertook an investigation of marine sediments of the Pilbara coast in 2005 to estimate the background concentrations for selected contaminants (DEC 2006). Sediment samples collected from coastal waters at Port Hedland, Dampier Archipelago, Onslow, Ashburton River Mouth and Exmouth Gulf were analysed for TBT, PAHs, TPH, BTEXN, organochlorine pesticides and polychlorinated biphenyls (PCBs), and total metals and metalloids (Al, As, Cd, Cr, Co, Cu, Fe, Pb, Hg, Ni, Se, Ag, V and Zn) (DEC 2006). Background sediment quality was found to be high and concentrations of most metals and metalloids were found to be at similar levels or lower than found in other studies undertaken in northern Australia. However, total arsenic concentrations were found to be relatively high (median of 36 mg/kg for one site off Onslow) and exceeded the recommended sediment quality guideline at some of the essentially unimpacted locations sampled across the region. The elevations are considered to be natural and likely to be related to the geology of the region. The results of this study were used to develop a set of Interim Sediment Quality Guidelines (ISQGs) appropriate for four levels of ecological protection (LEPs) in the coastal marine environment of the Pilbara region shown in Table 4. The LEPs for the Mardie Project have been derived and are presented in the Environmental Quality Plan (O2 Marine 2019b).

Table 4 Summary of recommended sediment quality guidelines for the Pilbara coastal waters

Level of EcologicaL Protection	ISQG available	Natural background exceeds ISQG	No ISQG available
Maximum	(All metals) Use estimated natural background; or Derive site specific SQG from 80th percentile of reference site*. (Organic chemicals) No detectable concentration using lowest LoR available. or use 80th percentile of reference site.		(All metals) Use estimated natural background; or Derive site specific SQG from 80th percentile of reference site*. (Organic chemicals) No detectable concentration using lowest LoR available or use 80th percentile of reference site.
High	(As, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn) Use ISQG from ANZECC & ARMCANZ (2000) (Organic chemicals) Use ISQG from ANZECC & ARMCANZ (2000) unless below LoR then guideline should be no detectable concentration	(As) Use estimated natural background concentration; or Compare dilute acid extractable concentration with ISQG.	(eg. Al, Co, Fe, Se, V) Use median of natural background concentration multiplied by factor of 2*. (Organic chemicals) No detectable concentration using lowest LoR available or median of natural background concentration multiplied by a factor of 2.
Moderate	(As, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn) Use ISQG from ANZECC & ARMCANZ (2000) (Organic chemicals) Use ISQG from ANZECC & ARMCANZ (2000) unless below LoR then guideline should be no detectable concentration.	(As) Use estimated natural background concentration; or Compare dilute acid extractable concentration with ISQG	(eg. Al, Co, Fe, Se, V) Use median of natural background concentration multiplied by factor of 2*. (Organic chemicals) No detectable concentration using lowest LoR available or median of natural background concentration multiplied by a factor of 2.
Low	(Bioaccumulators or biomagnifiers eg. Cd, Hg) Use ISQG from ANZECC & ARMCANZ (2000) unless below LoR then guideline should be no detectable concentration.		(Bioaccumulators or biomagnifiers eg. Se) Use natural background concentration multiplied by a factor of 3* unless below LoR then guideline should be no detectable concentration.

* Assessment could be done on total contaminant concentration or on potentially bioavailable concentration

2.2.2. Identifying Contaminants of Potential Concern

Historical anthropogenic contamination of sediments in the Mardie Project area is unlikely due to the lack of coastal development. The National Assessment Guidelines for Dredging (NAGD 2009) identifies the common metals and metalloids (e.g. Cu, Pb, Zn, Cr, Cd, Ni, Hg, As) are the most widespread pollutants in Australia, being present in most contaminated sediments, sometimes at high levels. Metal contaminant sources may also derive from bitterns discharge and coastal construction processes. Organotin compounds are also common contaminants in ports and harbours and are frequently present at high levels in berths and inner harbour areas. The nearest Port is Cape Preston Port located approximately 50 km to the northeast of the Project area. Whilst it is possible that TBT may have entered the environment at Cape Preston, contamination in the Project area is considered to be a low risk.

Petroleum hydrocarbons and polycyclic aromatic hydrocarbons (PAHs) are also common but are normally found at elevated levels only in restricted locations and the potential for hydrocarbon spill is low if managed appropriately. However, it is noted that herbicide spraying is common in the adjacent Mardie catchment, with widespread spraying of Mesquite across Mardie Station. This spraying used a mixture of herbicide at a ratio of 1:50 with diesel. Therefore, diesel inputs to the catchment are possible, but are considered to represent a low risk.

A review of the potential contaminant sources of the North-West Shelf (NWS) was undertaken in Chevron (2010). Potential contaminants identified from marine based activities included organic and inorganic contaminants from the oil and gas industry, shipping activities, commercial and recreational fishing activities, aquaculture and tourism. Coastal issues such as domestic waste, e.g. sewage disposal, have been perceived as less significant in this region than elsewhere because of low population density. However, potential pollutants from diffuse sources in the region include metals and antifoulants from shipping, harbour works, shore-based plants and cross-shelf trunklines. A review of contaminant sources, impacts, pathways and effects on the NWS by Fandry et al. (2006) identified the following COPCs in the region, including:

- Metals: (Ba, Cd, Cr, Cu, Pb, Hg and Zn) associated with shipment of minerals and runoff from onshore mining activities;
- TBT: antifoulant on ships
- Nitrogen: Nutrients
- Wastewater from industrial processing; and
- Hydrocarbons associated with oil spills and chronic releases such as bilge and tank residues from ships.

Due to the undeveloped nature of the catchment and sparse farming practices it was considered that sources for PAHs and Organochlorine (OC) pesticides would be unlikely to make a substantial contribution to contaminant loads in offshore sediments (Fandry *et al.* 2006).

As identified above, Mesquite (a weed) is a wide-spread problem on Mardie Station with the single largest infestation of mesquite in Australia covering 2/3 of the 225,000 ha pastoral grazing lease. Strategic planning for containing and controlling mesquite on Mardie Station incorporates the use of chemicals to control further spreading. Phenoxyacetic Acid Herbicides have been extensively used as part of the plan which commenced in 2011. Herbicides used to treat Mesquite include Triclopyr +

picloram and Velpar (hexazinone). It is therefore possible that nearshore sediments could contain traces of these contaminants.

Based on literature review, there are very few known CoPC in the region and a few identified risks from proposed Mardie Project activities. Sampling and analysis is considered to be warranted for the following CoPC:

- Inorganic Compounds: Total metals and metalloids (Al, Ag, As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Sb, V and Zn);
- Organic Compounds: TPH, BTEXN, PAH and TBT;
- Phenoxyacetic Acid Herbicides (including triclopyr + picloram and velpar (hexazinone); and
- Nutrients (TN, TKN, NH4, NO2+NO3, TP, FRP).

Given the proliferation of unconsolidated silt, sand and gravel in the Mardie Project Development Envelope, benthic infauna is also monitored as the key ecological element of the habitat. Benthic infauna provides fundamental data that are relevant to general objectives to sustained Sediment Quality as they are sedentary and respond to pollutant stresses.

In addition, although the coastline is not mapped as an Acid Sulfate Soils risk area, given the dredge material is to be disposed of onshore, investigation into the potential for acid sulfate soils are also investigated.

3. Methods

3.1. Sampling design and rationale

The Sediment Quality Assessment was initially based on the preliminary marine infrastructure design for the proposed Mardie Project provided by Mardie Minerals in accordance with the *National Assessment Guidelines for Dredging* (NAGD, 2009). A sediment Sampling and Analysis Plan (SAP) was developed with a sampling design reflecting recommendations provided in ANZECC/ARMCANZ (2000), NAGD (2009), DER (2014) and NEPM (2013). This included dividing the original dredge footprint into distinct areas and calculating the number of sampling locations required based on the gross volume of sediment expected to be dredged in accordance with NAGD (2009), despite intention to reuse the dredge material. Additional samples were also targeted adjacent to the proposed outfall to collect baseline information on sediment quality and benthic infauna for the proposed discharges.

Following implementation of the SAP the proposed marine infrastructure design was modified, therefore additional sampling was undertaken to ensure an adequate sediment quality representation of the revised area. However, the close proximity between the originally and revised dredging footprints (~500 m), as well as the results indicating an area of high environmental quality, suggest sediment quality across the two areas is likely to be homogenous and the complete set of samples collected during the two surveys was determined to be appropriate to characterise the sediment quality of the area.

The locations, coordinates, target analysis and collection methods for all samples are presented in Table 5 and shown in Figure 3. Sediment samples were collected from a total of 32 nearshore locations. The sediment samples were analysed for physical characteristics at all 32 locations, for contaminants at 28 locations, potential acid sulfate soils (PASS) at 24 locations and benthic infauna was sampled at seven (7) locations. Samples were collected using a Vibrocorer from eight (8) locations, a sediment grab from 21 locations and diver cores were collected at three (3) locations. Sampling for CoPC was focussed on the surface 1 m of sediment rather than the volume of underlying natural geological materials which are, except for the surface 1 m of sediment, expected to be uncontaminated.

Sediment sampling took place over three separate field campaigns in December 2018, January 2019 and March 2019. Samples were collected from within the original footprint during surveys undertaken in December 2018 and January 2019. The trestle jetty was then extended a further ~1 km offshore, with the proposed dredging program moved respectively further offshore. In order to improve sediment sampling coverage within the new proposed dredge footprint, six (6) additional sites were added to the sampling program (RF1, RF2, RF3, RF4, RF5 & RF6). The modification to the dredge footprint and the additional sites are shown in Table 5.

Table 5 **Sediment sampling locations including coordinates, sampling design, method and field quality control**

Sampling Location	Coordinates		Target Analysis[1]	Method[2]	Field QC[3]
	Latitude	Longitude			
C1	21°2' 54.835" S	115°56' 6.785" E	RC, Ph, Pa	G	
C2	21°2' 58.378" S	115°56' 5.091" E	RC, Ph, Pa	G	
C3-1 (0-0.5 m) C3-2 (0.5-1 m)	21°3' 3.083" S	115°56' 4.327" E	AC, Ph, Pa	VC	
C4	21°3' 4.003" S	115°56' 0.715" E	AC, Ph, Pa	G	
C5	21°3' 11.351" S	115°55' 59.055" E	RC, Ph, Pa	G	
C6	21°3' 13.633" S	115°55' 58.337" E	AC, Ph, Pa	G	DUP (P1): AC, Pa
C7	21°3' 15.534" S	115°55' 57.208" E	AC, Ph, Pa	VC	
C8	21°3' 21.168" S	115°55' 57.979" E	RC, Ph, Pa	VC	
C9-1 (0-0.5 m) C9-2 (0.5-1 m)	21°3' 29.897" S	115°55' 57.520" E	RC, Ph, Pa Ph, Pa	VC	
C10	21°3' 37.300" S	115°55' 57.101" E	RC, Ph, Pa	VC	
C11	21°3' 39.167" S	115°55' 57.646" E	AC, Ph, Pa	D	
O1	21° 3' 53.039" S	115°55' 48.447" E	BI, RC, Ph	G	
O2	21° 3' 52.036" S	115°55' 52.096" E	BI, RC, Ph	G	
O3	21° 3' 57.017" S	115°55' 55.206" E	BI, RC, Ph	G	TRIP (T4): Ph TRIP (T5): RC, Ph, Pa
OC1	21° 2' 13.280" S	115° 56' 15.964" E	RC, Ph	VC	
OC2	21° 2' 20.577" S	115° 56' 14.246" E	RC, Ph, Pa	D	
OC3	21° 2' 26.830" S	115° 56' 13.812" E	RC, Ph, Pa	D	REP (T1): AC, Ph, Pa
RF1	21° 2' 38.879" S	115° 56' 7.202" E	Ph	G	
RF2	21° 1' 53.309" S	115° 56' 21.187" E	AC, Ph, Pa	G	
RF3	21° 1' 37.101" S	115° 56' 20.028" E	AC, Ph, Pa	G	
RF4	21° 1' 8.418" S	115° 56' 20.467" E	Ph	G	
RF5	21° 0' 28.278" S	115° 56' 27.677" E	Ph	G	
RF6	21° 2' 32.421" S	115° 56' 11.620" E	Ph	G	DUP (RFB): Ph
TB1	21°3' 44.901" S	115°55' 58.487" E	AC, Ph, Pa	VC	TRIP (T2): AC TRIP (T3): AC
TB2	21°3' 45.411" S	115°55' 56.891" E	BI, AC, Ph, Pa	G	SPLIT (S1): AC, Pa
TB3	21°3' 45.664" S	115°56' 4.225" E	RC, Ph, Pa	G	
TB4	21°3' 49.148" S	115°56' 2.833" E	RC, Ph, Pa	VC	SPLIT (S2): Ph
TB5	21°3' 50.946" S	115°56' 1.608" E	RC, Ph, Pa	G	SPLIT (S3): RC, Pa
TB6	21°3' 52.703" S	115°56' 2.347" E	BI, AC, Ph, Pa	G	
TB7	21°3' 52.700" S	115°56' 0.554" E	RC, Ph, Pa	G	
TB8	21°3' 52.174" S	115°55' 58.441" E	BI, AC, Ph, Pa	G	
TB10	21°3' 50.474" S	115°55' 55.421" E	BI, AC, Ph, Pa	G	REP (T6): RC, Ph, Pa

[1] Definitions: BI= Benthic Infauna, AC= All Contaminants, RC= Restricted Contaminant Suite (no Organotins/ Pesticide), Ph= Physical Characteristics, Pa= Potential Acid Sulfate Soils Field Screening Test

[2] Definitions: VC= Vibro-Core, G= Grab, D=Diver Coring

[3] Definitions: DUP= One sample split into 2 containers, TRIP= Three separate samples, REP=Two separate samples. SPLIT= One sample split into 2 containers, with one sample sent to secondary laboratory

Figure 3 **Sediment sampling locations with both old and revised footprint of the capital dredging program.**

3.2. Sampling Methods

3.2.1. Vibracoring

Vibracoring was performed at eight locations:

- Two (2) locations within the original berth pocket/turning circle (TB1 &TB4);
- Five (5) locations within the original channel (C3, C7, C8, C9 & C10); and
- One (1) location in the original outer channel which is directly adjacent to the revised channel (OC1).

Vibracoring was selected given this is the recommended technique for coarse or firm sediment in NAGD (2009).

A 76.2 mm diameter stainless steel tube of 6 m length was fastened to a custom-made bracket which uses the flexible shaft of a small concrete vibrator to penetrate the tube into unconsolidated sediment (Figure 4). The tube was suspended from a davit over the side of the vessel. Divers were deployed at the site to assist the positioning of the corer onto the seabed. Once in position, a signal was given to top-side, the vibro-corer was engaged and vibrated into unconsolidated sediment. A plastic liner was used inside the tube to collect the sample and a one-way core catcher was custom made for the tube to prevent losing the sample on recovery. Three-point anchoring was utilised during sampling.

The tube was recovered using the deck winch, the actual core depth was recorded and the core sample removed from the tube. The core sample was hung vertically to settle sediments prior to being laid out on the deck and a photographic and observation record taken before packing sediment into laboratory containers. Each sediment core was be divided into 0.5 m depth intervals and samples were collected at each interval. Refusal was encountered at less than 0.5 m depth below the seabed at all sites except for two locations (C9 & C3). Therefore, surface (0-0.5 m) sediment samples were collected at all eight locations and a deeper core sample (0.5-1 m) was collected from locations C9 and C3 only.

Replacement core liners were used for each core and core catchers were rinsed using appropriate decontamination solution (i.e. DECON) between samples.

Equipment required for the vibracore sampling included:

- Vibracorer:
- 5x Stainless pipes (76.2 mm);
- Plastic liner;
- 5x Stainless Core catchers;
- 3x vessel anchors;
- Deck winch;
- Sample collection tray;
- Laboratory supplied sample containers; and
- Decon 90.

3.2.2. Sediment Grab

Surficial sediment samples were collected using a Petite Ponar sediment grab (152 x 152 mm) at 21 locations:

- Seven (7) locations within the original berth pocket/turning circle (TB2, TB3, TB5, TB6, TB7, TB8 & TB10);
- Five (5) locations within the original channel (C1, C2, C4, C5 & C6);
- Three (3) locations surrounding the outfall (O1, O2 & O3); and
- Six (6) locations within the revised dredge footprint (RF1, RF2, RF3, RF4, RF5 & RF6).

The Petite Ponar is constructed of two 316 stainless steel buckets with a volume of 2.4 litres and samples an area of 152 x 152 mm. The grab is lightweight (6.8 kg) which enabled deployment by hand using a pulley block hung over the side of the vessel (Figure 4). The impact of the grab on the bottom surface triggers a release mechanism to shut the buckets together and collect the sample.

On return of the sample to the surface the water was carefully removed, a photographic and observation record of the sample was taken before packing sediment into laboratory containers.

The grab was rinsed using appropriate decontamination solution (i.e. DECON) between each sampling location.

Equipment required for the sediment grab sampling included:

- Petite Ponar Grab;
- Deck winch;
- Sample collection tray;
- Laboratory supplied sample containers; and
- Decon 90.

3.2.3. Diver Cores

Australian Diver Accreditation Scheme (ADAS) certified commercial divers were deployed with push corers at three (3) locations:

- One (1) location within the original channel (C11); and
- Two (2) locations within the outer channel (OC2 & OC3).

Two replicate sediment cores were collected by divers with the surface 0.5 m of sediment from the two cores homogenised to ensure a suitable sample size for laboratory analysis. Refusal was encountered within 0.5 m depth below the seabed at all three locations. Sediment corers and caps were rinsed using appropriate decontamination solution (i.e. DECON) between samples.

Equipment required for the diver core sampling method included:

- 4x Polycarbonate sediment corers with caps;
- Core sample collection tray;
- Laboratory supplied sample containers;
- Decon 90; and
- 95-100% Ethanol solution.

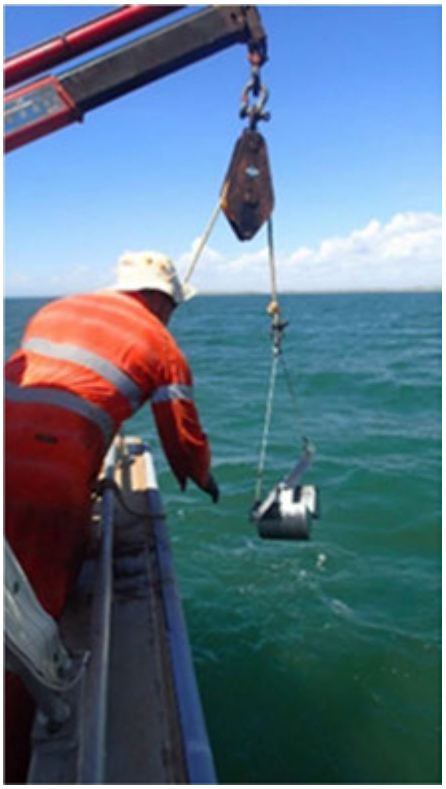
a)  b) 

Figure 4 **Field sampling images presenting a) vibracoring using a 6 m, 76.2 mm diameter stainless steel tube housing the flexible shaft from a small concrete vibrator, and b) the deployment of the sediment grab using a pulley block hung over the side of the vessel**

3.2.4. Benthic Infauna Sampling

Sediment samples for benthic infauna analysis was collected at seven (7) locations using the sediment grab as described in Section 3.2.2. Three (3) individual sediment grabs were required to provide the volume and statistical replication required for adequate analysis of benthic infauna.

Once the sample was recovered and secured on deck, personnel released the sample into the collection tray. O2 Marine personnel then undertook the following sample process/collection steps:

- Sediment was sieved through a 500 µm sieve using either the saltwater deck wash to remove fine sediment; and
- All material retained on the sieve, such as coarse sediment and benthic infauna, was carefully rinsed into two pre-labelled 2 kg zip-lock bags and preserved with 95-100% ethanol solution.

Samples were kept at 4ºC immediately after collection in the field and during transport.

Equipment required for the benthic infauna sediment sampling included:

- Petite Ponar Grab;
- Deck winch;
- Deck wash hose;
- Sample collection tray;
- Funnel (x2)

- 500 µm sieve box;
- 2 kg zip lock sample bags;
- Washing bottles;
- Decon 90; and
- 95-100% Ethanol solution.

3.3. Laboratory Testing

3.3.1. Analytical Testing

The sediment samples were packed into suitable (laboratory supplied) jars and plastic bags and stored on ice during the field program and transferred to a freezer at the completion of each day. All samples were marked with a unique identifier with the date/time and sampler's name using a 'Wet Write' permanent marker. All samples were listed on an O2 Marine Chain of Custody (CoC) form and that form was included with the samples when transported to the NATA-accredited laboratory for analysis. Copies of the CoC are provided in Appendix A.

For the analysis of marine sediment, ALS laboratory was used as the primary laboratory and MPL laboratory was used as the secondary laboratory to assess the inter-laboratory variability of the analytical results.

The sediment samples were analysed for the following testing:

- Physical Properties: Particle size analysis (PSA), Total organic carbon (TOC), Moisture content;
- Inorganic Compounds: Total metals and metalloids (Al, Ag, As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Sb, V and Zn);
- Organic Compounds: Total petroleum hydrocarbons (TPH), Benzene, toluene, ethylbenzene, xylene (BTEXN), Polynuclear aromatic hydrocarbons (PAHs), Organotins Monobutyltin (MBT), Dibutyltin (DBT) and Tributyltin (TBT);
- Nutrients (TN, TKN, NH4, NO2+NO3, TP, FRP);
- Pesticides: Phenoxyacetic Acid Herbicides; and
- Acid sulfate soils: Field screening analysis.

3.3.2. Benthic Infauna

Benthic infauna analysis was undertaken by Carijoa in Perth, Western Australia. On arrival, samples were unpacked and checked for integrity upon delivery. Picking of specimens from petri dishes was conducted under a dissecting microscope with all benthic fauna being separated from the sediment and counted. Identification of benthic fauna was to the lowest taxonomic level possible dependent on the quality of the preservation of individual animals. A reference collection was preserved and stored at Carijoa.

3.4. Quality Control/Quality Assurance (QA/QC)

3.4.1. Field QA/QC

The following QA/QC procedures were undertaken during field work in accordance with NEPM (1999), ANZECC/ARMCANZ (2000) and NAGD (2009) guidelines, including:

- Using suitably qualified environmental staff experienced in sediment sampling, field supervision and sediment logging;
- Samples were handled using gloved hands (powderless latex or nitrile gloves). New gloves were used for each sample to avoid potential cross-contamination;
- All sampling equipment, including mixing bowls etc. being decontaminated between sampling locations via a decontamination procedure involving a wash with ambient seawater and a laboratory grade detergent, and successive rinsing with fresh water; or by a similarly acceptable method;
- Logs were completed for each sample collected including time, location, initials of sampler, duplicate type, chemical analyses to be performed and site observations;
- Chain-of-custody (CoC) forms identifying (for each sample) the sampler, nature of the sample, collection date and time, analyses to be performed, sample preservation method and departure time from the site;
- The survey vessel that was thoroughly inspected and washed down prior to each survey;
- Samples were contained in appropriately cleaned, pre-treated and labelled sample containers;
- Samples were kept cool (4°C) after sampling and during transport, stored in eskies with pre-frozen ice bricks;
- Transportation of samples under CoC documentation (Appendix A); and
- Additional QC field samples collected in accordance with the NAGD (2009).

3.4.2. Field Quality Control Samples

Field quality control samples included the following sampling design in accordance with NAGD (2009) and NEPM (2013, 2013a):

- One (1) trip blank filled with inert chromographic sand;
- Two (2) field blanks filled with inert chromographic sand;
- Two (2) rinsate blanks filled with deionised water;
- Three (3) field triplicates (that is, three separate samples taken at the same location) to determine the variability of the physical and chemical characteristics;
- Two (2) field Replicates (that is, two separate samples taken at the same location) to determine the variability of the physical and chemical characteristics;
- One (1) field Duplicate (that is, samples thoroughly mixed then split into two sub-samples) to determine the variability of the physical and chemical characteristics;
- Three (3) field splits (that is, samples thoroughly mixed then split into two sub-samples with one of the samples sent to a secondary laboratory) to assess laboratory variation; and
- Field Triplicates are collected for all benthic infauna samples to account for typically high within site variability in addition to comparison between sites.

3.4.3. Laboratory QA/QC

A summary of the field QA/QC samples collected and the site location is provided in Table 5.

Both analytical laboratories are NATA-accredited to conduct the required testing and have comprehensive best practice QA/QC programs designed to provide highly defensible analytical data in accordance with NEPM (1999), ANZECC/ARMCANZ (2000) and (NAGD 2009) guidelines. Laboratory QA/QC includes Laboratory Control Samples (LCS), Method Blanks (MB), Matrix Spikes (MS), Laboratory Duplicates (Dups) and Surrogates (where applicable), at frequencies at or above the NEPM guidelines – revised 2013.

3.5. Data analysis

3.5.1. Comparison of Data to Screening Levels

The results are compared to the ISQG-Low, which were developed as part of the ANZECC/ARMCANZ Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ 2000). Revised sediment quality guidelines (SQGs) were applied where appropriate as detailed in Simpson et al. (2013). The recommended sediment quality guidelines (SQGs) for the Pilbara coastal waters were also applied for parameters in which no ISQG-low values are available. Estimated natural background data for Manganese is not available in DEC (2006) and therefore a low reliability guideline value from The Ontario Ministry of the Environment (Persaud et al. 1990) presented in ANZECC/ARMCANZ (2000b) has been applied. The 80th percentile has also been provided for deriving site specific SQG from the baseline data.

Based on NAGD (2009), a screening level is exceeded if the upper 95% upper confidence limit of the mean (95% UCL) for a contaminant exceeds the ISQG-Low. The USEPA's ProUCL software is used to calculate and recommend the most appropriate 95% UCL test to apply based on the data size, data distribution and skewness. If the 95% UCL does not exceed the screening level, this means there is a 95% probability that the mean concentration of that contaminant within the material to be dredged will not exceed the screening level. If the 95 UCL of a contaminant exceeds the specified screening level, it is a Contaminant of Potential Concern (COPC) and evaluation should proceed through the decision-tree described in NAGD (2009).

The capital dredge material will be disposed to land, therefore characterisation of the material and assessment of its compatibility with the receiving environment and associated land uses on a site-specific basis is required in accordance with guidance provided in Schedule B2 of the NEPM (1999). These guidelines consist of Ecological Health Investigation Levels (EILs) and Screening Levels (ESLs), as well as Health Investigation Levels (HILs) and Screening Levels (ESLs). Health Investigation Level D for industrial areas was applied, as this material would be disposed to a potential future proposed Industrial Area. Whilst NEPM (1999) recommends these values should not be directly applied to the contamination of sediments, these values are recognised for the fact that these concentrations will be required to be met once the material is placed on land and has dried.

Normalising to a reference element was undertaken to enable a better determination of ambient baseline level. Organic chemicals are known to have a strong affinity to organic matter and hence normalisation to 1% total organic carbon content is recommended for comparing to the sediment quality guidelines (ANZECC & ARMCANZ, 2000). Metals tend to have a high affinity for the very fine particulate fraction of sediments. The <63 µm fraction is the most widely accepted measure used for

normalizing metal concentrations to particle size. Normalization to geochemical normalisers such as Aluminium or Iron concentrations (which represent proxies for clay mineral content) are also accepted practices (ANZECC & ARMCANZ, 2000; Kersten and Smedes, 2002).

3.5.2. PASS Field Screening Test

The results of field screening tests are presented in a table to present the results of the three (3) combining factors considered in arriving at a 'positive field sulphide identification':

- A reaction with hydrogen peroxide as classified in – the reaction is rated in accordance with Table 6.
- The actual value of pH_{FOX}: A pH_{FOX} <3, and a significant reaction occurred, then it strongly indicates PASS.
- A much lower pH_{FOX} than field pH_F . The lower the final pH_{FOX} value and the greater the difference between the pH_{FOX} compared to the pH_F, the more indicative of the presence of PASS.

Table 6 Reaction observations to determine appropriate rating

Reaction Rating	Key	Observations
Slight	1	Little to no reaction, languid bubble formation
Moderate	2	Languid bubble formation two or more layers
Strong	3	Active bubble formation inside test tube, mild effervescence
Extreme	4	Foaming or overflow/eruption, moderate to strong effervescence, sulfuric odour

3.5.3. Benthic Infauna

P.A.S.T v3.22 (Hammer et al. 2001) was used to calculate diversity indices in order to provide greater insight into community composition and included:

- Margalef's richness index (d): a richness index that calculates richness based on the total number of individuals in a sample
- Shannon's index (H): a diversity index that accounts for abundance and evenness
- Shannon's Evenness index (EH): an evenness index that calculates how evenly individuals are spread among species. Evenness is scaled on a value between 0 and 1 (1 = complete evenness).
- Dominance (D, 1-Simpson Index): assesses taxon dominance within a sample and ranges between 0 (all taxa are equally present) to 1 (one taxon dominates the community completely)

Raw abundance data was standardised to remove sampling bias due to variation of sample size within and between samples (sites). Standardised data was subsequently square root transformed to even out the contribution of common vs rarer taxa where higher abundance of some taxa could overshadow the contribution of less common taxa. Community similarity analyses were carried out with Primer v6 software (Clarke & Gorley, 2006).

Cluster and Principle Coordinates analysis (PCO) was run on Bray Curtis similarity matrix and was performed to obtain an ordination of sites based on relative similarity in composition and abundance

of the shared taxa. Canonical Analysis of Principle Coordinates (CAP) was then used to provide a constrained ordination of sites and to correlate the variables (taxa) with patterns on the CAP plot (Anderson and Willis, 2003, Anderson, 2003). This was done using vector overlays that show the strength and direction of the Spearman correlation of taxa relative to the axis of the plotted ordination and the pattern of the sites plotted according to their similarity to each other. This provides a strong indication of which taxa are contributing most to the plotted distribution and grouping of the sites.

At a coarser level, a one-way Analysis of Similarity (ANOSIM) was used to determine if there was a difference in community composition between the area allocated for the Turning Basin (TB2, TB6, TB8, TB10) and the area surrounding the outfall (O1, O2, O3). ANOSIM produces an R-value with a range from 0 (no difference in composition) – 1 (compositions are completely different). A Similarity Percentage (SIMPER) routine was used to determine which taxa are contributing to the similarity/dissimilarity between the two locations.

Classifying taxa according to feeding guilds can be useful for assessing impacts at the ecosystem level. The feeding guilds used to characterise the taxa from each sample are defined by MacDonald et al. (2010) and included:

- Food source
  - Epibenthic = above sediment or from water column
  - Surface = surface of sediment
  - Subsurface = below sediment surface
- Diet
  - Carnivorous = animal matter
  - Herbivorous = plant matter
  - Omnivorous = animal and plant matter
  - Feeding mode
  - Deposit feeder = ingests sediment
  - Detritus feeder = ingests particular matter only, without sediment
  - Suspension/filter feeder = strains particles from the water
  - Predator = eats live animals only
  - Scavenger = carrion only
  - Grazer = feeds by scraping, either on algae or sessile animals
  - Browsing = feeds by tearing or gathering particular items

Feeding guilds were overlaid on nMDS plots to assess whether guilds could be contributing to any differences between sites.

The most common foraminifera found in the benthic samples were counted to provide a qualitative representation only of their commonality and relative abundance.

3.5.4. QA/QC Assessment

The precision of the sediment analyses was determined by quantifying the differences between the concentrations of analytes in the QA/QC samples, using the method outlined in NAGD (2009).

The relative percent difference (RPD) was calculated for analyte concentrations in the sample splits (both inter-laboratory and intra-laboratory splits) and field replicates.

The RPD is calculated as follows:

$$\text{RPD (\%)} = \frac{(difference\ between\ sample\ splits)\ X\ 100}{(average\ of\ sample\ spli\ \ )}$$

The RPD of sample splits should be less than ±35% for field splits and ±50% for field replicates, although the guidelines note that this may not always be the case where the sediments are very heterogeneous or greatly differing in grain size (NAGD 2009). Where three (3) or more samples were collected from the one location the relative standard deviation (RSD) was calculated for analyte concentrations in the sample splits. If the RPD for a measured analyte fell outside of these limits, the value of the measured analyte was flagged as an estimate rather than a precise value (NAGD 2009).

The RSD is calculated as follows:

$$\frac{(standard\ deviation\ of\ samples)}{(average\ of\ samples)}$$

For benthic infauna, picking quality assurance was completed on 2 samples (10% of the total samples) with a 5% permissible error. Previous samples are checked if the error was greater than 5% and repeated until a rate of less than 5% was achieved.

4. Results and Discussion

4.1. Observations

Field observations recorded for each sample are presented in Table 7. Field observations of the sediment characteristics varied from fine mud, to silt, silt/sand, sand, coarse sand, sand/gravel and gravel (Table 7). Colour varied from brown/grey, grey/red/, dark grey, red/brown, dark brown to brown. There was no foreign material recorded in any samples representing an area of very little disturbance. A slight sulphur smell was detected in only one sample and organic elements in samples predominantly recorded from the outer channel of the original dredge footprint and revised dredge footprint typically consisted of shell grit.

Of the nine (9) sites where vibracoring was conducted, only two cores (C3 & C9) penetrated to 1 m. At each of these sites, two depth strata were collected (0 - 0.5 m & 0.5 – 1 m). Only the 0 - 0.5 m sediment depth strata was collected at all other sites due to core refusal.

4.2. Physical characteristics

4.2.1. Particle size distribution (PSD)

The PSD results are presented in Figure 5. The raw laboratory PSD results are included in Appendix D.

Sand and gravel size fractions dominate the PSD results from locations within the channel (C1-1 to C8) and the outer channel (OC1-OC3) of the original dredge footprint, and within the revised dredge footprint sample area (RF1-RF6). Sites closer to shore within the turning basin (TB1-TB10), around the outfall (O1-O3) and the inner channel (C9-C11) of the original footprint were comprised of a higher proportion of fines (i.e. silt and clay).

Sites C1-C8 in the channel of the original dredge footprint are comprised of approximately 55% and 40% of sand and gravel respectively, with a smaller proportion (<10%) of silt and clay. There is a substantial shift in PSD between sites C6 and C10 where fines comprise <3% to more than 50% of the sample, combined with equivalent reductions in the composition of gravel. This identifies the area of transition from the intertidal mudflats to marine deposits. The outer channel samples from the original footprint and revised footprint were composed of approximately 60% sands, 20% gravel and 20% fines.

The fines content in turning basin and inner channel (C9-C11) samples closer to shore in the original dredge footprint are approximately 50%, combined with ~40% sands and <10% gravel. The outfall sample sites from the original dredge footprint were variable. Sites O1-O2 comprised a similar PSD to the nearshore sites in the turning basin and inner channel, whilst replicates collected at site O3 in the shallowest location contained a smaller proportion of fines (<20%) and higher proportion of sand fractions (68%-85%).

Table 7 **Observations of sediment samples recorded during the field survey**

Site	Sample details				Observations				
	Date	Time	Water Depth (m)	Sediment type	Colour	Foreign material	Shell/ Biota	Odour	Comments
C1	12/12/2018	0800	1.0	gravel	brown/grey		yes	nil	
C2	12/12/2018	0900	1.0						
C3-1	12/12/2018	1000	1.0	Gravel	grey/red		high	nil	Refusal 1.5 m
C3-2	12/12/2018	1000	1.0	Gravel/Shell	grey/red		high	nil	2 depth samples: 0-0.5 m, 0.5-1 m
C4	12/12/2018	1000	1.8	Silt					
C5	12/12/2018	1100	2.0	Gravel/silt					
C6	12/12/2018	1120	3.0						QC DUP P1
C7	15/01/2018	1330		sand/silt	grey/brown		high	nil	Refusal 0.5 m. Large shells
C8	15/01/2018	1230	2.8	sand	grey/brown				Refusal 1.0 m
C9-1	15/01/2018	1115	2.3	Sand/silt	dark grey		10%	nil	Refusal 1.3m
C9-2	15/01/2018	1115	2.3	Sand/gravel	grey				2 depth samples: 0-0.5 m, 0.5-1 m
C10	12/12/2018	0800	1.0	sand					Refusal 0.8 m.
C11	16/01/2019			sand/silt					
OC1	16/01/2019	0800	3.4	sand/silt	red/brown		10%	Slight sulphur	Refusal 0.5 m
OC2	15/12/2018	1000	4.0						Dive Cores
OC3	15/12/2018	0930	3.5						Dive Cores
O1	15/01/2019	0730	2.0						ref in gravel photo taken
O2	16/01/2019	0930	1.6	silt					
O3	16/01/2019	0900	1.7	sand					
TB1	15/01/2019	1020							Refusal in gravel
TB2	12/12/2018	1150	3.6	silt					
TB3	12/12/2018	1230							
TB4	15/01/2019	0900	1.9	silt					refusal

Site	Sample details			Observations					
	Date	Time	Water Depth (m)	Sediment type	Colour	Foreign material	Shell/ Biota	Odour	Comments
TB5	16/01/2019	0900	1.8	silt/sand					
TB6	16/01/2019	0945	1.7						
TB7	16/01/2019	1025	2.0						
TB8	16/01/2019	1045	1.8						
TB9	15/01/2019	0800	2.4	silt					refusal
TB10	16/01/2019	1100	2.2						
RF1	1/03/2019	0700		fine mud	dark brown		yes	nil	muddy low shell grit
RF2	1/03/2019	0800		fine mud	dark brown		yes	nil	muddy low shell grit
RF3	1/03/2019	0900		fine mud	dark brown		yes	nil	muddy low shell grit
RF4	1/03/2019	1000		fine mud	dark brown		yes	nil	muddy low shell grit
RF5	1/03/2019	0830		coarse sand	brown		yes	nil	coarse sand high shell grit
RF6	3/03/2019	0930		fine mud	dark brown		yes	nil	muddy low shell grit

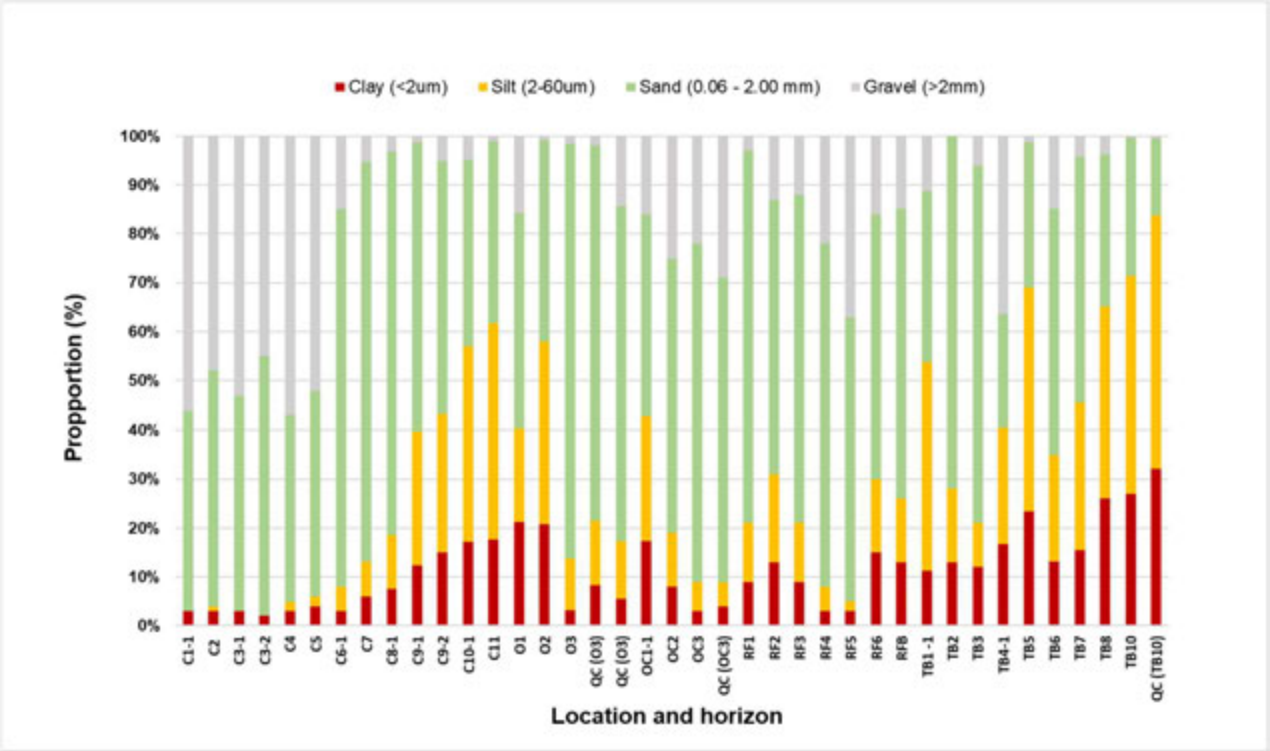


Figure 5 **Proportion of sediment in each size class at all sites and depth horizons analysed.**

4.2.2. Total Organic Carbon and Moisture Content

The TOC and moisture content of sediment samples are presented in Table 8 and raw laboratory results are provided in Appendix B. The relationship between sediment moisture and organic carbon can be used as a simple means to estimate the organic content and bulk density of flooded mineral soils by a simple determination of a sediment water content.

Sediment samples are composed of relatively low percentages of TOC (0.08–0.42%) and moisture content ranged between 13.8% and 50.3%. Higher proportions of TOC and moisture are typically recorded nearshore within samples from the turning basin of the original dredge footprint and further offshore in the outer channel from the original footprint and the revised dredge footprint sample area. Lowest TOC and moisture concentrations are recorded within the channel of the original dredge footprint.

Table 8 Total organic carbon and moisture content for sediment samples

Location	Total Organic Carbon (%)	Moisture Content (%)
C1_1	0.09	14.2
C2	0.08	18.8
C3_1	0.12	17.6
C3_2	----	13.8
C4	0.15	22.4
C5	0.19	26.5
C6_1	0.2	32.4
C7	0.08	27.2
C8-1	0.1	28.5
C9-1	0.18	30.5
C9-2	----	23.9
C10-1	0.11	29.5
C11	0.22	35.2
O1	0.12	21.1
O2	0.16	36.3
O3	0.16	28.8
OC1-1	0.15	25.8
OC2	0.21	34.9
OC3	0.24	33.3
RF2	0.27	32
RF3	0.23	25.2
TB1-1	0.22	33.3
TB2	0.34	50.3
TB3	0.42	40.4
TB4-1	0.15	30.4
TB5	0.28	37.1
TB6	0.15	23.5
TB7	0.21	35.4
TB8	0.22	35.3
TB10	0.26	35.4

4.3. Metals and Metalloids

Twenty-eight (28) samples were analysed for total metals and concentrations were typically below ISQG-low guideline values. Estimated background median concentrations multiplied by a factor of two (2) was applied as the SQG where no ISQG are available as recommended in DEC (2006). The levels of metals and metalloids for the sampling conducted for the Mardie Project are shown in Table 9.

Shaded yellow cells in Table 9 indicate concentrations above the ISQG-low value and bold font identifies concentrations above the low reliability guideline values. The 95% UCLs were calculated from the mean across all 28 sites. The 95% UCL was above the ISQG-low value for Arsenic and Nickel. In addition, the 95% UCL is above the SQG for Aluminium, Cobalt and Iron. and Vanadium

is above the background SQG. Three samples exceed the low reliability guideline value for Manganese. All concentrations for all metals are below EIL and HIL screening levels. The standard deviation of the sample data is less than 50% of the relevant HILs across all metals and no single value exceeds 250% of the relevant HILs.

The ISQG-low for Arsenic of 20 mg/kg was exceeded at thirteen (13) sites, predominantly within samples further offshore in the channel of the original dredge footprint and revised dredge footprint. The 95% UCL for Arsenic (As) over all locations was 26.53 mg/kg. Elevated levels of Arsenic in Pilbara sediments were also recorded in DEC (2006), with highest estimated background concentrations of 34 mg/kg recorded near Onslow. DEC (2006) concluded that the ISQG-low value for arsenic may not be suitable for use across much of the marine environment of the Pilbara region and that alternative guidelines based on local data should be derived.

The Nickel ISQG-low value of 21 mg/kg was exceeded at nine (9) sites. The 95% UCL of the mean for Nickel across all sites also slightly exceeded the ISQG-low value at 21.1 mg/kg. Elevated Nickel concentrations have previously been recorded in sediments during historical sampling conducted in nearshore waters close to the Ashburton River for the Wheatstone Project (O2 Marine 2017) and has regularly been recorded above the ISQG-low value in Dampier (O2 Marine 2019c).

Aluminium, Iron and Vanadium are common naturally occurring metals in sediments which were found at concentrations higher than recommended sediment quality guidelines for the Pilbara coastal waters (DEC 2006). Results recorded for Aluminium, Iron and Vanadium were more than twice the median concentrations for sediments in the Pilbara at all locations except for two Aluminium and three Vanadium locations. It is noted however, results recorded at the Ashburton Rivermouth and Onslow were significantly higher than other areas of the Pilbara sampled in DEC (2006) and are comparable to the results in this study. Therefore, median concentrations from these areas, or site-specific derived percentile values, are likely to be more appropriate to develop relevant sediment quality guidelines (SQGs) for future comparison.

Fourteen locations and the calculated 95% UCL Cobalt concentrations are slightly above recommended sediment quality guidelines for Pilbara coastal waters (DEC 2006). Three (3) locations have Manganese concentrations above the Ontario Ministry of the Environment, although the 95% UCL remains below the low reliability guideline value.

Table 9 **Total metal concentrations (normalised concentrations) in marine sediments for all sites at Mardie, WA.**

Analyte	Aluminium	Antimony	Arsenic	Cadmium	Chromium	Cobalt	Copper	Iron	Manganese	Mercury	Nickel	Silver	Vanadium	Zinc
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LoR	50	0.5	1	0.1	1	0.5	1	1	10	0.01	1	0.1	2	1
ISQG-low	6300[1]	2	20	1.5	80	10[1]	65	16200[1]	460[2]	0.15	21	1.0	44[1]	200
EILs	-	-	80	-	-	(III) 540	340	-	-	-	680	-	-	17000
HILs	-	-	3000	800	4000	(VI) 3000	250000	-	40000	4000	4000	-	-	400000
C1-1	**7030**	<0.50	**35.8**	0.2	29.5	8.7 **(10.8)**	8.3	**33600**	449	<0.01	14.1 (18.1)	<0.1	**52.4 (65.2)**	17.9
C2	**9940**	<0.50	**30.6**	0.1	45.3	**10.2** (9.4)	10.6	**39800**	445	<0.01	**22.3** (19.6)	<0.1	**58.4 (54.2)**	22.6
C3-1	**6410**	<0.50	**53.8**	0.3	24.8	8.1 (11.0)	7.5	**36000**	**583**	<0.01	12 (15.9)	<0.1	**52.5 (78.1)**	13.9
C4	5690	<0.50	**41.9**	0.3	22.2	7.1 (10.1)	6.9	**30500**	**661**	<0.01	10 (10.0)	<0.1	43.3 (66.3)	12.6
C5	**6090**	<0.50	**48.6**	0.2	23.4	7.2 (9.0)	7.4	**34000**	443	<0.01	11.6 (16.3)	<0.1	**46.5 (67.5)**	13.6
C6-1	5150	<0.50	**31.4**	0.1	21.1	6.6 (6.6)	6	**27000**	373	<0.01	10 (10.0)	<0.1	39.4 (39.4)	12.5
C7	**6980**	<0.50	**29**	<0.1	32	**10.2 (13.9)**	8	**33400**	314	<0.01	16.3 **(22.8)**	<0.1	**54.7 (70.5)**	20.2
C8-1	**9120**	<0.50	**24.1**	<0.1	44.3	**13** (12.6)	11.4	**42600**	264	<0.01	**22.3** (**21.5**)	<0.1	**65.3 (63.7)**	26.9
C9-1	**9330**	<0.50	18.2	<0.1	39	**10.8 (10.3)**	11.4	**36600**	266	<0.01	18.7 (17.8)	<0.1	**51 (49.7)**	23.6
C10-1	**8960**	<0.50	16.3	<0.1	36.1	9.3 (9.2)	11	**33100**	242	<0.01	17.1 (16.9)	<0.1	**46 (45.9)**	21.8
C11	**8330**	<0.50	17	<0.1	36.3	**10.3 (10.9)**	10.7	**33800**	270	<0.01	17.6 (18.9)	<0.1	**47.6 (49.0)**	22.4
O1	**14800**	<0.50	10.4	<0.1	56.8	**12.2** (8.8)	22.4	**54900**	218	<0.01	**31** (18.1)	<0.1	**81.6 (55.7)**	36.6
O2	**10,700**	<0.50	17.8	<0.1	44.3	**11.6** (10.0)	13.5	**41,700**	284	<0.01	**21.8** (17.9)	<0.1	**59.8 (53.1)**	27.8
O3	**6610**	<0.50	**22.7**	<0.1	28.3	8.9 **(12.5)**	8.1	**29400**	294	<0.01	14.8 **(22.2)**	<0.1	**48.2 (61.9)**	18.4
OC1-1	**17200**	<0.50	14.2	<0.1	62.9	**19.2** (10.5)	32.1	**58400**	368	<0.01	**33.8** (17.4)	<0.1	**79.3 (51.7)**	38.8
OC2	**7530**	<0.50	17.3	0.2	31.4	9.6 (11.3)	9.5	**37600**	276	<0.01	15.2 (18.1)	<0.1	**46.8 (51.0)**	19
OC3	**8750**	<0.50	**20.9**	<0.1	36.5	9.3 (9.4)	10.6	**37100**	316	<0.01	17.1 (17.3)	<0.1	**49 (49.3)**	20.5
RF2	**7840**	<0.50	**23.8**	0.1	31.2	8.3 (9.0)	8.2	**36000**	291	<0.01	14.1 (15.7)	<0.1	**44.7 (46.7)**	16.7
RF3	**7230**	<0.50	**26.2**	0.1	30.1	8.2 (9.5)	7.5	**34900**	281	<0.01	13.2 (15.7)	<0.1	**44.0 (47.6)**	15.6
TB1-1	**13200**	<0.50	16.6	<0.1	50.5	**12.2** (9.2)	19.1	**48200**	299	<0.01	**24.5** (16.7)	<0.1	**67.9 (52.6)**	31.4
TB2	**11600**	<0.50	**21**	<0.1	44.7	**12** (9.7)	13.5	**44700**	**478**	<0.01	**22.4** (17.2)	0.1	**59.8 (51.2)**	29

Analyte	Aluminium	Antimony	Arsenic	Cadmium	Chromium	Cobalt	Copper	Iron	Manganese	Mercury	Nickel	Silver	Vanadium	Zinc
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LoR	50	0.5	1	0.1	1	0.5	1	1	10	0.01	1	0.1	2	1
ISQG-low	6300[1]	2	20	1.5	80	10[1]	65	16200[1]	460[2]	0.15	21	1.0	44[1]	200
EILs	-	-	80	-	-	(III) 540	340	-	-	-	680	-	-	17000
HILs	-	-	3000	800	4000	(VI) 3000	250000	-	40000	4000	4000	-	-	400000
TB3	**8240**	<0.50	14.7	<0.1	31.9	8.6 (9.0)	9.8	**33100**	224	<0.01	16.1 (17.4)	<0.1	42.7 (43.4)	20.9
TB4-1	**17800**	<0.50	11	<0.1	68.7	**13.8** (8.7)	41.1	**65800**	227	<0.01	**35.5** (17.5)	<0.1	**95.1 (55.8)**	44.9
TB5	**10400**	<0.50	17.2	<0.1	42.9	**10.6** (9.4)	13.6	**38,900**	266	<0.01	20.7 (17.6)	<0.1	**56.6 (51.6)**	26.4
TB6	**9350**	<0.50	16.8	<0.1	39.8	**10.3** (9.9)	11.6	**38300**	252	<0.01	19.5 (18.4)	<0.1	**56.1 (54.2)**	24.8
TB7	**9520**	<0.50	17	<0.1	40.3	**10.5** (9.9)	12.5	**38200**	264	<0.01	20 (18.5)	<0.1	**54.7 (70.5)**	24.6
TB8	**10500**	<0.50	17.4	<0.1	43.4	**11.2** (9.8)	13.5	**41900**	277	<0.01	**21.8** (18.2)	<0.1	**59.7 (53.5)**	26.8
TB10	**8790**	<0.50	15.6	<0.1	37.8	10 **(10.1)**	11.8	**35200**	258	<0.01	18.2 (18.4)	<0.1	**50.4 (50.7)**	23.6
Mean	**9396.1**	<0.5	**23.1**	0.1	38.4	**10.3 (10.1)**	12.8	**39096.4**	328.0	<0.01	19.0 (17.8)	0.1	**55.5 (55.3)**	23.4
80th %ile	**10620**	<0.5	**30**	0.1	44.5	**11.8 (10.9)**	13.5	**42320**	415	<0.01	**22.3** (18.5)	0.1	**59.8 (63.3)**	27.4
95% UCL	**10392.9**	<0.5	**26.5**	0.1	42.1	**11.1 (10.6)**	15.2	**41844.2**	362.7	<0.01	**21.1** (18.6)	0.1	**59.5 (58.0)**	25.8

[1] No ISQG available, used median concentrations in Pilbara sediments from DEC (2006) as background concentration multiplied by a factor of 2

[2] Low reliability guideline value from The Ontario Ministry of the Environment (Persaud et al. 1990) from ANZECC/ARMCANZ (2000)

4.3.1. Normalisation of Trace Metals

The correlation coefficient results of the normalisation tests for the <63 µm particle size distribution (PSD), Aluminium concentration and Iron concentration are presented in Table 10. A strong positive correlation was calculated between Aluminium and Iron, although weak correlations were recorded for comparison with the <63 µm PSD. This is contradictory to findings from other studies in the region where grain size was determined to be the principle factor which controls concentrations of most trace metals in whole sediments (O2 Marine 2018). However, the PSD results collected from the Development Envelope were highly variable (see Section 4.2.1).

The data for metal contaminants that recorded elevated concentrations (Arsenic, Nickel, Vanadium, Cobalt and Manganese) were graphed against the Aluminium and Iron concentration normalisers to investigate which would give the best correlation for the trace metals. Concentrations of Aluminium and Iron correlated well with most trace metals, with Aluminium providing slightly better correlations overall. Linear regression results with trace metals and Aluminium are presented in Figure 6 showing a strong positive correlation with Nickel (R^2=0.96), Cobalt, (R^2= 0.77) and Vanadium (R^2=0.84), suggesting that these metals are lithogenically derived and of natural origin. Comparably, a weak linear correlation exists between Arsenic (R^2= 0.4) and Manganese (R^2=0.1) and therefore normalisation was not undertaken on these metals. Findings that Arsenic did not correlate with any of the normalisers is consistent with previous sediment quality studies in the Pilbara region (DEC 2006, Chevron 2010, O2 Marine 2017).

The normalised results for Nickel, Cobalt and Vanadium are presented in Table 9 (in brackets). The median and 95% UCL results are only slightly lower than the original results, likely due in part to the weak relationship with <63 µm PSD. The normalised mean, 80th percentile and 95% UCL values for Nickel are below the ISQG-low value of 21 mg/L, although the values calculated for Cobalt and Vanadium remain above twice the median concentrations for sediments in the Pilbara.

Table 10 Correlation coefficients between the normalisers aluminium concentration, iron concentration and <63µm particle size fraction.

	<63 µm vs Al	<63 µm vs Fe	Al vs Fe
Correlation Coefficient	R^2=0.2	R^2=0.1	R^2=0.9

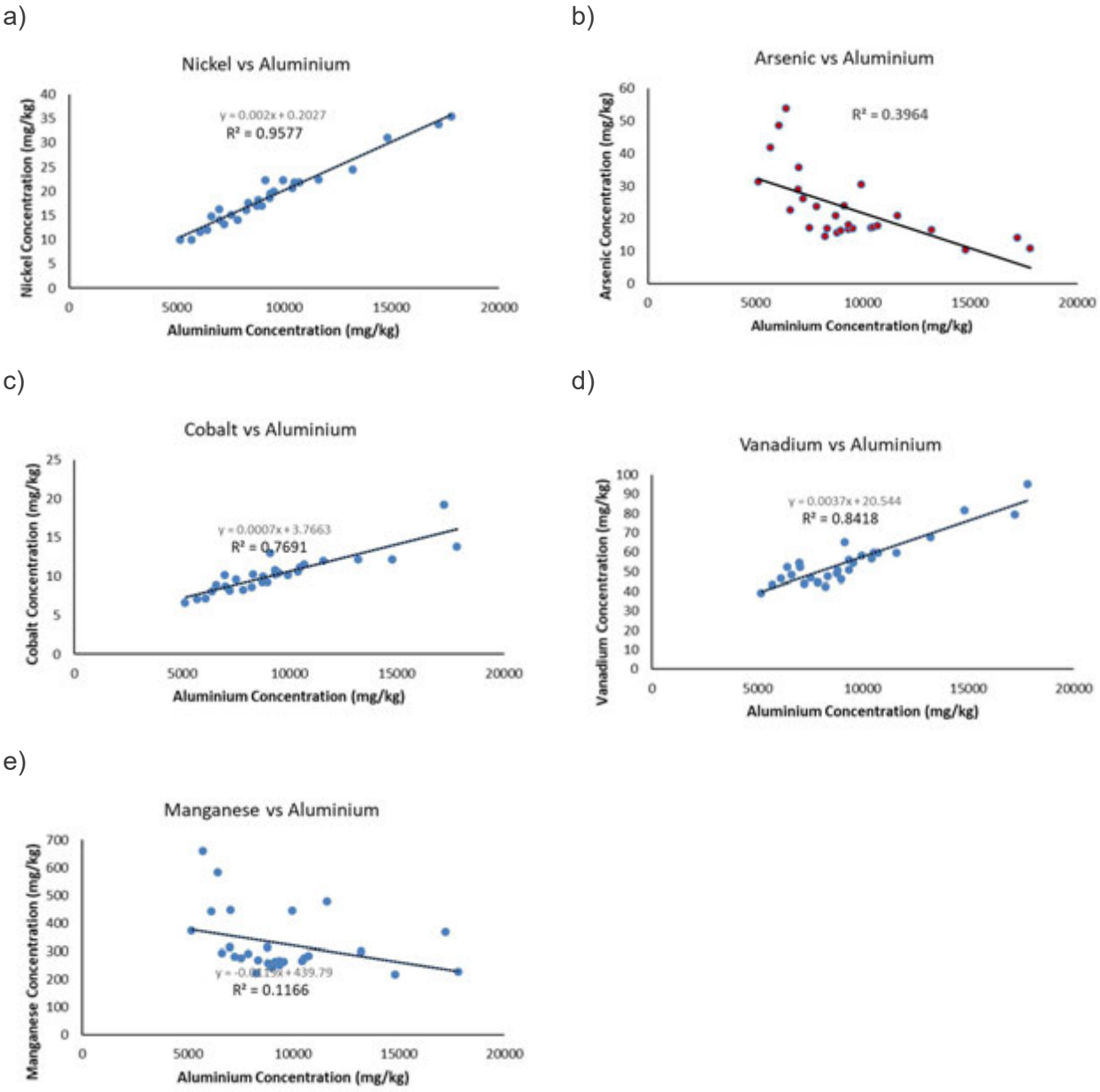


Figure 6 **Linear regression showing the correlation between concentrations of Aluminium and a) Nickel b) Arsenic, c) Cobalt, d) Vanadium and e) Magnesium**

4.4. Organic Compounds

The raw laboratory results for all organic compounds are included in Appendix B.

4.4.1. Hydrocarbons

The TPH, TRH, BTEXN and PAH analytes were tested for all twenty-eight (28) sites listed in Table 5. The list of individual analytes and respective Limits of Reporting (LoR), ANZECC/ARMCANZ (2000) ISQGs, Ecological Screening Levels (ESLs) and Health Screening Levels (HSLs) from NEPM (1999) for TPH and TRH are provided below in Table 11. The results provided have been normalised to 1% TOC in accordance with Simpson et al. (2013). Shaded yellow cells in Table 11 indicate concentrations above the LoR.

The TPH results are below all ISQG, ESL and HSL values. Only five (5) sites recorded concentrations above the LoR; two (2) within the inner channel (C9, C11), one (1) near the outfall (O3) and two (2) in the turning basin (TB7, TB10) of the original dredge footprint. No samples from the revised dredge footprint recorded concentrations above the LoR. Detectable concentrations are recorded within the C16-C34 carbon fractions in all five sites and at two sites from the inner channel (C9, C11) within the C34-C40 carbon fractions.

Similar low levels of hydrocarbons were detected in the TRH results, all below ISQG, ESL and HSL values. Seven (7) sites recorded concentrations above the LoR; three (3) within the inner channel (C8, C9, C11), one (1) near the outfall (O3) and three (3) in the turning basin (TB6, TB7, TB10) of the original dredge footprint. No samples from the revised dredge footprint recorded concentrations above the LoR. Detectable concentrations are recorded within the C34-C40 carbon fractions only.

All BTEXN and PAH analytes recorded concentrations below the LoR for all sites.

4.4.2. Organotins

Monobutyltin (MBT), Dibutyltin (DBT) and Tributyltin (TBT) were analysed in thirteen (13) samples as shown in Table 5. All sites recorded concentrations below the LoR for all three analytes.

4.5. Pesticides

The herbicide analytes were sampled at thirteen (13) sites as listed in Table 5. All 14 analytes in this suite were recorded below the LoR. The raw laboratory results for all herbicide analytes tested are provided in Appendix B.

Table 11 **Normalised results for TPH and TRH analytes to 1% TOC. Yellow shaded areas present results above the LoR.**

Analyte	TPH				TRH			
	C6-C9	C10-C14	C15-C28	C29-C36	C6-C10	C10-C16	C16-C34	C34-C40
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LoR	3	3	3	5	0.2	0.2	0.2	0.5
ESLs	215	170	1700		700	1000	3500	10000
HSLs	260	NL	NL		26000	20000	27000	38000
ISQGs			280					
C1_1	<3	<3	<3	<5	<3	<3	<3	<3
C2	<3	<3	<3	<5	<3	<3	<3	<3
C3_1	<3	<3	<3	<5	<3	<3	<3	<3
C4	<3	<3	<3	<5	<3	<3	<3	<3
C5	<3	<3	<3	<5	<3	<3	<3	<3
C6_1	<3	<3	<3	<5	<3	<3	<3	<3
C7	<3	<3	<3	<5	<3	<3	<3	<3
C8-1	<3	<3	<3	<5	<3	<3	<3	25.0
C9-1	<3	<3	20.0	60.0	<3	<3	<3	70.0
C10-1	<3	<3	<3	<5	<3	<3	<3	<3
C11	<3	<3	18.2	<5	<3	<3	<3	27.3
O1	<3	<3	<3	<5	<3	<3	<3	<3
O2	<3	<3	<3	<5	<3	<3	<3	<3
O3	<3	<3	20.0	<5	<3	<3	<3	30
OC1-1	<3	<3	<3	<5	<3	<3	<3	<3
OC2	<3	<3	<3	<5	<3	<3	<3	<3
OC3	<3	<3	<3	<5	<3	<3	<3	<3
RF2	<3	<3	<3	<5	<3	<3	<3	<3
RF3	<3	<3	<3	<5	<3	<3	<3	<3
TB1-1	<3	<3	<3	<5	<3	<3	<3	<3
TB2	<3	<3	<3	<5	<3	<3	<3	<3
TB3	<3	<3	<3	<5	<3	<3	<3	<3
TB4-1	<3	<3	<3	<5	<3	<3	<3	<3
TB5	<3	<3	<3	<5	<3	<3	<3	<3
TB6	<3	<3	<3	<5	<3	<3	<3	15.0
TB7	<3	<3	19.0	<5	<3	<3	<3	33.3
TB8	<3	<3	<3	<5	<3	<3	<3	<3
TB10	<3	<3	11.5	<5	<3	<3	<3	26.9

4.6. Nutrients

Nutrient levels were sampled for and analysed at twenty-eight (28) sites. There are no relevant guidelines for marine sediments. All nutrient levels are shown in Table 12 and raw laboratory results are presented in full in Appendix B.

Inorganic forms of nutrients in sediments (NO_2, NO_3, NH_4, FRP) are either below the laboratory LoR, or are recorded at very low concentrations. Levels above the LoR were recorded in one Nitrite

sample at 0.2 mg/kg (C2), in 16 samples for Nitrate below 0.6 mg/kg and in 13 sites below 0.6 mg/kg for reactive phosphorus. No results for ammonia are recorded above the LoR.

Results for Total Nitrogen (TKN/TN) and Total Phosphorus (TP) is therefore likely to be predominantly organically bound and representative of the typically low organic concentrations of sediments of the Pilbara which must be broken down into inorganic forms to be available for uptake by plants. Concentrations of TKN/TN range from 110 to 500 mg/kg and TP ranges from 179 to 468 mg/kg. However, these concentrations are notably higher than organic material reported in sediments near Onslow which ranged from 30 to 360 mg/kg and 43 to 293 mg/kg, respectively (O2 Marine 2018).

Table 12 Summary of all nutrient levels analysed at Mardie, WA.

Analyte	NH_4	NO_{-2}	NO_{-3}	NO_X	TKN	TN	TP	FRP
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LoR	20	0.1	0.1	0.1	20	20	2	0.1
C1_1	<20	<0.1	0.2	0.2	180	180	342	<0.1
C2	<20	0.2	0.4	0.6	290	290	415	0.1
C3_1	<20	<0.1	<0.1	<0.1	160	160	400	<0.1
C4	<20	<0.1	0.2	0.2	190	190	468	<0.1
C5	<20	<0.1	0.1	0.1	280	280	422	0.2
C6_1	<20	<0.1	0.1	0.1	330	330	358	0.1
C7	<20	<0.1	0.1	0.1	110	110	349	<0.1
C8-1	<20	<0.1	0.6	0.6	170	170	341	<0.1
C9-1	<20	<0.1	0.1	0.1	360	360	342	0.1
C10-1	<20	<0.1	0.1	0.1	350	350	269	0.1
C11	<20	<0.1	0.1	0.1	430	430	275	0.1
O1	<20	<0.1	<0.1	<0.1	200	200	179	<0.1
O2	<20	<0.1	<0.1	<0.1	500	500	321	<0.1
O3	<20	<0.1	0.3	0.3	330	330	309	<0.1
OC1-1	<20	<0.1	<0.1	<0.1	180	180	274	0.6
OC2	<20	<0.1	0.3	0.3	480	480	252	0.2
OC3	<20	<0.1	0.2	0.2	440	440	338	0.2
RF2	<20	<0.1	0.1	0.1	380	380	466	<0.1
RF3	<20	<0.1	<0.1	<0.1	380	380	430	<0.1
TB1-1	<20	<0.1	<0.1	<0.1	330	330	288	0.1
TB2	<20	<0.1	0.2	0.2	490	490	348	0.2
TB3	<20	<0.1	0.2	0.2	370	370	245	0.2
TB4-1	<20	<0.1	<0.1	<0.1	160	160	211	0.2
TB5	<20	<0.1	<0.1	<0.1	400	400	314	<0.1
TB6	<20	<0.1	0.2	0.2	330	330	270	<0.1
TB7	<20	<0.1	0.1	0.1	360	360	282	<0.1
TB8	<20	<0.1	0.1	0.1	330	330	221	<0.1
TB10	<20	<0.1	0.1	0.1	320	320	180	<0.1
Median	<20	<0.1	0.1	0.1	330	330	317	<0.1
80^{th} %ile	<20	<0.1	0.2	0.2	392	392	383	0.2

4.7. PASS Field Screening

The results from the field screening test for PASS undertaken on twenty-eight (28) samples are presented in Table 13. Values across all sites for pH_F in deionised water range from 7.4 to 9.3, reflecting seawater influence (pH 8.2) and possibly dissolved carbonates typical of sediments in marine systems. Values for pH_{FOX} with 30% hydrogen peroxide remained high ranging from 6.8 to 8.6, and the maximum change in pH_F and pH_{FOX} values was 1.7. The reaction to hydrogen peroxide was recorded as "Moderate" in 13 samples, "Strong" in four (4) samples and "Extreme" in 10 samples. Whilst "Extreme" reactions were recorded in a reasonable number of samples from the site, results from the other two combining factors indicate a 'positive field sulphide identification' was not detected. The reactions observed were possibly caused from organic material within the sample.

Table 13 Summary of pH_F, pH_{FOX} and Reaction results at each of the sites sampled at Mardie, WA.

Analyte	pH_F	pH_{FOX}	ΔpH	Reaction	Results		
					Reaction > 3	pH_{FOX} < 3	ΔpH >2
C1_1	8.3	7	1.3	2	x	x	x
C2	8.3	7	1.3	2	x	x	x
C3_1	8.7	7	1.7	2	x	x	x
C4	8.4	7	1.4	2	x	x	x
C5	7.4	6.8	0.6	2	x	x	x
C6_1	8	6.9	1.1	2	x	x	x
C7	7.8	7	0.8	2	x	x	x
C8-1	8.5	7.9	0.6	3	x	x	x
C9-1	8.8	7.8	1	4	✓	x	x
C10-1	8.8	8	0.8	4	✓	x	x
C11	8.9	8.1	0.8	4	✓	x	x
O1	8.2	7.9	0.3	4	✓	x	x
O2	8.7	7.6	1.1	3	x	x	x
O3	7.6	7.1	0.5	2	x	x	x
OC1-1	7.7	7.2	0.5	2	x	x	x
OC2	8	7	1	2	x	x	x
OC3	8.2	7.3	0.9	2	x	x	x
RF2	9.3	8.6	0.7	4	✓	x	x
RF3	8.2	6.9	1.3	2	x	x	x
TB1-1	8.1	7.2	0.9	2	x	x	x
TB2	8.5	7.7	0.8	4	✓	x	x
TB3	8.4	7.8	0.6	4	✓	x	x
TB4-1	8.3	7.8	0.5	4	✓	x	x
TB5	8.6	8.1	0.5	4	✓	x	x
TB6	8.6	7	1.6	3	x	x	x
TB7	8.9	7.5	1.4	3	x	x	x
TB8	8.3	7	1.3	2	x	x	x
TB10	8.3	7	1.3	2	x	x	x

4.8. Benthic Infauna

Benthic infauna sampling and analysis was carried out on samples collected at seven (7) locations within the turning basin and surrounding the outfall of the original dredge footprint. A total of 128 individuals from 27 morphological species were identified. The three most common taxa across all sites were Nematoda (n = 30), Sipuncula sp. (n = 25) and Polychaeta sp. 3 (n = 14). Polychaeta was the most diverse class in terms of the number of morphological species identified (14).

The full laboratory methods and results of the benthic infauna analysis are presented in Appendix E.

Key items identified from the report are:

- The distribution and abundance of taxa across the survey area is heterogeneous, so there was no significant difference in species richness, diversity or composition identified across sites.
- Surface feeding was the most common source of food for all sites and omnivores dominated across all sites.
- The genus of foraminifera *Quinqueloculina* spp., which is found in relatively high abundance within these sediments, may be considered a good bioindicator for disturbance.

5. QA/QA Results

5.1. Field QA/QC Samples

The QA/QC sampling component of this marine sediment quality investigation included collection of Field QC samples for comparison to primary samples to determine interlaboratory, intra-laboratory and field variability in the data (i.e. triplicate, replicate, duplicate and split samples).

5.1.1. Physical Characteristics

The RPD results for the physical sediment characteristics data for the field quality control samples are shown in Table 14, results are presented in full in Appendix C. The RPD of ±35% in field splits/ duplicates and ±50% in field replicates/ triplicates for all physical parameters are met in two sample locations. One sample from three at O3 contained a higher proportion of gravel sized fractions, and there was a minor discrepancy of sand fractions at TB10. The interlaboratory split results from TB4 identifies there was some disparity in clay and gravel fractions within sub-samples of the same sample, indicating these results are likely to represent disparity between results from the empirical laboratories.

Table 14 **Relative percent difference (RPD) or Relative Standard Deviation (RSD) values for the physical sediment characteristics in the field quality control samples. Yellow shaded cells identify values above the specified RPD/RSD.**

Locations	Clay	Silt	Sand	Gravel	TOC	Moisture
	(<2 µm)	(<2 µm)	(0.06-2.0 mm)	(>2 mm)	(%)	(%)
O3	3.2	10.6	84.7	1.5	0.16	28.8
TRIP4	8.3	13.3	76.6	1.8		20.8
TRIP5	5.5	11.8	68.4	14.3	0.2	21
RSD (%)	**45.1%**	**11.4%**	**10.6%**	**124.5%**	**12%**	**19%**
OC3	3	7	64	26	0.24	33.3
REP (T1)	4	5	59	32	0.34	29.9
RPD (%)	**29%**	**33.3%**	**8.1%**	**20.7%**	**34.5%**	**10.8%**
RF6	15	15	54	16	-	-
DUP (RFB)	13	13	59	15	-	-
RPD (%)	**14.3%**	**14.3%**	**8.8%**	**6.5%**	**-**	**-**
TB4/TB5	16.7	23.8	23	36.5	0.28	30.4
SPLIT (S2/S3)	31.4	29.6	22.8	16.2	0.24	32
RPD (%)	**61.1%**	**21.7%**	**0.9%**	**77.0%**	**15.4%**	**5.1%**
TB10	27	44.3	28.4	0.3	0.26	35.4
REP (T6)	32.1	51.7	15.8	0.4	0.26	36.4
RPD (%)	**17.3%**	**15.4%**	**57.0%**	**28.6%**	**0.0%**	**2.8%**

5.1.2. Metals

The RPD/RSD results for metal concentrations from the field quality control samples are shown in Table 15, results are presented in full in Appendix C.

The RPD of ±35% is not met for Antimony, Cadmium, Mercury and Silver in split samples from TB2 due to the difference in the LoR for these analytes at the secondary laboratory, which was slightly higher than the primary laboratory. Both laboratories recorded concentrations below the LoR for these analytes and results are therefore considered accurate. The results recorded for Manganese at this site (39.6%) was slightly above an RPD of ±35%. NAGD (2009) recommends that results which fall outside these limits should be identified as estimates rather than precise values.

An RPD/RSD value of 66.7% was recorded for Cadmiun at sites C6 and O3. The large difference was due primarily to comparison of concentrations at the LoR of 0.1 mg/kg and below the LoR (<0.1 mg/kg). Converting the concentration below the LoR value of half the laboratory limit of reporting (0.05 mg/kg) for calculations in accordance with NAGD (2009) caused a misrepresentation of variability between the two samples, and this high RPD value for Cadmium may be disregarded in this case.

Table 15 **Relative percent difference (RPD) and Relative Standard Deviation (RSD) values for the total metal concentrations in the field quality control samples. Yellow shaded cells identify values above the specified RPD/RSDs.**

Analyte	Aluminium	Antimony	Arsenic	Cadmium	Chromium	Cobalt	Copper	Iron	Manganese	Mercury	Nickel	Silver	Vanadium	Zinc
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LoR	50	0.5	1	0.1	1	0.5	1	1	10	0.01	1	0.1	2	1
C6	5150	0.25	31.4	0.1	21.1	6.6	6	27000	373	0.005	10	0.05	39.4	12.5
DUP (P1)	5530	0.25	24.2	0.05	21.9	6.6	5.8	25900	329	0.005	10.8	0.05	37.5	13.2
RPD	**7.1%**	**0.0%**	**25.9%**	**66.7%**	**3.7%**	**0.0%**	**3.4%**	**4.2%**	**12.5%**	**0.0%**	**7.7%**	**0.0%**	**4.9%**	**5.4%**
O3	6610	0.25	22.7	0.05	28.3	8.9	8.1	29400	294	0.005	14.8	0.05	48.2	18.4
TRIP5	7930	0.25	22.7	0.05	33.4	9.9	9.6	33800	391	0.005	17.1	0.05	54.9	21.6
RPD	**18.2%**	**0.0%**	**0.0%**	**0.0%**	**16.5%**	**10.6%**	**16.9%**	**13.9%**	**28.3%**	**0.0%**	**14.4%**	**0.0%**	**13.0%**	**16.0%**
OC3	8750	0.25	20.9	0.05	36.5	9.3	10.6	37100	316	0.005	17.1	0.05	49	20.5
REP (T1)	7640	0.25	23.1	0.1	29.3	8.1	8.8	32600	302	0.005	14	0.05	44.2	17.4
RPD	**13.5%**	**0.0%**	**10.0%**	**66.7%**	**21.9%**	**13.8%**	**18.6%**	**12.9%**	**4.5%**	**0.0%**	**19.9%**	**0.0%**	**10.3%**	**16.4%**
TB1	13200	0.25	16.6	0.05	50.5	12.2	19.1	48200	299	0.005	24.5	0.05	67.9	31.4
TRIP2	11800	0.25	15.1	0.05	47	11.2	17.7	44500	271	0.005	23.7	0.05	63.3	28.7
TRIP3	11900	0.25	15.6	0.05	47.3	11.5	17.3	44900	283	0.005	25.8	0.05	63.1	29.6
RSD	**6.3%**	**0.0%**	**4.8%**	**0.0%**	**4.0%**	**4.4%**	**5.2%**	**4.4%**	**4.9%**	**0.0%**	**4.3%**	**0.0%**	**4.2%**	**4.6%**
TB2	11600	0.25	21	0.05	44.7	12	13.5	44700	478	0.005	22.4	0.1	59.8	29
SPLIT (S1)	12000	3.5	20	0.2	41	11	15	39000	320	0.05	19	0.5	56	23
RPD	**3.4%**	**173.3%**	**4.9%**	**120.0%**	**8.6%**	**8.7%**	**10.5%**	**13.6%**	**39.6%**	**163.6%**	**16.4%**	**133.3%**	**6.6%**	**23.1%**
TB5	10400	0.25	17.2	0.05	42.9	10.6	13.6	38900	266	0.005	20.7	0.05	56.6	26.4
SPLIT (S3)	9700	0.25	19	0.05	44	11	12	37000	340	0.005	21	0.05	60	27
RPD	**7.0%**	**0.0%**	**9.9%**	**0.0%**	**2.5%**	**3.7%**	**12.5%**	**5.0%**	**24.4%**	**0.0%**	**1.4%**	**0.0%**	**5.8%**	**2.2%**
TB10	8790	0.25	15.6	0.05	37.8	10	11.8	35200	258	0.005	18.2	0.05	50.4	23.6
REP (T6)	9020	0.25	16.4	0.05	38.3	9.8	11.4	36600	254	0.005	18.7	0.05	50.9	23
RPD	**2.6%**	**0.0%**	**5.0%**	**0.0%**	**1.3%**	**2.0%**	**3.4%**	**3.9%**	**1.6%**	**0.0%**	**2.7%**	**0.0%**	**1.0%**	**2.6%**

5.1.3. Organic Compounds

Almost all results for organic compounds in field quality control samples are below the LoR. The RPD/RSD results for TPH/TRH from the field quality control samples are shown in Table 16.

Concentrations between interlaboratory split samples at TB2 and TB5 exceeded the RPD of ±35% for all TRH samples due to the secondary laboratory having a higher LoR. However, the cumulative totals of these LoRs are well below ISQG-low values for TPH of 280 mg/kg and all concentrations recorded were below the LoRs.

An RPD/RSD value of 66.7% was recorded for TPH chainage C15-C28 at site TB10. The large difference was due primarily to comparison of concentrations at the LoR of 3.0 mg/kg and below the LoR (<3.0 mg/kg). Converting the concentration below the LoR value of half the laboratory limit of reporting (1.5 mg/kg) for calculations in accordance with NAGD (2009) caused a misrepresentation of variability between the two samples, and this high RPD value for TPH chainage C15-C28 may be disregarded in this case.

The result recorded for TRH C16-C34 (54.5%) at TB10 was slightly above an RPD of ±50%. NAGD (2009) recommends that results which fall outside these limits should be identified as estimates rather than precise values.

The difference between the LoR between the primary and secondary laboratories continued to record RPD/RSD values greater than 35% for BTEXN, PAH, Organotin and Herbicide suites as described for TPH/TRH. However, the values remained below the LoR throughout all testing and represent the only exceedance of the RPD/RSD. Therefore, these high RPDs are negligible in the context of ANZECC ISQGs. The RPD results for these organic suites are not presented, although results are provided in full in Appendix C.

Of the surrogates tested for TPH/BTEXN, Base/Neutral Extractable, Organotin and Herbicide, only one RPD/RSD results value was calculated above 35%/50%. A duplicate sample from site C6 recorded an RPD of 38%, slightly above the 35% criteria, for 1.2-Dichloroethane-D4. However, all TPH, TRH and BTEXN results were below the LoR so this finding is unlikely to have affected interpretation of the laboratory results. The results for the organic surrogates are provided in full in Appendix C.

Table 16 **Relative percent difference (RPD) and Relative Standard Deviation (RSD) calculations for QA/QC samples TPH/TRH analytes. Yellow shaded cells identify values above the specified RPD/RSDs.**

Analyte	TPH				TRH			
	C6-C9	C10-C14	C15-C28	C29-C36	C6-C10	C10-C16	C16-C34	C34-C40
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LoR	3	3	3	5	0.2	0.2	0.2	0.5
C6	1.5	1.5	1.5	2.5	1.5	1.5	1.5	2.5
DUP (P1)	1.5	1.5	1.5	2.5	1.5	1.5	1.5	2.5
RPD	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
O3	1.5	1.5	4	2.5	1.5	1.5	6	2.5
TRIP5	1.5	1.5	4	2.5	1.5	1.5	5	2.5
RPD	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**18.2%**	**0.0%**
OC3	1.5	1.5	1.5	2.5	1.5	1.5	1.5	2.5
REP (T1)	1.5	1.5	1.5	2.5	1.5	1.5	1.5	2.5
RPD	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
TB1	1.5	1.5	1.5	2.5	1.5	1.5	1.5	2.5
TRIP2	1.5	1.5	1.5	2.5	1.5	1.5	1.5	2.5
TRIP3	1.5	1.5	1.5	2.5	1.5	1.5	1.5	2.5
RSD	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
TB2					1.5	1.5	1.5	2.5
SPLIT (S1)					12.5	25	50	50
RPD					**157.1%**	**177.4%**	**188.3%**	**181.0%**
TB5					1.5	1.5	1.5	2.5
SPLIT (S3)					12.5	12.5	12.5	12.5
RPD					**157.1%**	**157.1%**	**157.1%**	**133.3%**
TB10	1.5	1.5	3	2.5	1.5	1.5	7	2.5
REP (T6)	1.5	1.5	1.5	2.5	1.5	1.5	4	2.5
RPD	**0.0%**	**0.0%**	**66.7%**	**0.0%**	**0.0%**	**0.0%**	**54.5%**	**0.0%**

5.1.4. Nutrients

The RPD results for the physical sediment characteristics data for the field quality control samples are shown in Table 17, results are presented in full in Appendix C.

The RPD/RSD of 35%/50% is not met at three sites for nitrate (O3, TB2, TB5) and reactive phosphorus (OC3, TB5, TB10), and at TB5 for ammonia. Nitrite+nitrate, concentrations mirror the levels above the LoR for nitrate so similar results are recorded in this column. The cause of the high proportional variation between control samples was primarily due to comparison of small values below the LoR, where half the LoR is used in the calculation, with low concentrations of detected nutrients in the other sample, or differences in the LoR between the primary and secondary laboratory at TB and TB5. These results are not compared to ISQG-low guidelines and therefore are not used as precise values. Results from the QC samples indicate that recorded nutrient concentrations provide a reasonable estimate.

Table 17 **Relative percent difference (RPD) and Relative Standard Deviation (RSD) calculations for QA/QC samples nutrient analytes. Yellow shaded cells identify values above the specified RPD/RSDs.**

Analyte	NH_4	NO_{-2}	NO_{-3}	NO_X	TKN	TN	TP	FRP
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LoR	20	0.1	0.1	0.1	20	20	2	0.1
C6	10	0.05	0.05	0.05	330	330	358	0.05
DUP (P1)	10	0.05	0.05	0.05	250	250	296	0.05
RPD	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**27.6%**	**27.6%**	**19.0%**	**0.0%**
O3	10	0.05	0.3	0.3	330	330	309	0.05
TRIP5	10	0.05	0.05	0.05	230	230	241	0.05
RPD	**0.0%**	**0.0%**	**142.9%**	**142.9%**	**35.7%**	**35.7%**	**24.7%**	**0.0%**
OC3	10	0.05	0.2	0.2	440	440	338	0.2
REP (T1)	10	0.05	0.3	0.3	350	350	324	0.1
RPD	**0.0%**	**0.0%**	**40.0%**	**40.0%**	**22.8%**	**22.8%**	**4.2%**	**66.7%**
TB1	10	0.05	0.05	0.05	330	330	288	0.1
TRIP2	10	0.05	0.05	0.05	310	310	258	0.1
TRIP3	10	0.05	0.1	0.1	330	330	231	0.1
RSD	**0.0%**	**0.0%**	**43.3%**	**43.3%**	**0.0%**	**0.0%**	**15.5%**	**0.0%**
TB2	10	0.05	0.2	0.2	490	490	348	0.2
SPLIT (S1)	7.1	0.05	0.05	---	350	350	300	0.25
RPD	**33.9%**	**0.0%**	**120.0%**	**n/a**	**33.3%**	**33.3%**	**14.8%**	**22.2%**
TB5	10	0.05	0.05	0.05	400	400	314	0.05
SPLIT (S3)	5.7	0.05	0.11	---	440	440	250	0.25
RPD	**54.8%**	**0.0%**	**75.0%**	**n/a**	**9.5%**	**9.5%**	**22.7%**	**133.3%**
TB10	10	0.05	0.1	0.1	320	320	180	0.05
REP (T6)	10	0.05	0.1	0.1	470	470	271	0.2
RPD	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**38.0%**	**38.0%**	**40.4%**	**120.0%**

5.1.5. PASS Field Screening

The comparison of pH_F and pH_{FOX} results provide RPD values less than 35%. The RPD results for these organic suites are not presented, although results are provided in full in Appendix C.

5.2. Laboratory QA/QC

The laboratory quality control reports and the laboratory QA/QC compliance assessment reports are provided in Appendix C. The findings of these results determined:

- No Method Blank outliers occur;
- No Duplicate outliers occur;
- Laboratory Control outliers exist;
- Matrix Spike outliers exist;
- Surrogate recovery outliers exist;
- Analysis holding time outliers exist; and

- Quality Control Sample Frequency Outliers exist.

No results were qualified as unusable during the data review process due to laboratory control, matrix spike, analysis holding time or quality control sample frequency outliers.

From the December 2018 and February 2019 sampling events, a laboratory control recovery for MBT and DBT were slightly greater than the upper control limit of 132%. However, all concentrations recorded for MBT and DBT in the samples are below the LoR.

Matrix spike recoveries were not determined for Aluminium and Iron in four samples (TRIP 1, Trip 3, O3, RF3) due to the background level being greater than or equal to four times the spike level. NAGD (2009) recommends matrix spike data should not be reported if the naturally occurring levels in the sample are greater than twice the spiking level. Therefore, the matrix spike recoveries for Aluminium and Iron can be omitted from reported results. Ammonia background was also greater than four times the spike levels in one anonymous sample.

The matrix spike recovery for TP from sample Trip 1 was 60.8%, less than the lower data quality objective of 70%. The results for TP were considered to be variable and used for background informative purposes, specific values were not compared to SQG values.

The organotin surrogate Tripropyltin had recovery levels slightly greater (~9%) than the upper data quality objective.

All analysis holding time outliers occurred from samples collected in January 2019. Analysis holding times for TPH, TRH, BTEXN and PAHs were approximately 34-35 days overdue by the time analysis was undertaken. Deionised water samples for the Rinsate blank were also overdue for nutrients and hydrocarbons. Other parameters identified with a holding time breach included the PASS field screen analysis for six (6) sites tested, and moisture, hydrocarbons and nutrients for the three QC blank samples. All results for these parameters were very low, below the LoR, or PASS was not detected, indicating there is a very low likelihood these outliers would affect interpretation of the findings.

The quality control frequency of a laboratory duplicate and matrix spike for Rinsate samples was not undertaken for the semi-volatile fraction of TRH and PAH/ Phenols, although all samples were below the LoR anyway. The TRH Volatile/ BTEXN matrix spike testing was one test short of conformance with NEPM (1999) standards.

6. Conclusions

A baseline sediment quality assessment has been undertaken in the Mardie Project area to document background marine environmental quality within the receiving marine environment and enable the derivation of sediment and benthic infauna environmental quality criteria (EQC). The sampling was undertaken with consideration to the requirements of the Environment Protection (Sea dumping) Act 1981 and associated guidance and includes both physical (i.e. particle size) and chemical (metals, tributyltin, hydrocarbons) testing in accordance with the requirements specified in the ESD. The marine project footprint was revised following the first two sampling events, with one further sampling event conducted following the project modification.

The samples collected within the nearshore proposed Development Envelope at Mardie are comprised of uncontaminated sediments and are considered suitable for onshore disposal. The background sediment quality at the site is considered to be representative of natural environmental conditions that are largely un-impacted by anthropogenic influences. However, some concentrations for metals and nutrients in sediments are naturally higher than recorded for marine sediment programs in other areas of the Pilbara, Western Australia, and revised site-specific EQC are recommended.

6.1. Physical Characteristics

The colour of the sediment samples varied from brown/grey, grey/red/, dark grey, red/brown, dark brown to brown. Sand and gravel size fractions dominate the PSD results from locations within the channel (C1-1 to C8) and the outer channel (OC1-OC3) of the original dredge footprint, and within the revised dredge footprint sample area (RF1-RF6). Sites closer to shore within the turning basin (TB1-TB10), around the outfall (O1-O3) and the inner channel (C9-C11) of the original footprint sediment samples were comprised of a higher proportion of fines (i.e. silt and clay). The TOC levels are typically low, although notably lower proportions of TOC and moisture were found in samples collected within the channel of the original dredge footprint, between the original proposed turning basin and revised dredge sample area. Samples from this area also comprised of very low proportions of fines, suggesting this area experiences strong currents immediately adjacent to the intertidal mudflat which scours fine sediment from the seabed.

6.2. Metals and Metalloids

The results for total metals in sediment from the Mardie Project area indicate the estimated natural background concentrations are typically higher than recorded across the Pilbara region. The 95% UCLs of the mean were calculated across all 28 sites. The 95% UCL is above the ISQG-low value for Arsenic and Nickel. In addition, the 95% UCL is above the background SQG for Pilbara waters for Aluminium, Cobalt, Iron and Vanadium. Three samples exceed the low reliability guideline value for Manganese. All concentrations for all metals are below EIL and HIL screening levels. The standard deviation of the sample data is less than 50% of the relevant HILs across all metals and no single value exceeds 250% of the relevant HILs.

Normalisation tests conducted on the results for metals in sediment samples found a strong positive correlation between Aluminium and Iron, although weak correlations for comparison of these natural elements with the <63 µm PSD. The results indicate naturally high levels of trace metals occur in marine

sediments in the Development Envelope, likely dependant on the geology and mineralogy of the area, although apparently not strongly correlated to PSD. This is contradictory to findings from other studies in the region where grain size was determined to be the principle factor which controls concentrations of most trace metals in whole sediments (O2 Marine 2018). However, the PSD results collected from the Development Envelope were highly variable. The results may be influenced by terrigenous input from the Fortescue River catchment, similar to DEC (2006) findings of higher natural concentrations in sediments from Ashburton River Mouth compared to levels measured at other locations along the Pilbara coast.

The data for metal contaminants that recorded elevated concentrations (Arsenic, Nickel, Vanadium, Cobalt and Manganese) were graphed against the Aluminium normaliser concentration. A strong positive correlation with Nickel, Cobalt, and Vanadium suggests these metals are lithogenically derived and of natural origin. The normalised results for Nickel are below the ISQG-low value of 21 mg/L, although values for Cobalt and Vanadium remain above the SQG for Pilbara waters. Weak linear correlations are observed between Aluminium and Arsenic or Manganese, therefore normalisation was not undertaken on these metals. DEC (2006) concluded that the ISQG-low value for Arsenic may not be suitable for use across much of the marine environment of the Pilbara region and that alternative guidelines based on local data should be derived. In addition, the Manganese low reliability guideline value was derived from The Ontario Ministry of the Environment and therefore natural exceedance of this value is unlikely to indicate a Contaminant of Potential Concern.

Site-specific EQC have been derived for metals in sediment for the Mardie Project area in accordance with DEC (2006) and EPA (2016) and are presented in Table 18.

6.3. Organic Compounds

Organic compounds tested included TPH, TRH, BTEXN, PAHs and organotins. All contaminant concentrations are below ANZECC/ARMCANZ (2000) ISQG-low, ESL and HSL values, and the vast majority of organic analytes are below the laboratory LoR. The only organic compounds recorded above the LoR are TPH/TRH concentrations in the larger carbon fractions at seven sites.

EQC for these organic compounds will use values derived in ISQG or the guideline may be no detectable concentration.

6.4. Pesticides

All 14 tested Phenoxyacetic Acid Herbicide analytes are recorded at concentrations below the LoR. Herbicides were identified early as a CoPC due to historical use on Mardie Station. This SAP found no evidence of Herbicides in marine sediments.

EQC for these herbicide analytes will use values derived in ISQG or the guideline may be no detectable concentration.

6.5. Nutrients

Inorganic forms of nutrients in sediments (NO_2, NO_3, NH_4, FRP) are either below the laboratory LoR, or are recorded at very low concentrations. Results for TKN/TN and TP is therefore likely to be

predominantly organically bound and representative of the typically low organic concentrations of sediments of the Pilbara, which must be broken down into inorganic forms to be available for uptake by plants. Concentrations of TKN/TN range from 110 to 500 mg/kg and TP from 179 to 468 mg/kg. However, these concentrations are notably higher than organic material reported in sediments near Onslow which ranged from 30 to 360 mg/kg and 43 to 293 mg/kg, respectively (O2 Marine 2018).

Site-specific EQC have been derived for nutrients in sediment for the Mardie Project area in accordance with DEC (2006) and EPA (2016) and are presented in Table 18. No EQC are provided for Ammonia as this would be based on no detectable concentration.

6.6. PASS Screening

Values across all sites for pH_F in deionised water range from 7.4 to 9.3, reflecting seawater influence (pH 8.2) and possibly dissolved carbonates typical of sediments in marine systems. The maximum change in pH_F and pH_{FOX} values was 1.7. The reaction to hydrogen peroxide was recorded as “Extreme” in 10 samples. Whilst “Extreme” reactions were recorded in a reasonable number of samples from the site, results from the other two combining factors to identify a ‘positive field sulphide identification’ were not triggered and it is therefore PASS are considered to not be detected. The reactions observed were possibly caused from organic material within the sample.

6.7. Benthic Infauna

The distribution and abundance of benthic infauna taxa across the survey area is heterogeneous, and there was no significant difference in species richness, diversity or composition identified across sites. The results suggest that it would be difficult to develop EQC for detecting anthropogenic impacts based on the variability of benthic infauna observed within samples. The genus of foraminifera *Quinqueloculina* spp., which is found in relatively high abundance within these sediments, may be considered a good bioindicator for disturbance. These foraminifera have been shown to be sensitive taxa and the faunal composition and morphology respond to human-induced environmental perturbations in coastal marine areas. However, further targeted investigation would be required to develop specific biomonitoring EQC.

Table 18 **Recommended environmental quality criteria (EQC) for metals and organic nutrients in whole sediment at the Mardie Project area**

Analyte	Level of Ecological Protection (LEP)			
	Max	High	Moderate	Low
Units	mg/kg	mg/kg	mg/kg	mg/kg
Aluminium	10,620	17,750	17,750	26,625
Antimony	0.5	2	2	25
Arsenic	30	36	36	54
Cadmium	0.1	1.5	1.5	10
Chromium	44.5	80	80	370
Cobalt	11.8	20.4	20.4	30.6
Copper	13.5	65	65	270
Iron	42,320	73,700	73,700	110,550
Manganese	415	565	565	847
Mercury	<0.01	0.15	0.15	1
Nickel	22.3	35.8	35.8	52
Silver	0.1	1	1	3.7
Vanadium	59	104	104	157
Zinc	27.4	200	200	410
Total Nitrogen	392	660	660	990
Total Phosphorus	383	635	635	952
Nitrite+Nitrate	0.2	0.2	0.2	0.3
Reactive Phosphorus	0.2	0.4	0.4	0.6

7. References

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Appendix A Chain of Custody Forms

1-6

Project Details	
Job Number:	18WAU-0002
Project Title:	Mardie Project - Sediment Sampling
Client:	BCI Minerals
Field Lead:	Claudio Del Deo

Sampling Requirements		
Primary Lab	**Secondary Lab**	**Benthic Infauna Lab**
ALS Sediment - Per Sample	**MPL Sediment - Per Sample**	Sieved Sediment - Per Sample
3x 250ml Glass Jar (J) (1 if no ORG) 2x clipseal 500g plastic bag (P) 1x 50g plastic bag (P)	3x 250ml Glass Jar (1 if no ORG) 2x clipseal 500g plastic bag (P); 1x 50g plastic	1x 500g clipseal plastic bag per sample

Weather Observations	
Sampling Dates:	
Air Temp. (°C):	
Wind Speed (knts):	
Wind Direction:	
Sea State:	

SITE	Latitude	Longitude	Method	BI	CoPC	ORG	PHYS	TRIP	SPLIT	DATE	TIME	WATER DEPTH (m)	SEDIMENT TYPE	COLOUR	FOREIGN MATERIAL	SHELL/BIOTA	ODOUR	COMMENTS
C3-1	21°3' 3.083" S	115°56' 4.327" E	VC		1J	2J	3P			12/12/18	[illegible]	1m	Grav	Grey/Red		High	Mil	Ref 1.5m
C3-2	"	"	VC				3P			"	"	"	Grav-Shell	Grey/Red		High	Mil	"
C3-3			VC				3P											
C3-4			VC				3P											
C4	21°3' 4.003" S	115°56' 0.715" E	G		1J		3P	X		12/12/18	10:00	1.8m	SILT					
C5	21°3' 11.351" S	115°55' 59.055" E	G		1J		3P			12/12/18	11:00	2m	Grav SILT					
C6-1	21°3' 13.633" S	115°55' 58.337" E	VC		1J	2J	3P		X	12/12/18	11:20	3m						
C6-2			VC				3P											
C6-3			VC				3P											
C6-4			VC				3P											
C7	21°3' 15.534" S	115°55' 57.208" E	VC		1J	2J	3P			15/12/18	1330		SAND SILT	GRAY BROWN		High	MK	Ref Sandy Silt

2-6

MARINE

Project Details	
Job Number:	18WAU-0002
Project Title:	Mardie Project - Sediment Sampling
Client:	BCI Minerals
Field Lead:	Claudio Del Deo

Sampling Requirements		
Primary Lab	**Secondary Lab**	**Benthic Infauna Lab**
ALS Sediment - Per Sample	**MPL Sediment - Per Sample**	Sieved Sediment - Per Sample
3x 250ml Glass Jar (J) (1 if no ORG) 2x clipseal 500g plastic bag (P) 1x 50g plastic bag (P)	3x 250ml Glass Jar (1 if no ORG) 2x clipseal 500g plastic bag (P); 1x 50g plastic	1x 500g clipseal plastic bag per sample

Weather Observations	
Sampling Dates:	
Air Temp. (°C):	
Wind Speed (knts):	
Wind Direction:	
Sea State:	

SITE	Latitude	Longitude	Method	BI	CoPC	ORG	PHYS	TRIP	SPLIT	DATE	TIME	WATER DEPTH (m)	SEDIMENT TYPE	COLOUR	FOREIGN MATERIAL	SHELL/BIOTA	ODOUR	COMMENTS
C8-1	21°3' 21.168" S	115°55' 57.979" E	VC		1J		3P			15/1/19	1230	2.8	SAND	GRAY BROWN				Ref 1.8 m
C8-2	↓	↓	VC				3P			↓	↓	↓	↓					
C8-3			VC				3P											
C8-4			VC				3P											
C9-1	21°3' 29.[illegible]7" S	115°55' 57.520" E	VC		1J		3P			15/1/19	1115	2.3	SAND/SILT	DARK GRAY		10%	NA	
C9-2			VC				3P			[illegible]			SAND-GRAV	GRAY				Ref 1.3 m
C9-3			VC				3P											
C9-4			VC				3P											
C10-1	21°3' 37.300" S	115°55' 57.101" E	VC		1J		3P			12/12/18	800	1	[illegible] SAND					0.8m Ref on gravel
C10-2			VC				3P											
C10-3			VC				3P											
C10-4			VC				3P											

3-6

MARINE

Project Details	
Job Number:	18WAU-0002
Project Title:	Mardie Project - Sediment Sampling
Client:	BCI Minerals
Field Lead:	Claudio Del Deo

Sampling Requirements		
Primary Lab	**Secondary Lab**	**Benthic Infauna Lab**
ALS Sediment - Per Sample	**MPL Sediment - Per Sample**	Sieved Sediment - Per Sample
3x 250ml Glass Jar (J) (1 if no ORG) 2x clipseal 500g plastic bag (P) 1x 50g plastic bag (P)	3x 250ml Glass Jar (1 if no ORG) 2x clipseal 500g plastic bag (P); 1x 50g plastic	1x 500g clipseal plastic bag per sample

Weather Observations	
Sampling Dates:	
Air Temp. (°C):	
Wind Speed (knts):	
Wind Direction:	
Sea State:	

SITE	Latitude	Longitude	Method	BI	CoPC	ORG	PHYS	TRIP	SPLIT	DATE	TIME	WATER DEPTH (m)	SEDIMENT TYPE	COLOUR	FOREIGN MATERIAL	SHELL/BIOTA	ODOUR	COMMENTS
C1 1	21°3' 39.167" S	115°55' 57.646" E	G		1J	2J	3P			15/12/18	10:00	4						Sample collected by DIVING
OC 1-1	21° 2' 13.280" S	115° 56' 15.964" E	VC		1J		3P			16/1/19	8:00	3.4	Sand/Silt ~~Gravel~~	Red Brown		10%	MARINE	Ref 50 cm
OC 1-2			VC				3P						CLAY					
OC 1-3			VC				3P											
OC 1-4			VC				3P											
OC 2	21° 2' 20.577" S	115° 56' 14.246" E	G		1J		3P			15/12/18	10:00	4						DUPLICATE
OC 3	21° 2' 26.830" S	115° 56' 13.812" E	G		3 1J		6 3P			15/12/18	9:30	3.5						1 Rep
O1	21° 3' 53.039" S	115°55' 48.447" E	G	3P	1J		3P			15/01/19	7:30	2.0						Ref 1m ON GRAV PHOTO TAKEN
O2	21° 3' 52.036" S	115°55' 52.096" E	G	3P	1J		3P			16/01/19	9:30	1.6	SILT					
O3	21° 3' 57.017" S	115°55' 55.206" E	G	3P	1J		3P			16/01/19	9:00	1.7	sand					

4-6

MARINE

Project Details	
Job Number:	18WAU-0002
Project Title:	Mardie Project - Sediment Sampling
Client:	BCI Minerals
Field Lead:	Claudio Del Deo

Sampling Requirements		
Primary Lab	**Secondary Lab**	**Benthic Infauna Lab**
ALS Sediment - Per Sample	**MPL Sediment - Per Sample**	Sieved Sediment - Per Sample
3x 250ml Glass Jar (J) (1 if no ORG) 2x clipseal 500g plastic bag (P) 1x 50g plastic bag (P)	3x 250ml Glass Jar (1 if no ORG) 2x clipseal 500g plastic bag (P); 1x 50g plastic	1x 500g clipseal plastic bag per sample

Weather Observations	
Sampling Dates:	
Air Temp. (°C):	
Wind Speed (knts):	
Wind Direction:	
Sea State:	

SITE	Latitude	Longitude	Method	BI	CoPC	ORG	PHYS	TRIP	SPLIT	DATE	TIME	WATER DEPTH (m)	SEDIMENT TYPE	COLOUR	FOREIGN MATERIAL	SHELL/BIOTA	ODOUR	COMMENTS
TB 1-1	21°3' 44.901" S	115°55' 58.487" E	VC		2J	4J	3P			15/1/19	10:20		SPLIT	for	COPC + ORG			Ref 1/1 ORG
TB 1-2	"	"	VC				3P			"	"		"	"	"	"	"	"
TB 1-3	"	"	VC				3P			"	"		"	"	"	"	"	"
TB 1-4	"	"	VC				3P			"	"		"	"	"	"	"	"
TB 2	21°3' 45.411" S	115°55' 56.891" E	G	3P	1J	2J	3P	X		12/12	11:50	3.6	SILT					
TB 3	21°3' 45.664" S	115°56' 4.225" E	G		1J		3P			12/12	12:30							
TB 4-1	21°3' 49.148" S	115°56' 2.833" E	VC		1J		3P			15/1/19	09:00	1.9	SILT	SPLIT for PSD				Vib + PSD
TB 4-2	"	"	VC				3P			"	"	"	"	"	"	"	"	"
TB 4-3	"	"	VC				3P			"	"	"	"	"	"	"	"	"
TB 4-4	"	"	VC				3P			"	"	"	"	"	"	"	"	"
TB 5	21°3' 50.946" S	115°56' 1.608" E	G		1J	2J	3P		X	16/1/19	9:45	1.8	SILT					
TB 6	21°3' 52.703" S	115°56' 2.347" E	G	3P	1J	2J	3P			16/1/19	10:10	1.7						

5-6

MARINE

Project Details	
Job Number:	18WAU-0002
Project Title:	Mardie Project - Sediment Sampling
Client:	BCI Minerals
Field Lead:	Claudio Del Deo

Sampling Requirements		
Primary Lab	Secondary Lab	Benthic Infauna Lab
ALS Sediment - Per Sample	MPL Sediment - Per Sample	Sieved Sediment - Per Sample
3x 250ml Glass Jar (J) (1 if no ORG) 2x clipseal 500g plastic bag (P) 1x 50g plastic bag (P)	3x 250ml Glass Jar (1 if no ORG) 2x clipseal 500g plastic bag (P); 1x 50g plastic	1x 500g clipseal plastic bag per sample

Weather Observations				
Sampling Dates:				
Air Temp. (°C):				
Wind Speed (knts):				
Wind Direction:				
Sea State:				

SITE	Latitude	Longitude	Method	BI	CoPC	ORG	PHYS	TRIP	SPLIT	DATE	TIME	WATER DEPTH (m)	SEDIMENT TYPE	COLOUR	FOREIGN MATERIAL	SHELL/BIOTA	ODOUR	COMMENTS
TB 7	21°3' 52.700" S	115°56' 0.554" E	G		1J		3P			6/1/19	1025	2						
C11	✓		G		1J		6P			6/1/19			SAND/SILT					
C10	OK		VC		1J		3P			6/1/19	1250	2.6						
C10-1							3P											
C10-2							3P											
C10-3							3P											

Chain of Custody (CoC) Record

Project:	Mardie Project: Sediment Sampling		
Client:	BCI Minerals	**Job No.:**	18WAU-0002
Lab Quote No.:	EP/1145/18	**Turnaround Time:**	Standard
O2M Project Manager	Claudio Del Deo	**Email Address:**	claudio.deldeo@o2marine.com.a

Laboratory:	ALS
Address:	
Lab. Contact:	Lauren Biagioni

Please Note:
Please sign copy on receipt of samples and email signed copy of CoC record to O2M Project Manager.

Email laboratory analysis results to O2M Project Manager.

	O2M Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix (S-Soil / SL-Sludge / W-Water / A-Air)	Containers: Type (B-Bottle / J-Jar / V-Vial / G-Glass / P-Plastic Bag)	Containers: No. of Samples	Containers: Total Volume (mL)	Analyse = A; Hold = H: Metals (EG020-SD; EG005-SD; EG035-SD)	PAH, TRH/BTEXN (EP132B-SD; EP080-SD; EP071-SD)	Nutrients (NT-8AS)	TBT (EP090)	Phenoxyacetic acids (EP202)	ASS Screening Test (EA037)	ASS (Scr) (EA026)	TOC (EP003)	Moisture Content (EA055)	PSD (EA150H/Ea152	Comments
1	SPLIT-P1		DEC 18		S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	All soil samples are marine sediment
2	SPLIT-P2		15-1-19		S	3P	1	1300	A	A	A			A	H	A	A	A	TB4 (PSD) II LAB
3	TRIP-1		DEC 18		S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
4	TRIP-2		15-1-19	10:20	S	2J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	TB1
5	TRIP-3		15-1-19	10:20	S	2J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	TB1
6	TRIP-4		16-1-19		S	5J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	PSD - 03 (ESS)
7	TRIP-5		16-1-19		S	1J, 3P	1	1800	A	A	A			A	H	A	A	A	PSD - 03 (ESS)
8	TRIP-6		16-1-19		S	1J, 3P	1	1800	A	A	A			A	H	A	A	A	TB10
9	RINSATE 1		15-1-19	17:10	S	1B	1	500	A	A	A								
10	TRIPB	TB5521	6-12-18	11:20	S	1B	1	500	A	A	A								NEVER OPEN
11	FIELDB FB2	TB5519	6-12-18	11:20	S	1J	1	250	A	A	A								FIELD BLANC (OPEN ON SITE)
12	TB1-1		15-1-19	10:20	S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
13	TB1-2	REA			S	3P	1	1050						A	H		A	A	
14	TB1-3				S	3P	1	1050						A	H		A	A	
15	TB1-4				S	3P	1	1050						A	H		A	A	
16	TB2	DEC	18		S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
17	TB3	DEC	18		S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	

18	TB4-1		15·1·19	9:00	S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	
19	TB4-2				S	3P	1	1050						A	H	A	A	A	Refuse NO Sample
20	TB4-3				S	3P	1	1050						A	H	A	A	A	11 11 11
21	TB4-4				S	3P	1	1050						A	H	A	A	A	11 11 11
22	TB5		16·1·19	9:45	S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
23	TB6		16·1·19	10:10	S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
24	TB7		16·1·19	10:25	S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	
25	TB8		16·1·19	10:45	S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
26	TB9-1	DEC	18		S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	
27	TB9-2	↓	↓	↓	S	3P	1	1050						A	H		A	A	
28	TB9-3	↓	↓	↓	S	3P	1	1050						A	H		A	A	
29	TB9-4	↓	↓	↓	S	3P	1	1050						A	H		A	A	
30	TB10		16·1·19	11:40	S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
31	C1-1	DEC	18		S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	
32	C1-2	↓	↓	↓	S	3P	1	1050						A	H		A	A	
33	C1-3	↓	↓	↓	S	3P	1	1050						A	H		A	A	
34	C1-4	↓	↓	↓	S	3P	1	1050						A	H		A	A	
35	C2	DEC	18		S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	
36	C3-1	DEC	18		S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
37	C3-2	↓	↓	↓	S	3P	1	1050						A	H		A	A	
38	C3-3	↓	↓	↓	S	3P	1	1050						A	H		A	A	
39	C3-4	↓	↓	↓	S	3P	1	1050						A	H		A	A	
40	C4	DEC	18		S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
41	C5	DEC	18		S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	
42	C6-1	DEC	18		S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
43	C6-2	↓	↓	↓	S	3P	1	1050						A	H		A	A	
44	C6-3	↓	↓	↓	S	3P	1	1050						A	H		A	A	
45	C6-4	↓	↓	↓	S	3P	1	1050						A	H		A	A	
46	C7	〃	16-1-19	13:30	S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	⊄ TRIP 6 NO PSD
47	C8-1		15·1·19	12:30	S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	

PD

Page 8 of 8

Project:	Mardie Project: Sediment Sampling		
Client:	BCI Minerals	**Job No.:**	18WAU-0002
Lab Quote No.:	EP/1145/18	**Turnaround Time:**	Standard
O2M Project Manager	Claudio Del Deo	**Email Address:** claudio.deldeo@o2marine.com.a	

Laboratory: ALS
Address:
Lab. Contact: Lauren Biagioni

Please Note:
Please sign copy on receipt of samples and email signed copy of CoC record to O2M Project Manager.

Email laboratory analysis results to O2M Project Manager.

	O2M Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix S-Soil / SL-Sludge / W-Water / A-Air	Containers: Type B-Bottle / J-Jar / V-Vial / G-Glass / P-Plastic / B-Bag	No. of Samples	Total Volume (mL)	Metals (EG020-SD; EG005-SD; EG035-SD)	PAH, TRH/BTEXN (EP132B-SD; EP080-SD; EP071-SD)	Nutrients (NT-8AS)	TBT (EP090)	Phenoxyacetic acids (EP202)	ASS Screening Test (EA037)	ASS (Sed) (EA026)	TOC (EP005)	Moisture Content (EA055)	PSD (EA150H/EA152)	Comments
51	C9-1		15·1·19	11:30	S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	
52	C9-2		15·1·19	11:30	S	3P	1	1050						A	H		A	A	
53	C9-3	—	—	—	S	3P	1	1050						A	H		A	A	Refusal
54	C9-4	—	—	—	S	3P	1	1050						A	H		A	A	Refusal
55	C10-1		16·1·19	13:00	S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	—
56	C10-2	REF	—	—	S	3P	1	1050						A	H		A	A	Refusal
57	C10-3	REF	—	—	S	3P	1	1050						A	H		A	A	Refusal
58	C10-4	REF	—	—	S	3P	1	1050						A	H		A	A	11 11
59	C11		16·1·19	11:40	S	4J, 3P	1	1300	A	A	A	A	A	A	H	A	A	A	
60	OC1-1	~~18~~ -	15·1·19	800	S	1J, 3P	1	1800	A	A	A			A	H	A	A	A	
61	OC1-2	REFUSAL			S	3P	1	1050						A	H		A	A	
62	OC1-3				S	3P	1	1050						A	H		A	A	
63	OC1-4				S	3P	1	1050						A	H		A	A	
64	OC2	DEC 18			S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	
65	OC3	DEC 18	~~16·1·19~~	~~9:00~~	S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	BIG 1500mg BAG
66	O1	~~15·1·19~~	15·1·19	7:30	S	1J, 3P	1	1300	A	A	A					A	A	A	
67	O2		16·1·19	9:30	S	1J, 3P	1	1300	A	A	A					A	A	A	
68	O3		16·1·19	900	S	1J, 3P	1	1300	A	A	A					A	A	A	

[illegible]

48	C8-2	Refusal			S	3P	1	1050						A	H		A	A
49	C8-3	"	"		S	3P	1	1050						A	H		A	A
50	C8-4	"	"		S	3P	1	1050						A	H		A	A

Sampled By:		Date/Time:	
Received By Lab:		Date/Time:	
Sample Cold (Yes/No):		Sample Container Sealed (Yes/No):	

Relinquished By:

Courier:

Chain of Custody (CoC) Record

Project:	Mardie Project: Sediment Sampling		
Client:	BCI Minerals	Job No.:	18WAU-0002
Lab Quote No.:	EP/1145/18	Turnaround Time:	Standard
O2M Project Manager	Claudio Del Deo	Email Address:	claudio.deldeo@o2marine.com.a

Laboratory: ALS

Address:

Lab. Contact: Lauren Biagioni

Please Note:
Please sign copy on receipt of samples and email signed copy of CoC record to O2M Project Manager.

Email laboratory analysis results to O2M Project Manager.

O2M Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix (S-Soil / SL-Sludge / W-Water / A-Air)	Containers: Type (B-Bottle / J-Jar / V-Vial / G-Glass / P-Plastic / B-Bag)	Containers: No. of Samples	Total Volume (mL)	Analyses = A; Hold = H: Metals (EG020-SD; EG005-SD; EG035-SD)	PAH, TRH/BTEXN (EP132B-SD; EP080-SD; EP071-SD)	Nutrients (NT-BAS)	TBT (EP090)	Phenoxyacetic acids (EP202)	ASS Screening Test (EA037)	ASS (Scr) (EA026)	TOC (EP003)	Moisture Content (EA055)	PSD (EA150H/Ea152	Comments
C9-1				S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	
C9-2	REF NO SAMPLE			S	3P	1	1050						A	H		A	A	
C9-3	" " "			S	3P	1	1050						A	H		A	A	
C9-4	REFUSAL NO SAMP			S	3P	1	1050						A	H		A	A	
C10-1				S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	
C10-2				S	3P	1	1050						A	H		A	A	
C10-3				S	3P	1	1050						A	H		A	A	
C10-4				S	3P	1	1050						A	H		A	A	
C11				S	3J, 3P	1	1300	A	A	A	A	A	A	H	A	A	A	
OC1-1				S	1J, 3P	1	1800	A	A	A			A	H	A	A	A	
OC1-2				S	3P	1	1050						A	H		A	A	
OC1-3				S	3P	1	1050						A	H		A	A	
OC1-4				S	3P	1	1050						A	H		A	A	
OC2				S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	

					S	1J, 3P	1	1300	A	A	A			A	H	A	A	A							
					S	1J, 3P	1	1300	A	A	A					A	A	A							
					S	1J, 3P	1	1300	A	A	A					A	A	A							
					S	1J, 3P	1	1300	A	A	A					A	A	A							
69	RINS VET 2		16·1·19	16:20	~~S~~	1B	1	500	A	~~A~~	A														
70	SPLIT P3		16·1·19	9:45	S	3J	1	750	A	A	A	A	A	A	H	A	A		TB5 II LAB						
71	RINS VOL 2		16·1·19	16:20	S	1B	1	500		A															
72	RINS VOL 1		15·1·19	17:00	S	1B	1	500	A		A														
73	FB1	TB5620	6·12·18	11:20	S	1B	1	250	A	A	A								OPENED ON SITE						

Sampled By:			Date/Time:													Relinquished By:		
Received By Lab:			Date/Time:													Courier:		
Sample Cold (Yes/No):		Sample Container Sealed (Yes/No):																

Chain of Custody (CoC) Record

Project:	Mardie Project: Sediment Sampling		
Client:	BCI Minerals	**Job No.:**	18WAU-0002
Lab Quote No.:	EP/1145/18	**Turnaround Time:**	Standard
O2M Project Manager	Claudio Del Deo	**Email Address:**	claudio.deldeo@o2marine.com.a

Laboratory:	ALS
Address:	
Lab. Contact:	Lauren Biagioni

Please Note:
Please sign copy on receipt of samples and email signed copy of CoC record to O2M Project Manager.

Email laboratory analysis results to O2M Project Manager.

O2M Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix (S-Soil / SL-Sludge / W-Water / A-Air)	Containers: Type (B-Bottle / J-Jar / V-Vial / G-Glass / P-Plastic Bag)	Containers: No. of Samples	Containers: Total Volume (mL)	Analyse = A; Hold = H: Metals (EG020-SD; EG005-SD; EG035-SD)	PAH, TRH/BTEXN (EP132B-SD; EP080-SD; EP071-SD)	Nutrients (NT-8AS)	TBT (EP090)	Phenoxyacetic acids (EP202)	ASS Screening Test (EA037)	ASS (Scr) (EA025)	TOC (EP003)	Moisture Content (EA055)	PSD (EA150SH/EA152)	Comments
✓ SPLIT-P1		12/12/18	11:20	S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	All soil samples are marine sediment
SPLIT-P2		15/1/19		S	3P	1	1300	A	A	A			A	H	A	A	A	PSD ONLY II LAB
✓ TRIP-1		15/12/18	09:30	S	3J, 2P	1	1800	A	A	A	A	A	A	H	A	A	A	
TRIP-2				S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
TRIP-3				S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
TRIP-4				S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
TRIP-5				S	1J, 3P	1	1800	A	A	A			A	H	A	A	A	
TRIP-6				S	1J, 3P	1	1800	A	A	A			A	H	A	A	A	
RINSB				S	1B	1	500	A	A	A								
TRIPB				S	1B	1	500	A	A	A								
FIELDB				S	1J	1	250	A	A	A								
TB1-1				S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
TB1-2				S	3P	1	1050						A	H		A	A	
TB1-3				S	3P	1	1050						A	H		A	A	
TB1-4				S	3P	1	1050						A	H		A	A	
✓ TB2		12/12/18	11:50	S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
✓ TB3		12/12/18	12:30	S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	
TB4-1				S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	
TB4-2				S	3P	1	1050						A	H	A	A	A	
TB4-3				S	3P	1	1050						A	H	A	A	A	
TB4-4				S	3P	1	1050						A	H	A	A	A	

DATE TIME

TB5				S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
TB6				S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
TB7				S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	
TB8				S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
TB9-1				S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	
TB9-2				S	3P	1	1050						A	H		A	A	
TB9-3				S	3P	1	1050						A	H		A	A	
TB9-4				S	3P	1	1050						A	H		A	A	
TB10				S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
C1-1		12/12/18	08:00	S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	
~~C1-2~~				S	3P	1	1050						A	H		A	A	
~~C1-3~~				S	3P	1	1050						A	H		A	A	
~~C1-4~~		12/12/18		S	3P	1	1050						A	H		A	A	
C2	✓	~~12/12/18~~	0900	S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	Refusal 1 run
C3-1	✓	12/12/18	10:00	S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
C3-2	✓	12/12/18	10:00	S	2P	1	1050						A	H		A	A	only 2 bags
~~C3-3~~	N/A			S	3P	1	1050						A	H		A	A	
~~C3-4~~	N/A			S	3P	1	1050						A	H		A	A	
C4		12/12/18	10:00	S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
C5		12/12/18	11:00	S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	
C6-1	✓	12/12/18	11:20	S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
~~C6-2~~	N/A			S	3P	1	1050						A	H		A	A	
~~C6-3~~	N/A			S	3P	1	1050						A	H		A	A	
~~C6-4~~	N/A			S	3P	1	1050						A	H		A	A	
C7				S	3J, 3P	1	1800	A	A	A	A	A	A	H	A	A	A	
C8-1				S	1J, 3P	1	1300	A	A	A			A	H	A	A	A	
C8-2				S	3P	1	1050						A	H		A	A	
C8-3				S	3P	1	1050						A	H		A	A	
C8-4				S	3P	1	1050						A	H		A	A	

Sampled By:		**Date/Time:**	
Received By Lab:		**Date/Time:**	
Sample Cold (Yes/No):		**Sample Container Sealed (Yes/No):**	
		Relinquished By:	
		Courier:	

O2 MARINE

Chain of Custody (CoC) Record

Appendix B Laboratory Results

Table 1 - SAP and 95% UCL Results versus NAGD Screening Levels

Analytical Group	Analyte	Units	LoR	Location ID	RF1	RF2	RF3	RF4	RF5	RF6	TB1-1	TB4-1	TB5	TB6	TB7	TB8	TB10	C7	C8-1	C9-1	C9-2	C10-1	C11	OC1-1	O1	O2
				NAGD (ISQG Trigger Value)																						
Organics	Total Organic Carbon	%	0	-	---	0.27	0.23	---	---	---	0.22	0.15	0.28	0.15	0.21	0.22	0.26	0.08	0.1	0.18	----	0.11	0.22	0.15	0.12	0.16
Metals	Aluminium	mg/kg	50	-	---	7840	7230	---	---	---	13200	17800	10400	9350	9520	10500	8790	6980	9120	9330	----	8960	8330	17200	14800	10,700
	Antimony	mg/kg	0.5	2	---	<0.50	<0.50	---	---	---	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	----	<0.50	<0.50	<0.50	<0.50	<0.50
	Arsenic	mg/kg	1	20	---	23.8	26.2	---	---	---	16.6	11	17.2	16.8	17	17.4	15.6	29	24.1	18.2	----	16.3	17	14.2	10.4	17.8
	Cadmium	mg/kg	0.1	1.5	---	0.1	0.1	---	---	---	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	----	<0.1	<0.1	<0.1	<0.1	<0.1
	Chromium	mg/kg	1	80	---	31.2	30.1	---	---	---	50.5	68.7	42.9	39.8	40.3	43.4	37.8	32	44.3	39	----	36.1	36.3	62.9	56.8	44.3
	Cobalt	mg/kg	0.5	-	---	8.3	8.2	---	---	---	12.2	13.8	10.6	10.3	10.5	11.2	10	10.2	13	10.8	----	9.3	10.3	19.2	12.2	11.6
	Copper	mg/kg	1	65	---	8.2	7.5	---	---	---	19.1	41.1	13.6	11.6	12.5	13.5	11.8	8	11.4	11.4	----	11	10.7	32.1	22.4	13.5
	Iron	mg/kg	1	-	---	36000	34900	---	---	---	48200	65800	38,900	38300	38200	41900	35200	33400	42600	36600	----	33100	33800	58400	54900	41,700
	Manganese	mg/kg	10	-	---	291	281	---	---	---	299	227	266	252	264	277	258	314	264	266	----	242	270	368	218	284
	Mercury	mg/kg	0.01	0.15	---	<0.01	<0.01	---	---	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	----	<0.01	<0.01	<0.01	<0.01	<0.01
	Nickel	mg/kg	1	21	---	14.1	13.2	---	---	---	24.5	35.5	20.7	19.5	20	21.8	18.2	16.3	22.3	18.7	----	17.1	17.6	33.8	31	21.8
	Silver	mg/kg	0.1	1.0	---	<0.1	<0.1	---	---	---	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	----	<0.1	<0.1	<0.1	<0.1	<0.1
	Vanadium	mg/kg	2	-	---	44.7	44.0	---	---	---	67.9	95.1	56.6	56.1	54.7	59.7	50.4	54.7	65.3	51	----	46	47.6	79.3	81.6	59.8
	Zinc	mg/kg	1	200	---	16.7	15.6	---	---	---	31.4	44.9	26.4	24.8	24.6	26.8	23.6	20.2	26.9	23.6	----	21.8	22.4	38.8	36.6	27.8
TRH	TRH C6 - C10	mg/kg	3	550	---	<3	<3	---	---	---	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	----	<3	<3	<3	<3	<3
	C6 - C10 Fraction minus BTEX (F1)	mg/kg	3	550	---	<3.0	<3.0	---	---	---	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	----	<3.0	<3.0	<3.0	<3.0	<3.0
	TRH >C10 - C16	mg/kg	3	550	---	<3	<3	---	---	---	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	----	<3	<3	<3	<3	<3
	TRH >C16 - C34	mg/kg	3	550	---	<3	<3	---	---	---	<3	<3	<3	3	7	<3	7	<3	5	14	----	<3	6	<3	<3	<3
	TRH >C34 - C40	mg/kg	5	550	---	<5	<5	---	---	---	<5	<5	<5	<5	<5	<5	<5	<5	<5	9	----	<5	<5	<5	<5	<5
	TRH >C10 - C40 Fraction (sum)	mg/kg	3	550	---	<3	<3	---	---	---	<3	<3	<3	3	7	<3	7	<3	5	4	----	<3	6	<3	<3	<3
	TRH >C10 - C16 Fraction minus Naphthalene (F2)	mg/kg	3	550	---	<3	<3	---	---	---	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	----	<3	<3	<3	<3	<3
TPH	C6 - C9 Fraction	mg/kg	3	550	---	<3	<3	---	---	---	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	----	<3	<3	<3	<3	<3
	C10 - C14 Fraction	mg/kg	3	550	---	<3	<3	---	---	---	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	----	<3	<3	<3	<3	<3
	C15 - C28 Fraction	mg/kg	3	550	---	<3	<3	---	---	---	<3	<3	<3	<3	4	<3	3	<3	<3	4	----	<3	4	<3	<3	<3
	C29 - C36 Fraction	mg/kg	5	550	---	<5	<5	---	---	---	<5	<5	<5	<5	<5	<5	<5	<5	<5	12	----	<5	<5	<5	<5	<5
	C10 - C36 Fraction (sum)	mg/kg	3	550	---	<3	<3	---	---	---	<3	<3	<3	<3	4	<3	3	<3	<3	16	----	<3	4	<3	<3	<3
BTEXN	Benzene	mg/kg	0.2	-	---	<0.2	<0.2	---	---	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	----	<0.2	<0.2	<0.2	<0.2	<0.2
	Toluene	mg/kg	0.2	-	---	<0.2	<0.2	---	---	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	----	<0.2	<0.2	<0.2	<0.2	<0.2
	Ethylbenzene	mg/kg	0.2	-	---	<0.2	<0.2	---	---	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	----	<0.2	<0.2	<0.2	<0.2	<0.2
	m+p-xylene	mg/kg	0.2	-	---	<0.2	<0.2	---	---	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	----	<0.2	<0.2	<0.2	<0.2	<0.2
	o-xylene	mg/kg	0.2	-	---	<0.2	<0.2	---	---	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	----	<0.2	<0.2	<0.2	<0.2	<0.2
	Total Xylenes	mg/kg	0.5	-	---	<0.5	<0.5	---	---	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	----	<0.5	<0.5	<0.5	<0.5	<0.5
	Sum of BTEX	mg/kg	0.2	-	---	<0.2	<0.2	---	---	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	----	<0.2	<0.2	<0.2	<0.2	<0.2
	Naphthalene	µg/kg	5	-	---	<0.2	<0.2	---	---	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	----	<0.2	<0.2	<0.2	<0.2	<0.2
OC/OP Pesticides	2-Methylnaphthalene	µg/kg	5	-	---	<5	<5	---	---	---	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	----	<5	<5	<5	<5	<5
	Acenaphthene	µg/kg	4	-	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Acenaphthylene	µg/kg	4	-	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Anthracene	µg/kg	4	-	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Benzo(a)anthracene	µg/kg	4	-	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Benzo(a)pyrene	µg/kg	4	-	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Benzo(b+j)fluoranthene	µg/kg	4	-	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Benzo(k)fluoranthene	µg/kg	4	-	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Benzo(e)pyrene	µg/kg	4	-	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Benzo(g,h,i)perylene	µg/kg	4	-	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Chrysene	µg/kg	4	-	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Coronene	µg/kg	5	-	---	<5	<5	---	---	---	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	----	<5	<5	<5	<5	<5
	Dibenzo(a,h)anthracene	µg/kg	4	-	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Fluoranthene	µg/kg	4	-	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Fluorene	µg/kg	4	-	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Indeno(1,2,3-c,d)pyrene	µg/kg	5	-	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Naphthalene (PAH)	µg/kg	5.0	-	---	<5	<5	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Perylene	µg/kg	4	-	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Phenanthrene	µg/kg	4	-	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Pyrene	µg/kg	4	-	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
	Sum of PAHs	µg/kg	4	10000	---	<4	<4	---	---	---	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	----	<4	<4	<4	<4	<4
Organotin Surrogate	Tripropyltin	%	0.5		---	114	139	---	---	---	82.2	----	75.4	72.2	----	75.2	86	82.9	----	----	----	----	51.9	----	----	----

Table 1 - SAP and 95% UCL Results versus NAGD Screening Levels

Analytical Group	Analyte	Units	LoR	Location ID	RF1	RF2	RF3	RF4	RF5	RF6	TB1-1	TB4-1	TB5	TB6	TB7	TB8	TB10	C7	C8-1	C9-1	C9-2	C10-1	C11	OC1-1	O1	O2
				NAGD (ISQG Trigger Value)																						
Organotins	Monobutyltin as Sn	µg/kg	1	-	---	<1	<1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Dibutyltin as Sn	µg/kg	1	-	---	<1	<1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Tributyltin as Sn	µg/kg	0.5	9	---	<0.5	<0.5	---	---	---	<0.5	----	<0.5	<0.5	----	<0.5	<0.5	<0.5	----	----	----	----	<0.5	----	----	----
Phyiscal	Moisture	%	1	-	---	32	25.2	---	---	---	33.3	30.4	37	23.5	35.4	35.3	35.4	27.2	28.5	30.5	23.9	29.5	35.2	25.8	21.1	36
	75.0 mm	% passing	1	-	<1	<1	1	<1	<1	<1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	37.5 mm	% passing	1	-	<1	<1	<1	<1	<1	<1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	19.0 mm	% passing	1	-	<1	<1	<1	<1	<1	<1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	9.5 mm	% passing	1	-	<1	<1	<1	<1	<1	<1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	4.75 mm	% passing	1	-	<1	5	6	5	15	8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	2.36 mm	% passing	1	-	3	13	12	22	37	16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	1.18 mm	% passing	1	-	8	26	24	52	63	25	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	0.600 mm	% passing	1	-	15	39	38	76	84	32	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	0.425 mm	% passing	1	-	18	44	45	82	88	37	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	0.300 mm	% passing	1	-	26	48	52	85	91	42	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	0.150 mm	% passing	1	-	52	55	65	88	93	55	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	0.075 mm	% passing	1	-	68	60	73	91	94	61	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Soil Classification based on particle size	Clay (<2 µm)	%	1	-	9	14	10	3	3	16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Silt (2-60 µm)	%	1	-	14	20	13	5	2	17	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Sand (0.06-2.00 mm)	%	1	-	72	49.0	62.0	60	50	49	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Gravel (>2mm)	%	1	-	5	17.0	15.0	32	45	18	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Cobbles (>6cm)	%	1	-	<1	<1	<1	<1	<1	<1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Soil Particle Density	Soil Particle Density (Clay/Silt/Sand)	g/cm3	0.01	-	2.75	2.72	2.7	2.73	2.72	2.73	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Nutrients	Ammonia as N	mg/kg	20	-	---	<20	<20	---	---	---	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	----	<20	<20	<20	<20	<20
	Nitrite as N (Sol.)	mg/kg	0.1	-	---	<0.1	<0.1	---	---	---	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	----	<0.1	<0.1	<0.1	<0.1	<0.1
	Nitrate as N (Sol.)	mg/kg	0.1	-	---	0.1	<0.1	---	---	---	<0.1	<0.1	<0.1	0.2	0.1	0.1	0.1	0.1	0.6	0.1	----	0.1	0.1	<0.1	<0.1	<0.1
	Nitrite + Nitrate as N (Sol.)	mg/kg	0.1	-	---	0.1	<0.1	---	---	---	<0.1	<0.1	<0.1	0.2	0.1	0.1	0.1	0.1	0.6	0.1	----	0.1	0.1	<0.1	<0.1	<0.1
	Total Kjeldahl Nitrogen as N	mg/kg	20	-	---	380	380	---	---	---	330	160	400	330	360	330	320	110	170	360	----	350	430	180	200	500
	Total Nitrogen as N	mg/kg	20	-	---	380	380	---	---	---	330	160	400	330	360	330	320	110	170	360	----	350	430	180	200	500
	Total Phosphorus as P	mg/kg	2	-	---	466	430	---	---	---	288	211	314	270	282	221	180	349	341	342	----	269	275	274	179	321
	Reactive Phosphorus as P	mg/kg	0.1	-	---	<0.1	<0.1	---	---	---	0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	----	0.1	0.1	0.6	<0.1	<0.1
Phenoxyacetic Acid Herbicides by LCMS	4-Chlorophenoxy acetic acid	mg/kg	0.02	-	---	<0.02	<0.02	---	---	---	<0.02	----	<0.02	<0.02	----	<0.02	<0.02	<0.02	----	----	----	----	<0.02	----	----	----
	2.4-DB	mg/kg	0.02	-	---	<0.02	<0.02	---	---	---	<0.02	----	<0.02	<0.02	----	<0.02	<0.02	<0.02	----	----	----	----	<0.02	----	----	----
	Dicamba	mg/kg	0.02	-	---	<0.02	<0.02	---	---	---	<0.02	----	<0.02	<0.02	----	<0.02	<0.02	<0.02	----	----	----	----	<0.02	----	----	----
	Mecoprop	mg/kg	0.02	-	---	<0.02	<0.02	---	---	---	<0.02	----	<0.02	<0.02	----	<0.02	<0.02	<0.02	----	----	----	----	<0.02	----	----	----
	MCPA	mg/kg	0.02	-	---	<0.02	<0.02	---	---	---	<0.02	----	<0.02	<0.02	----	<0.02	<0.02	<0.02	----	----	----	----	<0.02	----	----	----
	2.4-DP	mg/kg	0.02	-	---	<0.02	<0.02	---	---	---	<0.02	----	<0.02	<0.02	----	<0.02	<0.02	<0.02	----	----	----	----	<0.02	----	----	----
	2.4-D	mg/kg	0.02	-	---	<0.02	<0.02	---	---	---	<0.02	----	<0.02	<0.02	----	<0.02	<0.02	<0.02	----	----	----	----	<0.02	----	----	----
	Triclopyr	mg/kg	0.02	-	---	<0.02	<0.02	---	---	---	<0.02	----	<0.02	<0.02	----	<0.02	<0.02	<0.02	----	----	----	----	<0.02	----	----	----
	2.4.5-TP (Silvex)	mg/kg	0.02	-	---	<0.02	<0.02	---	---	---	<0.02	----	<0.02	<0.02	----	<0.02	<0.02	<0.02	----	----	----	----	<0.02	----	----	----
	2.4.5-T	mg/kg	0.02	-	---	<0.02	<0.02	---	---	---	<0.02	----	<0.02	<0.02	----	<0.02	<0.02	<0.02	----	----	----	----	<0.02	----	----	----
	MCPB	mg/kg	0.02	-	---	<0.02	<0.02	---	---	---	<0.02	----	<0.02	<0.02	----	<0.02	<0.02	<0.02	----	----	----	----	<0.02	----	----	----
	Picloram	mg/kg	0.02	-	---	<0.02	<0.02	---	---	---	<0.02	----	<0.02	<0.02	----	<0.02	<0.02	<0.02	----	----	----	----	<0.02	----	----	----
	Clopyralid	mg/kg	0.02	-	---	<0.02	<0.02	---	---	---	<0.02	----	<0.02	<0.02	----	<0.02	<0.02	<0.02	----	----	----	----	<0.02	----	----	----
	Fluroxypyr	mg/kg	0.02	-	---	<0.02	<0.02	---	---	---	<0.02	----	<0.02	<0.02	----	<0.02	<0.02	<0.02	----	----	----	----	<0.02	----	----	----
TPH(V)/BTEX Surrogates	1.2-Dichloroethane-D4	%	0.2	-	---	119	128	---	---	---	106	112	93.1	100	93.6	86.6	92.4	98.2	102	120	----	129	105	106	124	90.2
	Toluene-D8	%	0.2	-	---	81.8	92.4	---	---	---	85.2	117	79.2	100	94.5	73.1	92.3	80	89.6	97.7	----	98	99.5	110	112	95.1
	4-Bromofluorobenzene	%	0.2	-	---	82.2	75.4	---	---	---	88.7	114	81.6	96.9	92.2	73.2	84.5	79.8	86.8	96	----	97.2	91.7	99	106	89.7
Base/Neutral Extractable Surrogates	2-Fluorobiphenyl	%	10	-	---	96.5	112	---	---	---	93	108	86	85.6	80.7	73.4	79.3	75.3	79.8	77.8	----	76.4	79.8	76.5	89.9	79.6
	Anthracene-d10	%	10	-	---	81	80	---	---	---	89	101	88.5	95.2	84.2	91.6	90.6	95.9	81.2	94.6	----	104	93.5	81.2	80.8	84.4
	4-Terphenyl-d14	%	10	-	---	80.5	88.8	---	---	---	99.6	97.9	94.2	78.3	90.2	103	94.8	102	108	94.1	----	100	103	82.8	95.1	91.2
Phenoxyacetic Acid Herbicide Surrogate	2.4-Dichlorophenyl Acetic Acid	%	0.02	-	---	72.7	66.9	---	---	---	48.8	----	49.9	46.4	----	56.3	60.2	50.1	----	----	----	----	54.7	----	----	----
Ass Field Screening Analysis	pH (F)	pH Unit	0.1	8.4	---	8	8.2	---	---	---	9.3	8.5	8.4	8.3	8.6	8.6	8.9	8.5	8.8	8.8	8.9	8.2	8.7	----	----	----
	pH (Fox)	pH Unit	0.1	7.7	---	7	7.3	---	---	---	8.6	7.7	7.8	7.8	8.1	7	7.5	7.9	7.8	8	8.1	7.9	7.6	----	----	----
	Reaction Rate		1	4	---	Moderate	Moderate	---	---	---	4	4	4	4	4	3	3	3	4	4	4	4	3	----	----	----

Table 1 - SAP and 95% UCL Results versus NAGD Screening Levels

				Location ID	O3	TB2	TB3	C1-1	C2	C3-1	C3_2	C4	C5	C6-1	OC2	OC3	95% UCL
Analytical Group	Analyte	Units	LoR	NAGD (ISQG Trigger Value)													
Organics	Total Organic Carbon	%	0	-	0.16	0.34	0.42	0.09	0.08	0.12	----	0.15	0.19	0.2	0.21	0.24	0.21
Metals	Aluminium	mg/kg	50	-	6610	11600	8240	7030	9940	6410	----	5690	6090	5150	7530	8750	10,392.87
	Antimony	mg/kg	0.5	2	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	----	<0.50	<0.50	<0.50	<0.50	<0.50	0.25
	Arsenic	mg/kg	1	20	22.7	21	14.7	35.8	30.6	53.8	----	41.9	48.6	31.4	17.3	20.9	26.53
	Cadmium	mg/kg	0.1	1.5	<0.1	<0.1	<0.1	0.2	0.1	0.3	----	0.3	0.2	0.1	0.2	<0.1	0.12
	Chromium	mg/kg	1	80	28.3	44.7	31.9	29.5	45.3	24.8	----	22.2	23.4	21.1	31.4	36.5	42.07
	Cobalt	mg/kg	0.5	-	8.9	12	8.6	8.7	10.2	8.1	----	7.1	7.2	6.6	9.6	9.3	11.07
	Copper	mg/kg	1	65	8.1	13.5	9.8	8.3	10.6	7.5	----	6.9	7.4	6	9.5	10.6	15.20
	Iron	mg/kg	1	-	29400	44700	33100	33600	39800	36000	----	30500	34000	27000	37600	37100	41,844.24
	Manganese	mg/kg	10	-	294	478	224	449	445	583	----	661	443	373	276	316	362.71
	Mercury	mg/kg	0.01	0.15	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	----	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
	Nickel	mg/kg	1	21	14.8	22.4	16.1	14.1	22.3	12	----	10	11.6	10	15.2	17.1	21.03
	Silver	mg/kg	0.1	1.0	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	----	<0.1	<0.1	<0.1	<0.1	<0.1	0.05
	Vanadium	mg/kg	2	-	48.2	59.8	42.7	52.4	58.4	52.5	----	43.3	46.5	39.4	46.8	49	59.52
	Zinc	mg/kg	1	200	18.4	29	20.9	17.9	22.6	13.9	----	12.6	13.6	12.5	19	20.5	25.82
TRH	TRH C6 - C10	mg/kg	3	550	<3	<3	<3	<3	<3	<3	----	<3	<3	<3	<3	<3	1.50
	C6 - C10 Fraction minus BTEX (F1)	mg/kg	3	550	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	----	<3.0	<3.0	<3.0	<3.0	<3.0	1.50
	TRH >C10 - C16	mg/kg	3	550	<3	<3	<3	<3	<3	<3	----	<3	<3	<3	<3	<3	1.50
	TRH >C16 - C34	mg/kg	3	550	6	<3	<3	<3	<3	<3	----	<3	<3	<3	<3	<3	3.74
	TRH >C34 - C40	mg/kg	5	550	<5	<5	<5	<5	<5	<5	----	<5	<5	<5	<5	<5	3.12
	TRH >C10 - C40 Fraction (sum)	mg/kg	3	550	6	<3	<3	<3	<3	<3	----	<3	<3	<3	<3	<3	3.07
	TRH >C10 - C16 Fraction minus Naphthalene (F2)	mg/kg	3	550	<3	<3	<3	<3	<3	<3	----	<3	<3	<3	<3	<3	1.50
TPH	C6 - C9 Fraction	mg/kg	3	550	<3	<3	<3	<3	<3	<3	----	<3	<3	<3	<3	<3	1.50
	C10 - C14 Fraction	mg/kg	3	550	<3	<3	<3	<3	<3	<3	----	<4	<3	<3	<3	<3	1.50
	C15 - C28 Fraction	mg/kg	3	550	4	<3	<3	<3	<3	<3	----	<3	<3	<3	<3	<3	2.20
	C29 - C36 Fraction	mg/kg	5	550	<5	<5	<5	<5	<5	<5	----	<5	<5	<5	<5	<5	3.41
	C10 - C36 Fraction (sum)	mg/kg	3	550	4	<3	<3	<3	<3	<3	----	<4	<3	<3	<3	<3	3.22
BTEXN	Benzene	mg/kg	0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	----	<0.2	<0.2	<0.2	<0.2	<0.2	0.10
	Toluene	mg/kg	0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	----	<0.2	<0.2	<0.2	<0.2	<0.2	0.10
	Ethylbenzene	mg/kg	0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	----	<0.2	<0.2	<0.2	<0.2	<0.2	0.10
	m+p-xylene	mg/kg	0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	----	<0.2	<0.2	<0.2	<0.2	<0.2	0.10
	o-xylene	mg/kg	0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	----	<0.2	<0.2	<0.2	<0.2	<0.2	0.10
	Total Xylenes	mg/kg	0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	----	<0.5	<0.5	<0.5	<0.5	<0.5	0.25
	Sum of BTEX	mg/kg	0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	----	<0.2	<0.2	<0.2	<0.2	<0.2	0.10
	Naphthalene	µg/kg	5	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	----	<0.2	<0.2	<0.2	<0.2	<0.2	2.50
OC/OP Pesticides	2-Methylnaphthalene	µg/kg	5	-	<5	<5	<5	<5	<5	<5	----	<5	<5	<5	<5	<5	2.50
	Acenaphthene	µg/kg	4	-	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.00
	Acenaphthylene	µg/kg	4	-	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.00
	Anthracene	µg/kg	4	-	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.00
	Benzo(a)anthracene	µg/kg	4	-	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.00
	Benzo(a)pyrene	µg/kg	4	-	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.00
	Benzo(b+j)fluoranthene	µg/kg	4	-	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.00
	Benzo(k)fluoranthene	µg/kg	4	-	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.00
	Benzo(e)pyrene	µg/kg	4	-	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.00
	Benzo(g,h,i)perylene	µg/kg	4	-	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.00
	Chrysene	µg/kg	4	-	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.00
	Coronene	µg/kg	5	-	<5	<5	<5	<5	<5	<5	----	<5	<5	<5	<5	<5	2.50
	Dibenzo(a,h)anthracene	µg/kg	4	-	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.00
	Fluoranthene	µg/kg	4	-	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.00
	Fluorene	µg/kg	4	-	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.00
	Indeno(1,2,3-c,d)pyrene	µg/kg	5	-	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.50
	Naphthalene (PAH)	µg/kg	5.0	-	<4	<5	<5	<5	<5	<5	----	<5	<5	<5	<5	<5	2.50
	Perylene	µg/kg	4	-	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.00
	Phenanthrene	µg/kg	4	-	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.00
	Pyrene	µg/kg	4	-	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.00
	Sum of PAHs	µg/kg	4	10000	<4	<5	<4	<4	<4	<4	----	<4	<4	<4	<4	<4	2.00
Organotin Surrogate	Tripropyltin	%	0.5		----	89.2	----	----	----	86.3	----	94.5	----	85.5	----	----	97.14

Table 1 - SAP and 95% UCL Results versus NAGD Screening Levels

Analytical Group	Analyte	Units	LoR	Location ID	O3	TB2	TB3	C1-1	C2	C3-1	C3_2	C4	C5	C6-1	OC2	OC3	95% UCL
				NAGD (ISQG Trigger Value)													
Organotins	Monobutyltin as Sn	µg/kg	1	-	---	<1	----	----	----	<1	----	<1	----	<1	----	----	0.50
	Dibutyltin as Sn	µg/kg	1	-	---	<1	----	----	----	<1	----	<1	----	<1	----	----	0.50
	Tributyltin as Sn	µg/kg	0.5	9	----	<0.5	----	----	----	<0.5	----	<0.5	----	<0.5	----	----	0.25
Phyiscal	Moisture	%	1	-	28.8	50.3	40.4	14.2	18.8	17.6	13.8	22.4	26.5	32.4	34.9	33.3	31.73
	75.0 mm	% passing	1	-	---	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0.58
	37.5 mm	% passing	1	-	---	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0.50
	19.0 mm	% passing	1	-	---	<1	<1	11	6	<1	<1	<1	<1	<1	<1	<1	2.59
	9.5 mm	% passing	1	-	---	<1	<1	26	28	21	15	17	21	2	11	<1	12.83
	4.75 mm	% passing	1	-	---	<1	5	48	40	39	34	42	37	7	18	12	25.83
	2.36 mm	% passing	1	-	---	<1	6	56	48	53	45	58	52	15	25	22	36.62
	1.18 mm	% passing	1	-	---	<1	6	67	58	67	59	73	69	30	35	36	50.95
	0.600 mm	% passing	1	-	---	<1	6	76	67	82	74	84	80	51	44	50	64.32
	0.425 mm	% passing	1	-	---	1	7	80	72	89	82	86	83	60	49	58	69.57
	0.300 mm	% passing	1	-	---	2	8	85	78	93	90	88	85	68	55	66	74.46
	0.150 mm	% passing	1	-	---	6	14	92	90	95	95	90	87	75	67	79	81.60
	0.075 mm	% passing	1	-	---	47	55	95	94	97	97	94	91	87	76	86	87.14
Soil Classification based on particle size	Clay (<2 µm)	%	1	-	---	13	12	3	3	3	2	3	4	3	8	3	8.54
	Silt (2-60 µm)	%	1	-	---	17	14	<1	1	<1	<1	2	2	6	12	7	10.67
	Sand (0.06-2.00 mm)	%	1	-	---	70	68	38	45	40	49	32	37	71	52	64	58.69
	Gravel (>2mm)	%	1	-	---	<1	6	59	51	57	49	63	57	20	28	26	40.87
	Cobbles (>6cm)	%	1	-	---	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0.50
Soil Particle Density	Soil Particle Density (Clay/Silt/Sand)	g/cm3	0.01	-	---	2.62	2.6	2.68	2.68	2.71	2.68	2.67	2.64	2.63	2.6	2.64	2.70
Nutrients	Ammonia as N	mg/kg	20	-	<20	<20	<20	<20	<20	<20	----	<20	<20	<20	<20	<20	10.00
	Nitrite as N (Sol.)	mg/kg	0.1	-	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	----	<0.1	<0.1	<0.1	<0.1	<0.1	0.06
	Nitrate as N (Sol.)	mg/kg	0.1	-	0.3	0.2	0.2	0.2	0.4	<0.1	----	0.2	0.1	0.1	0.3	0.2	0.19
	Nitrite + Nitrate as N (Sol.)	mg/kg	0.1	-	0.3	0.2	0.2	0.2	0.6	<0.1	----	0.2	0.1	0.1	0.3	0.2	0.20
	Total Kjeldahl Nitrogen as N	mg/kg	20	-	330	490	370	180	290	160	----	190	280	330	480	440	349.95
	Total Nitrogen as N	mg/kg	20	-	330	490	370	180	290	160	----	190	280	330	480	440	349.95
	Total Phosphorus as P	mg/kg	2	-	309	348	245	342	415	400	----	468	422	358	252	338	343.16
	Reactive Phosphorus as P	mg/kg	0.1	-	<0.1	0.2	0.2	<0.1	0.1	<0.1	----	<0.1	0.2	0.1	0.2	0.2	0.15
Phenoxyacetic Acid Herbicides by LCMS	4-Chlorophenoxy acetic acid	mg/kg	0.02	-	----	<0.02	----	----	----	<0.02	----	<0.02	----	<0.02	----	----	0.01
	2.4-DB	mg/kg	0.02	-	----	<0.02	----	----	----	<0.02	----	<0.02	----	<0.02	----	----	0.01
	Dicamba	mg/kg	0.02	-	----	<0.02	----	----	----	<0.02	----	<0.02	----	<0.02	----	----	0.01
	Mecoprop	mg/kg	0.02	-	----	<0.02	----	----	----	<0.02	----	<0.02	----	<0.02	----	----	0.01
	MCPA	mg/kg	0.02	-	----	<0.02	----	----	----	<0.02	----	<0.02	----	<0.02	----	----	0.01
	2.4-DP	mg/kg	0.02	-	----	<0.02	----	----	----	<0.02	----	<0.02	----	<0.02	----	----	0.01
	2.4-D	mg/kg	0.02	-	----	<0.02	----	----	----	<0.02	----	<0.02	----	<0.02	----	----	0.01
	Triclopyr	mg/kg	0.02	-	----	<0.02	----	----	----	<0.02	----	<0.02	----	<0.02	----	----	0.01
	2.4.5-TP (Silvex)	mg/kg	0.02	-	----	<0.02	----	----	----	<0.02	----	<0.02	----	<0.02	----	----	0.01
	2.4.5-T	mg/kg	0.02	-	----	<0.02	----	----	----	<0.02	----	<0.02	----	<0.02	----	----	0.01
	MCPB	mg/kg	0.02	-	----	<0.02	----	----	----	<0.02	----	<0.02	----	<0.02	----	----	0.01
	Picloram	mg/kg	0.02	-	----	<0.02	----	----	----	<0.02	----	<0.02	----	<0.02	----	----	0.01
	Clopyralid	mg/kg	0.02	-	----	<0.02	----	----	----	<0.02	----	<0.02	----	<0.02	----	----	0.01
	Fluroxypyr	mg/kg	0.02	-	----	<0.02	----	----	----	<0.02	----	<0.02	----	<0.02	----	----	0.01
TPH(V)/BTEX Surrogates	1.2-Dichloroethane-D4	%	0.2	-	114	75.6	72.4	94.1	82.7	87	----	84.4	98.7	106	80.8	96	104.73
	Toluene-D8	%	0.2	-	96.5	76.6	72	90.1	97.2	96.7	----	110	101	111	112	106	99.15
	4-Bromofluorobenzene	%	0.2	-	91.4	70.8	72	81.6	82.7	84.7	----	92.7	90.3	99.9	95.8	91.8	92.08
Base/Neutral Extractable Surrogates	2-Fluorobiphenyl	%	10	-	72.5	97.6	102	83	87.3	90.1	----	83.7	88.1	92.2	76.1	80.6	89.04
	Anthracene-d10	%	10	-	98.8	92.7	86.2	81.9	109	72.5	----	103	86	87.6	95.2	95.2	92.87
	4-Terphenyl-d14	%	10	-	99.3	99.9	82.2	81.1	83.7	101	----	93.4	84.6	103	88.3	92.4	95.89
Phenoxyacetic Acid Herbicide Surrogate	2.4-Dichlorophenyl Acetic Acid	%	0.02	-	----	108	----	----	----	90.2	----	82.7	----	84.7	----	----	76.14
Ass Field Screening Analysis	pH (F)	pH Unit	0.1	8.4	---	8.2	8.1	8.3	8.3	8.7	8.4	7.4	8	7.8	7.6	7.7	8.50
	pH (Fox)	pH Unit	0.1	7.7	---	6.9	7.2	7	7	7	7	6.8	6.9	7	7.1	7.2	7.59
	Reaction Rate		1	4	---	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	3.92

					triplicate				duplicate			duplicate			duplicate			replicate		
				Location I	TB1	TB1	TB1	RSD (%)	TB10	TB10	RPD (%)	O3	O3	RPD (%)	OC3	OC3	RPD (%)	C6	C6	RPD (%)
				Lab	ALS	ALS	ALS		ALS	ALS		ALS	ALS		ALS	ALS		ALS	ALS	
Analytical Group	Analyte	Units	LoR	NAGD (ISQG Trigger																
Organics	Total Organic Carbon	%	0	-	0.19	0.22	0.26	16	0.26	0.26	0	0.2	0.2	12	0.34	0.24	34	0.24	0.2	18
Metals	Aluminium	mg/kg	50	-	11800	13200	11900	6	9020	8790	3	7930.0	6610.0	18	7640	8750	14	5530	5150	7
	Antimony	mg/kg	0.5	2	0.25	0.25	0.25	0	0.25	0.25	0	0.3	0.3	0	0.25	0.25	0	0.25	0.25	0
	Arsenic	mg/kg	1	20	15.1	16.6	15.6	5	16.4	15.6	5	22.7	22.7	0	23.1	20.9	10	24.2	31.4	26
	Cadmium	mg/kg	0.1	1.5	0.05	0.05	0.05	0	0.05	0.05	0	0.1	0.1	0	0.1	0.05	67	0.05	0.1	67
	Chromium	mg/kg	1	80	47	50.5	47.3	4	38.3	37.8	1	33.4	28.3	17	29.3	36.5	22	21.9	21.1	4
	Cobalt	mg/kg	0.5		11.2	12.2	11.5	4	9.8	10	2	9.9	8.9	11	8.1	9.3	14	6.6	6.6	0
	Copper	mg/kg	1	65	17.7	19.1	17.3	5	11.4	11.8	3	9.6	8.1	17	8.8	10.6	19	5.8	6	3
	Iron	mg/kg	1	-	44500	48200	44900	4	36600	35200	4	33800.0	29400.0	14	32600	37100	13	25900	27000	4
	Manganese	mg/kg	10	-	271	299	283	5	254	258	2	391.0	294.0	28	302	316	5	329	373	13
	Mercury	mg/kg	0.01	0.15	0.005	0.005	0.005	0	0.005	0.005	0	0.0	0.0	0	0.005	0.005	0	0.005	0.005	0
	Nickel	mg/kg	1	21	23.7	24.5	25.8	4	18.7	18.2	3	17.1	14.8	14	14	17.1	20	10.8	10	8
	Silver	mg/kg	0.1	1.0	0.05	0.05	0.05	0	0.05	0.05	0	0.1	0.1	0	0.05	0.05	0	0.05	0.05	0
	Vanadium	mg/kg	2		63.3	67.9	63.1	4	50.9	50.4	1	54.9	48.2	13	44.2	49	10	37.5	39.4	5
	Zinc	mg/kg	1	200	28.7	31.4	29.6	5	23	23.6	3	21.6	18.4	16	17.4	20.5	16	13.2	12.5	5
TRH	TRH C6 - C10	mg/kg	3	550	1.5	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0
	C6 - C10 Fraction minus BTEX (F1)	mg/kg	3	550	1.5	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0
	TRH >C10 - C16	mg/kg	3	550	1.5	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0
	TRH >C16 - C34	mg/kg	3	550	1.5	1.5	1.5	0	4	7	55	5.0	6.0	18	1.5	1.5	0	1.5	1.5	0
	TRH >C34 - C40	mg/kg	5	550	2.5	2.5	2.5	0	2.5	2.5	0	2.5	2.5	0	2.5	2.5	0	2.5	2.5	0
	TRH >C10 - C40 Fraction (sum)	mg/kg	3	550	1.5	1.5	1.5	0	4	7	55	5.0	6.0	18	1.5	1.5	0	1.5	1.5	0
	TRH >C10 - C16 Fraction minus Naphthalene (F2)	mg/kg	3	550	1.5	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0
TPH	C6 - C9 Fraction	mg/kg	3	550	1.5	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0
	C10 - C14 Fraction	mg/kg	3	550	1.5	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0	1.5	1.5	0
	C15 - C28 Fraction	mg/kg	3	550	1.5	1.5	1.5	0	3	3	0	4.0	4.0	0	1.5	1.5	0	1.5	1.5	0
	C29 - C36 Fraction	mg/kg	5	550	2.5	2.5	2.5	0	2.5	2.5	0	2.5	2.5	0	2.5	2.5	0	2.5	2.5	0
	C10 - C36 Fraction (sum)	mg/kg	3	550	1.5	1.5	1.5	0	1.5	3	67	4.0	4.0	0	1.5	1.5	0	1.5	1.5	0
BTEXN	Benzene	mg/kg	0.2	-	0.1	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0
	Toluene	mg/kg	0.2	-	0.1	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0
	Ethylbenzene	mg/kg	0.2	-	0.1	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0
	m+p-xylene	mg/kg	0.2	-	0.1	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0
	o-xylene	mg/kg	0.2	-	0.1	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0
	Total Xylenes	mg/kg	0.5		0.25	0.25	0.25	0	0.25	0.25	0	0.3	0.3	0	0.25	0.25	0	0.25	0.25	0
	Sum of BTEX	mg/kg	0.2		0.1	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0
	Naphthalene	µg/kg	5	-	0.1	2.5	0.1	154	0.1	2.5	185	0.1	2.5	185	2.5	2.5	0	0.1	2.5	185
OC/OP Pesticides	2-Methylnaphthalene	µg/kg	5	-	2.5	2.5	2.5	0	<5	2.5		2.5	2.5	0	2.5	2.5	0	2.5	2.5	0
	Acenaphthene	µg/kg	4	-	2	2	2	0	<4	2		2.0	2.0	0	2	2	0	2	2	0
	Acenaphthylene	µg/kg	4	-	2	2	2	0	<4	2		2.0	2.0	0	2	2	0	2	2	0
	Anthracene	µg/kg	4	-	2	2	2	0	<4	2		2.0	2.0	0	2	2	0	2	2	0
	Benzo(a)anthracene	µg/kg	4	-	2	2	2	0	<4	2		2.0	2.0	0	2	2	0	2	2	0
	Benzo(a)pyrene	µg/kg	4	-	2	2	2	0	<4	2		2.0	2.0	0	2	2	0	2	2	0
	Benzo(b+j)fluoranthene	µg/kg	4		2	2	2	0	<4	2		2.0	2.0	0	2	2	0	2	2	0
	Benzo(k)fluoranthene	µg/kg	4		2	2	2	0	<4	2		2.0	2.0	0	2	2	0	2	2	0
	Benzo(e)pyrene	µg/kg	4	-	2	2	2	0	<4	2		2.0	2.0	0	2	2	0	2	2	0
	Benzo(g,h,i)perylene	µg/kg	4	-	2	2	2	0	<4	2		2.0	2.0	0	2	2	0	2	2	0
	Chrysene	µg/kg	4	-	2	2	2	0	<4	2		2.0	2.0	0	2	2	0	2	2	0
	Coronene	µg/kg	5	-	2.5	2.5	2.5	0	<5	2.5		2.5	2.5	0	2.5	2.5	0	2.5	2.5	0
	Dibenzo(a,h)anthracene	µg/kg	4	-	2	2	2	0	<4	2		2.0	2.0	0	2	2	0	2	2	0
	Fluoranthene	µg/kg	4	-	2	2	2	0	<4	2		2.0	2.0	0	2	2	0	2	2	0
	Fluorene	µg/kg	4	-	2	2	2	0	<4	2		2.0	2.0	0	2	2	0	2	2	0
	Indeno(1,2,3-c,d)pyrene	µg/kg	5	-	2	2.5	2	13	<4	2.5		2.0	2.5	22	2	2.5	22	2	2.5	22
	Naphthalene (PAH)	µg/kg	5.0		2	2.5	2	13	<4	2.5		2.0	2.5	22	2.5	2.5	0	2.5	2.5	0
	Perylene	µg/kg	4	-	2	2	2	0	<4	2		2.0	2.0	0	2	2	0	2	2	0
	Phenanthrene	µg/kg	4	-	2	2	2	0	<4	2		2.0	2.0	0	2	2	0	2	2	0
	Pyrene	µg/kg	4	-	2	2	2	0	<4	2		2.0	2.0	0	2	2	0	2	2	0
	Sum of PAHs	µg/kg	4	10000	2	2	2	0	<4	2		2.0	2.0	0	2	2	0	2	2	0

					triplicate				duplicate			duplicate			duplicate			replicate		
				Location I	TB1	TB1	TB1	RSD (%)	TB10	TB10	RPD (%)	O3	O3	RPD (%)	OC3	OC3	RPD (%)	C6	C6	RPD (%)
				Lab	ALS	ALS	ALS		ALS	ALS		ALS	ALS		ALS	ALS		ALS	ALS	
Analytical Group	Analyte	Units	LoR	NAGD (ISQG Trigger																
Organotin Surrogate	Tripropyltin	%	0.5		73.1	82.2	56.2	19	----	86		----	----		69.7	----		76.8	85.5	11
Organotins	Monobutyltin as Sn	µg/kg	1	-		---				---			---		<1	----		0.5	0.5	0
	Dibutyltin as Sn	µg/kg	1	-		---				---			---		<1	----		0.5	0.5	0
	Tributyltin as Sn	µg/kg	0.5	9	0.25	0.25	0.25	0	----	0.25		----	----		<0.5	----		0.25	0.25	0
Phyiscal	Moisture	%	1	-	28.8	33.3	31.2	7	36.4	35.4	3	21.0	28.8	31	29.9	33.3	11	26.3	32.4	21
	75.0 mm	% passing	1	-		---				---		---	---		0.5	0.5	0	----	0.5	
	37.5 mm	% passing	1	-		---				---		---	---		0.5	0.5	0	----	0.5	
	19.0 mm	% passing	1	-		---				---		---	---		0.5	0.5	0	----	0.5	
	9.5 mm	% passing	1	-		---				---		---	---		6	0.5	169	----	2	
	4.75 mm	% passing	1	-		---				---		---	---		19	12	45	----	7	
	2.36 mm	% passing	1	-		---				---		---	---		29	22	27	----	15	
	1.18 mm	% passing	1	-		---				---		---	---		40	36	11	----	30	
	0.600 mm	% passing	1	-		---				---		---	---		53	50	6	----	51	
	0.425 mm	% passing	1	-		---				---		---	---		60	58	3	----	60	
	0.300 mm	% passing	1	-		---				---		---	---		68	66	3	----	68	
	0.150 mm	% passing	1	-		---				---		---	---		83	79	5	----	75	
	0.075 mm	% passing	1	-		---				---		---	---		88	86	2	----	87	
Soil Classification based on particle size	Clay (<2 µm)	%	1	-		---				---			---		4	3	29	----	3	
	Silt (2-60 µm)	%	1	-		---				---			---		5	7	33	----	6	
	Sand (0.06-2.00 mm)	%	1	-		---				---			---		59	64	8	----	71	
	Gravel (>2mm)	%	1	-		---				---			---		32	26	21	----	20	
	Cobbles (>6cm)	%	1	-		---				---			---		0.5	0.5	0	----	0.5	
Soil Particle Density	Soil Particle Density (Clay/Silt/Sand)	g/cm3	0.01			---				---			---		2.61	2.64	1	----	2.63	
Nutrients	Ammonia as N	mg/kg	20		10	10	10	0	10	10	0	<20	10.0		10	10	0	10	10	0
	Nitrite as N (Sol.)	mg/kg	0.1		0.05	0.05	0.05	0	0.05	0.05	0	<0.1	0.1		0.05	0.05	0	0.05	0.05	0
	Nitrate as N (Sol.)	mg/kg	0.1		0.05	0.05	0.1	43	0.1	0.1	0	0.1	0.3	100	0.3	0.2	40	0.1	0.1	0
	Nitrite + Nitrate as N (Sol.)	mg/kg	0.1		0.05	0.05	0.1	43	0.1	0.1	0	0.1	0.3	100	0.3	0.2	40	0.1	0.1	0
	Total Kjeldahl Nitrogen as N	mg/kg	20		310	330	330	0	470	320	38	230.0	330.0	36	350	440	23	250	330	28
	Total Nitrogen as N	mg/kg	20		310	330	330	0	470	320	38	230.0	330.0	36	350	440	23	250	330	28
	Total Phosphorus as P	mg/kg	2		258	288	231	16	271	180	40	241.0	309.0	25	324	338	4	296	358	19
	Reactive Phosphorus as P	mg/kg	0.1		0.1	0.1	0.1	0	0.2	0.05	120	0.05	0.05	0	0.1	0.2	67	0.1	0.1	0
Phenoxyacetic Acid Herbicides by LCMS	4-Chlorophenoxy acetic acid	mg/kg	0.02		0.01	0.01	0.01	0	----	0.01		----	----		0.01	----		0.01	0.01	0
	2.4-DB	mg/kg	0.02		0.01	0.01	0.01	0	----	0.01		----	----		0.01	----		0.01	0.01	0
	Dicamba	mg/kg	0.02		0.01	0.01	0.01	0	----	0.01		----	----		0.01	----		0.01	0.01	0
	Mecoprop	mg/kg	0.02		0.01	0.01	0.01	0	----	0.01		----	----		0.01	----		0.01	0.01	0
	MCPA	mg/kg	0.02		0.01	0.01	0.01	0	----	0.01		----	----		0.01	----		0.01	0.01	0
	2.4-DP	mg/kg	0.02		0.01	0.01	0.01	0	----	0.01		----	----		0.01	----		0.01	0.01	0
	2.4-D	mg/kg	0.02		0.01	0.01	0.01	0	----	0.01		----	----		0.01	----		0.01	0.01	0
	Triclopyr	mg/kg	0.02		0.01	0.01	0.01	0	----	0.01		----	----		0.01	----		0.01	0.01	0
	2.4.5-TP (Silvex)	mg/kg	0.02		0.01	0.01	0.01	0	----	0.01		----	----		0.01	----		0.01	0.01	0
	2.4.5-T	mg/kg	0.02		0.01	0.01	0.01	0	----	0.01		----	----		0.01	----		0.01	0.01	0
	MCPB	mg/kg	0.02		0.01	0.01	0.01	0	----	0.01		----	----		0.01	----		0.01	0.01	0
	Picloram	mg/kg	0.02		0.01	0.01	0.01	0	----	0.01		----	----		0.01	----		0.01	0.01	0
	Clopyralid	mg/kg	0.02		0.01	0.01	0.01	0	----	0.01		----	----		0.01	----		0.01	0.01	0
	Fluroxypyr	mg/kg	0.02		0.01	0.01	0.01	0	----	0.01		----	----		0.01	----		0.01	0.01	0
TPH(V)/BTEX Surrogates	1.2-Dichloroethane-D4	%	0.2		96.7	106	115	9	104	92.4	12	107.0	114.0	6	76.3	96	23	71.9	106	38
	Toluene-D8	%	0.2		103	85.2	102	10	91	92.3	1	106.0	96.5	9	78.6	106	30	80.4	111	32
	4-Bromofluorobenzene	%	0.2		102	88.7	106	9	92.1	84.5	9	103.0	91.4	12	75.8	91.8	19	75.8	99.9	27
Base/Neutral Extractable Surrogates	2-Fluorobiphenyl	%	10		92.2	93	80.4	8	92.4	79.3	15	103.0	72.5	35	103	80.6	24	94.9	92.2	3
	Anthracene-d10	%	10		92.9	89	82.8	6	101	90.6	11	102.0	98.8	3	82.2	95.2	15	86.7	87.6	1
	4-Terphenyl-d14	%	10		103	99.6	97.8	3	103	94.8	8	103.0	99.3	4	88.5	92.4	4	101	103	2
Phenoxyacetic Acid Herbicide Surrogate	2.4-Dichlorophenyl Acetic Acid	%	0.02		59.8	48.8	53	10	----	60.2		----	----		99.5	----		90.4	84.7	7
Ass Field Screening Analysis	pH (F)	pH Unit	0.1	8.4	----	9.3	----		8.8	8.9	1	8.4	---		7.9	8	2.6	8	7.8	1
	pH (Fox)	pH Unit	0.1	7.7	----	8.6	----		8.0	7.5	7	7.6	---		7.0	7	2.8	7	7.0	1
	Reaction Rate		1	4	----	4.0	----		4	3.0	33	4	---		Moderate	Moderate		Moderate	Moderate	

				replicate			replicate		
				TB2	TB2	RPD (%)	TB5	TB5	RPD (%)
				ALS	MPL		ALS	MPL	
Analytical Group	Analyte	Units	LoR						
Organics	Total Organic Carbon	%	0	0.34	0.58	52	0.28	0.24	15
Metals	Aluminium	mg/kg	50	11600.0	12000.0	3	10400	9700	7
	Antimony	mg/kg	0.5	0.3	3.5	173	0.25	0.25	0
	Arsenic	mg/kg	1	21.0	20.0	5	17.2	19	10
	Cadmium	mg/kg	0.1	0.1	0.2	120	0.05	0.05	0
	Chromium	mg/kg	1	44.7	41.0	9	42.9	44	3
	Cobalt	mg/kg	0.5	12.0	11.0	9	10.6	11	4
	Copper	mg/kg	1	13.5	15.0	11	13.6	12	13
	Iron	mg/kg	1	44700.0	39000.0	14	38900	37000	5
	Manganese	mg/kg	10	478.0	320.0	40	266	340	24
	Mercury	mg/kg	0.01	0.0	0.1	164	0.005	0.005	0
	Nickel	mg/kg	1	22.4	19.0	16	20.7	21	1
	Silver	mg/kg	0.1	0.1	0.5	133	0.05	0.05	0
	Vanadium	mg/kg	2	59.8	56.0	7	56.6	60	6
	Zinc	mg/kg	1	29.0	23.0	23	26.4	27	2
TRH	TRH C6 - C10	mg/kg	3	1.5	12.5	157	1.5	12.5	157
	C6 - C10 Fraction minus BTEX (F1)	mg/kg	3	1.5	12.5	157	1.5	---	
	TRH >C10 - C16	mg/kg	3	1.5	25.0	177	1.5	12.5	157
	TRH >C16 - C34	mg/kg	3	1.5	50.0	188	1.5	12.5	157
	TRH >C34 - C40	mg/kg	5	2.5	50.0	181	2.5	12.5	133
	TRH >C10 - C40 Fraction (sum)	mg/kg	3	1.5	25.0	177	1.5	---	
	TRH >C10 - C16 Fraction minus Naphthalene (F2)	mg/kg	3	1.5	25.0	177	1.5	---	
TPH	C6 - C9 Fraction	mg/kg	3	1.5	12.5	157	1.5	12.5	157
	C10 - C14 Fraction	mg/kg	3	1.5	---		1.5	12.5	157
	C15 - C28 Fraction	mg/kg	3	1.5	50.0	188	1.5	12.5	157
	C29 - C36 Fraction	mg/kg	5	2.5	50.0	181	2.5	12.5	133
	C10 - C36 Fraction (sum)	mg/kg	3	1.5	---		1.5	---	
BTEXN	Benzene	mg/kg	0.2	0.1	0.1	0	0.1	0.1	0
	Toluene	mg/kg	0.2	0.1	0.3	86	0.1	0.1	0
	Ethylbenzene	mg/kg	0.2	0.1	0.5	133	0.1	0.1	0
	m+p-xylene	mg/kg	0.2	0.1	1.0	164	0.1	0.2	67
	o-xylene	mg/kg	0.2	0.1	0.5	133	0.1	0.1	0
	Total Xylenes	mg/kg	0.5	0.3	---		0.25	---	
	Sum of BTEX	mg/kg	0.2	0.1	---		0.1	---	
	Naphthalene	µg/kg	5	2.5	0.5	133	2.5	2.5	0
OC/OP Pesticides	2-Methylnaphthalene	µg/kg	5	2.5	---		2.5	2.5	0
	Acenaphthene	µg/kg	4	2.0	100.0	192	2	2.5	22
	Acenaphthylene	µg/kg	4	2.0	100.0	192	2	2.5	22
	Anthracene	µg/kg	4	2.0	100.0	192	2	2.5	22
	Benzo(a)anthracene	µg/kg	4	2.0	100.0	192	2	2.5	22
	Benzo(a)pyrene	µg/kg	4	2.0	100.0	192	2	2.5	22
	Benzo(b+j)fluoranthene	µg/kg	4	2.0	100.0	192	2	5	86
	Benzo(k)fluoranthene	µg/kg	4	2.0	---		2	2.5	22
	Benzo(e)pyrene	µg/kg	4	2.0	---		2	---	
	Benzo(g,h,i)perylene	µg/kg	4	2.0	100.0	192	2	2.5	22
	Chrysene	µg/kg	4	2.0	100.0	192	2	2.5	22
	Coronene	µg/kg	5	2.5	---		2.5	2.5	0
	Dibenzo(a,h)anthracene	µg/kg	4	2.0	100.0	192	2	2.5	22
	Fluoranthene	µg/kg	4	2.0	100.0	192	2	2.5	22
	Fluorene	µg/kg	4	2.0	100.0	192	2	2.5	22
	Indeno(1,2,3-c,d)pyrene	µg/kg	5	2.5	100.0	190	2.5	2.5	0
	Naphthalene (PAH)	µg/kg	5.0	2.5	100.0	190	2.5	---	
	Perylene	µg/kg	4	2.0	---		2	2.5	22
	Phenanthrene	µg/kg	4	2.0	100.0	192	2	2.5	22
	Pyrene	µg/kg	4	2.0	100.0	192	2	2.5	22
	Sum of PAHs	µg/kg	4	2.0	1000.0	199	2	---	

					replicate			replicate	
				TB2	TB2	RPD (%)	TB5	TB5	RPD (%)
				ALS	MPL		ALS	MPL	
Analytical Group	Analyte	Units	LoR						
Organotin Surrogate	Tripropyltin	%	0.5	89.2	---		75.4	---	
Organotins	Monobutyltin as Sn	µg/kg	1	0.5	---		---	---	
	Dibutyltin as Sn	µg/kg	1	0.5	---		---	---	
	Tributyltin as Sn	µg/kg	0.5	0.3	0.3	0	0.25	---	
Phyiscal	Moisture	%	1	50.3	36.0	33	37.1	31	18
	75.0 mm	% passing	1	0.5	---	---	---	---	
	37.5 mm	% passing	1	0.5	---	---	---	---	
	19.0 mm	% passing	1	0.5	---	---	---	---	
	9.5 mm	% passing	1	0.5	---	---	---	---	
	4.75 mm	% passing	1	0.5	---	---	---	---	
	2.36 mm	% passing	1	0.5	---	---	---	---	
	1.18 mm	% passing	1	0.5	---	---	---	---	
	0.600 mm	% passing	1	0.5	---	---	---	---	
	0.425 mm	% passing	1	1.0	---	---	---	---	
	0.300 mm	% passing	1	2.0	---	---	---	---	
	0.150 mm	% passing	1	6.0	---	---	---	---	
	0.075 mm	% passing	1	47.0	---	---	---	---	
Soil Classification based on particle size	Clay (<2 µm)	%	1	13.0	---		---	---	
	Silt (2-60 µm)	%	1	17.0	---		---	---	
	Sand (0.06-2.00 mm)	%	1	70.0	---		---	---	
	Gravel (>2mm)	%	1	0.5	---		---	---	
	Cobbles (>6cm)	%	1	0.5	---		---	---	
Soil Particle Density	Soil Particle Density (Clay/Silt/Sand)	g/cm3	0.01	2.6	---		---	---	
Nutrients	Ammonia as N	mg/kg	20	10.0	7.1	34	10	5.7	55
	Nitrite as N (Sol.)	mg/kg	0.1	0.1	0.1	0	0.05	0.05	0
	Nitrate as N (Sol.)	mg/kg	0.1	0.2	0.1	120	0.05	0.11	75
	Nitrite + Nitrate as N (Sol.)	mg/kg	0.1	0.2	---		0.05	---	
	Total Kjeldahl Nitrogen as N	mg/kg	20	490.0	350.0	33	400	440	10
	Total Nitrogen as N	mg/kg	20	490.0	350.0	33	400	440	10
	Total Phosphorus as P	mg/kg	2	348.0	300.0	15	314	250	23
	Reactive Phosphorus as P	mg/kg	0.1	0.2	0.3	22	0.05	0.25	133
Phenoxyacetic Acid Herbicides by LCMS	4-Chlorophenoxy acetic acid	mg/kg	0.02	0.0	0.3	185	0.01	---	
	2.4-DB	mg/kg	0.02	0.0	0.3	185	0.01	---	
	Dicamba	mg/kg	0.02	0.0	0.3	185	0.01	---	
	Mecoprop	mg/kg	0.02	0.0	0.3	185	0.01	---	
	MCPA	mg/kg	0.02	0.0	0.3	185	0.01	---	
	2.4-DP	mg/kg	0.02	0.0	0.3	185	0.01	---	
	2.4-D	mg/kg	0.02	0.0	0.3	185	0.01	---	
	Triclopyr	mg/kg	0.02	0.0	0.3	185	0.01	---	
	2.4.5-TP (Silvex)	mg/kg	0.02	0.0	0.3	185	0.01	---	
	2.4.5-T	mg/kg	0.02	0.0	0.3	185	0.01	---	
	MCPB	mg/kg	0.02	0.0	---		0.01	---	
	Picloram	mg/kg	0.02	0.0	0.3	185	0.01	---	
	Clopyralid	mg/kg	0.02	0.0	0.3	185	0.01	---	
	Fluroxypyr	mg/kg	0.02	0.0	---		0.01	---	
TPH(V)/BTEX Surrogates	1.2-Dichloroethane-D4	%	0.2	75.6	---		93.1	---	
	Toluene-D8	%	0.2	76.6	---		79.2	---	
	4-Bromofluorobenzene	%	0.2	70.8	---		81.6	---	
Base/Neutral Extractable Surrogates	2-Fluorobiphenyl	%	10	97.6	---		86	---	
	Anthracene-d10	%	10	92.7	---		88.5	---	
	4-Terphenyl-d14	%	10	99.9	93.0	7	94.2	68	32
Phenoxyacetic Acid Herbicide Surrogate	2.4-Dichlorophenyl Acetic Acid	%	0.02	108.0	0.3	199	49.9	---	
Ass Field Screening Analysis	pH (F)	pH Unit	0.1	8	8.0	2.5	8.4	8.4	0
	pH (Fox)	pH Unit	0.1	7	8.0	14.8	7.8	8.0	3
	Reaction Rate		1	Moderate	Volcanic		4.0	Volcanic	

Appendix C Laboratory QA/QC & Methods

QUALITY CONTROL REPORT

Work Order	: **EP1814856**	Page	: 1 of 11
Client	: **WA MARINE PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: Claudio Deldeo	Contact	: Marnie Thomsett
Address	: SUITE 5, 5/18 GRIFFON DRIVE PO BOX 1370 DUNSBOROUGH, PERTH WA, AUSTRALIA 6281	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1311
Project	: 18WAU-0002 Mardie Project: Sediment Sampling	Date Samples Received	: 19-Dec-2018
Order number	:	Date Analysis Commenced	: 20-Dec-2018
C-O-C number	: ----	Issue Date	: 07-Jan-2019
Sampler	: Claudio Deldeo		
Site	: ----		
Quote number	: EP/1145/18		
No. of samples received	: 13		
No. of samples analysed	: 13		

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

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

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Alex Rossi	Organic Chemist	Sydney Organics, Smithfield, NSW
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA
Diana Mesa	2IC Organic Chemist	Brisbane Organics, Stafford, QLD
Dianne Blane	Laboratory Coordinator (2IC)	Newcastle - Inorganics, Mayfield West, NSW
Efua Wilson	Metals Chemist	Perth Inorganics, Wangara, WA
Indra Astuty	Instrument Chemist	Perth Inorganics, Wangara, WA
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Sarah Ashworth	Laboratory Manager - Brisbane	Brisbane Organics, Stafford, QLD
Vanessa Nguyen	Organic Chemist	Perth Organics, Wangara, WA

General Comments

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

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

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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QC Lot: 2106549)									
EP1814856-001	SPLIT-P1	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
EP1814856-012	OC2	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
EA037: Ass Field Screening Analysis (QC Lot: 2108096)									
EP1814856-001	SPLIT-P1	EA037: pH (F)	----	0.1	pH Unit	7.9	8.0	1.26	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	6.9	6.9	0.00	0% - 20%
EP1814856-010	C5	EA037: pH (F)	----	0.1	pH Unit	8.0	7.9	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	6.9	6.9	0.00	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 2106558)									
EP1814856-001	SPLIT-P1	EA055: Moisture Content	----	0.1	%	26.3	25.0	5.13	0% - 20%
EP1814856-011	C6-1	EA055: Moisture Content	----	0.1	%	32.4	32.2	0.507	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 2106591)									
EP1814843-047	Anonymous	EA055: Moisture Content	----	0.1	%	4.4	4.4	0.00	No Limit
EP1814884-013	Anonymous	EA055: Moisture Content	----	0.1	%	11.0	10.8	1.84	0% - 50%
EG005-SD: Total Metals in Sediments by ICP-AES (QC Lot: 2106550)									
EP1814856-001	SPLIT-P1	EG005-SD: Aluminium	7429-90-5	50	mg/kg	5530	5670	2.51	0% - 20%
		EG005-SD: Iron	7439-89-6	50	mg/kg	25900	27000	4.32	0% - 20%
EP1814856-012	OC2	EG005-SD: Aluminium	7429-90-5	50	mg/kg	7530	7930	5.17	0% - 20%
		EG005-SD: Iron	7439-89-6	50	mg/kg	37600	32500	14.6	0% - 20%
EG020-SD: Total Metals in Sediments by ICPMS (QC Lot: 2106551)									
EP1814856-001	SPLIT-P1	EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
		EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
		EG020-SD: Antimony	7440-36-0	0.5	mg/kg	<0.50	<0.50	0.00	No Limit
		EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	6.6	6.9	4.50	0% - 50%
		EG020-SD: Arsenic	7440-38-2	1	mg/kg	24.2	25.6	5.78	0% - 20%

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020-SD: Total Metals in Sediments by ICPMS (QC Lot: 2106551) - continued									
EP1814856-001	SPLIT-P1	EG020-SD: Chromium	7440-47-3	1	mg/kg	21.9	22.9	4.62	0% - 20%
		EG020-SD: Copper	7440-50-8	1	mg/kg	5.8	6.2	5.99	No Limit
		EG020-SD: Nickel	7440-02-0	1	mg/kg	10.8	11.1	3.60	0% - 50%
		EG020-SD: Zinc	7440-66-6	1	mg/kg	13.2	14.1	6.10	0% - 50%
		EG020-SD: Manganese	7439-96-5	10	mg/kg	329	313	4.87	0% - 20%
		EG020-SD: Vanadium	7440-62-2	2	mg/kg	37.5	40.0	6.47	0% - 50%
EP1814856-012	OC2	EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	0.2	<0.1	68.6	No Limit
		EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
		EG020-SD: Antimony	7440-36-0	0.5	mg/kg	<0.50	<0.50	0.00	No Limit
		EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	9.6	7.8	20.7	0% - 50%
		EG020-SD: Arsenic	7440-38-2	1	mg/kg	17.3	18.1	4.31	0% - 50%
		EG020-SD: Chromium	7440-47-3	1	mg/kg	31.4	31.2	0.669	0% - 20%
		EG020-SD: Copper	7440-50-8	1	mg/kg	9.5	9.2	2.81	No Limit
		EG020-SD: Nickel	7440-02-0	1	mg/kg	15.2	14.9	2.35	0% - 50%
		EG020-SD: Zinc	7440-66-6	1	mg/kg	19.0	18.1	4.64	0% - 50%
		EG020-SD: Manganese	7439-96-5	10	mg/kg	276	263	4.77	0% - 20%
		EG020-SD: Vanadium	7440-62-2	2	mg/kg	46.8	42.4	9.95	0% - 20%
EK055: Ammonia as N (QC Lot: 2106559)									
EP1814856-001	SPLIT-P1	EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.00	No Limit
EP1814856-011	C6-1	EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.00	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2106555)									
EP1814856-011	C6-1	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP1814856-001	SPLIT-P1	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2106557)									
EP1814856-011	C6-1	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.1	0.2	0.00	No Limit
EP1814856-001	SPLIT-P1	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.1	0.1	0.00	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2106553)									
EP1814856-001	SPLIT-P1	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	250	260	4.14	0% - 50%
EP1814856-012	OC2	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	480	470	2.37	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2106552)									
EP1814856-001	SPLIT-P1	EK067G: Total Phosphorus as P	----	2	mg/kg	296	261	12.6	0% - 20%
EP1814856-012	OC2	EK067G: Total Phosphorus as P	----	2	mg/kg	252	260	3.42	0% - 20%
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2106556)									
EP1814856-012	OC2	EK071G: Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	0.2	0.2	0.00	No Limit
EP1814856-001	SPLIT-P1	EK071G: Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	0.1	0.1	0.00	No Limit
EP003: Total Organic Carbon (TOC) in Soil (QC Lot: 2119510)									
EP1814856-001	SPLIT-P1	EP003: Total Organic Carbon	----	0.02	%	0.24	0.23	0.00	0% - 50%
EP1814856-012	OC2	EP003: Total Organic Carbon	----	0.02	%	0.21	0.22	0.00	0% - 50%
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QC Lot: 2106892)									

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QC Lot: 2106892) - continued									
EP1814856-001	SPLIT-P1	EP080-SD: C6 - C9 Fraction	----	3	mg/kg	<3	<3	0.00	0% - 3%
EP1814856-012	OC2	EP080-SD: C6 - C9 Fraction	----	3	mg/kg	<3	<3	0.00	0% - 3%
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QC Lot: 2106896)									
EP1814856-001	SPLIT-P1	EP071-SD: C10 - C14 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: C15 - C28 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: C10 - C36 Fraction (sum)	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: C29 - C36 Fraction	----	5	mg/kg	<5	<5	0.00	No Limit
EP1814856-012	OC2	EP071-SD: C10 - C14 Fraction	----	3	mg/kg	<3	<4	40.0	No Limit
		EP071-SD: C15 - C28 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: C10 - C36 Fraction (sum)	----	3	mg/kg	<3	<4	40.0	No Limit
		EP071-SD: C29 - C36 Fraction	----	5	mg/kg	<5	<5	0.00	No Limit
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QC Lot: 2106892)									
EP1814856-001	SPLIT-P1	EP080-SD: C6 - C10 Fraction	C6_C10	3	mg/kg	<3	<3	0.00	0% - 3%
EP1814856-012	OC2	EP080-SD: C6 - C10 Fraction	C6_C10	3	mg/kg	<3	<3	0.00	0% - 3%
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QC Lot: 2106896)									
EP1814856-001	SPLIT-P1	EP071-SD: >C10 - C16 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: >C16 - C34 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: >C10 - C40 Fraction (sum)	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: >C34 - C40 Fraction	----	5	mg/kg	<5	<5	0.00	No Limit
EP1814856-012	OC2	EP071-SD: >C10 - C16 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: >C16 - C34 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: >C10 - C40 Fraction (sum)	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: >C34 - C40 Fraction	----	5	mg/kg	<5	<5	0.00	No Limit
EP080-SD: BTEXN (QC Lot: 2106892)									
EP1814856-001	SPLIT-P1	EP080-SD: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Toluene	108-88-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Total Xylenes	----	0.2	mg/kg	<0.5	<0.5	0.00	0% - .2%
		EP080-SD: Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Naphthalene	91-20-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
EP1814856-012	OC2	EP080-SD: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Toluene	108-88-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Total Xylenes	----	0.2	mg/kg	<0.5	<0.5	0.00	0% - .2%

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP080-SD: BTEXN (QC Lot: 2106892) - continued									
EP1814856-012	OC2	EP080-SD: Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Naphthalene	91-20-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
EP090: Organotin Compounds (QC Lot: 2109384)									
EP1814856-007	C3-1	EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	0.00	No Limit
		EP090: Monobutyltin	78763-54-9	1	µgSn/kg	<1	<1	0.00	No Limit
		EP090: Dibutyltin	1002-53-5	1	µgSn/kg	<1	<1	0.00	No Limit
EP132B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2106897)									
EP1814856-001	SPLIT-P1	EP132B-SD: Acenaphthylene	208-96-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Acenaphthene	83-32-9	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Fluorene	86-73-7	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Phenanthrene	85-01-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Anthracene	120-12-7	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Fluoranthene	206-44-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Pyrene	129-00-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benz(a)anthracene	56-55-3	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Chrysene	218-01-9	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(e)pyrene	192-97-2	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(a)pyrene	50-32-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Perylene	198-55-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(g.h.i)perylene	191-24-2	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Sum of PAHs	----	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Naphthalene	91-20-3	5	µg/kg	<5	<5	0.00	No Limit
		EP132B-SD: 2-Methylnaphthalene	91-57-6	5	µg/kg	<5	<5	0.00	No Limit
		EP132B-SD: Coronene	191-07-1	5	µg/kg	<5	<5	0.00	No Limit
EP1814856-012	OC2	EP132B-SD: Acenaphthylene	208-96-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Acenaphthene	83-32-9	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Fluorene	86-73-7	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Phenanthrene	85-01-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Anthracene	120-12-7	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Fluoranthene	206-44-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Pyrene	129-00-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benz(a)anthracene	56-55-3	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Chrysene	218-01-9	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	<4	<4	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP132B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2106897) - continued									
EP1814856-012	OC2	EP132B-SD: Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(e)pyrene	192-97-2	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(a)pyrene	50-32-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Perylene	198-55-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(g.h.i)perylene	191-24-2	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Sum of PAHs	----	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Naphthalene	91-20-3	5	µg/kg	<5	<5	0.00	No Limit
		EP132B-SD: 2-Methylnaphthalene	91-57-6	5	µg/kg	<5	<5	0.00	No Limit
		EP132B-SD: Coronene	191-07-1	5	µg/kg	<5	<5	0.00	No Limit
EP202A: Phenoxyacetic Acid Herbicides by LCMS (QC Lot: 2108754)									
EB1830936-003	Anonymous	EP202: 4-Chlorophenoxy acetic acid	122-88-3	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: 2.4-DB	94-82-6	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Dicamba	1918-00-9	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Mecoprop	93-65-2	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: MCPA	94-74-6	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: 2.4-DP	120-36-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: 2.4-D	94-75-7	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Triclopyr	55335-06-3	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: 2.4.5-TP (Silvex)	93-72-1	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: 2.4.5-T	93-76-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: MCPB	94-81-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Picloram	1918-02-1	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Clopyralid	1702-17-6	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Fluroxypyr	69377-81-7	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
EP1814856-002	TRIP-1	EP202: 4-Chlorophenoxy acetic acid	122-88-3	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: 2.4-DB	94-82-6	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Dicamba	1918-00-9	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Mecoprop	93-65-2	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: MCPA	94-74-6	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: 2.4-DP	120-36-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: 2.4-D	94-75-7	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Triclopyr	55335-06-3	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: 2.4.5-TP (Silvex)	93-72-1	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: 2.4.5-T	93-76-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: MCPB	94-81-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Picloram	1918-02-1	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Clopyralid	1702-17-6	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Fluroxypyr	69377-81-7	0.02	mg/kg	<0.02	<0.02	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QCLot: 2106549)								
EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	2.154 mg/kg	106	80	120
EG005-SD: Total Metals in Sediments by ICP-AES (QCLot: 2106550)								
EG005-SD: Aluminium	7429-90-5	50	mg/kg	<50	----	----	----	----
EG005-SD: Iron	7439-89-6	50	mg/kg	<50	----	----	----	----
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2106551)								
EG020-SD: Antimony	7440-36-0	0.5	mg/kg	<0.50	----	----	----	----
EG020-SD: Arsenic	7440-38-2	1	mg/kg	<1.00	21.62091 mg/kg	110	74	130
EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	4.6838 mg/kg	107	97	113
EG020-SD: Chromium	7440-47-3	1	mg/kg	<1.0	33.904 mg/kg	146	72	152
EG020-SD: Copper	7440-50-8	1	mg/kg	<1.0	33.782 mg/kg	104	76	116
EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	<0.5	----	----	----	----
EG020-SD: Manganese	7439-96-5	10	mg/kg	<10	----	----	----	----
EG020-SD: Nickel	7440-02-0	1	mg/kg	<1.0	51.10088 mg/kg	126	81	135
EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	----	----	----	----
EG020-SD: Vanadium	7440-62-2	2	mg/kg	<2.0	----	----	----	----
EG020-SD: Zinc	7440-66-6	1	mg/kg	<1.0	61.70999 mg/kg	121	81	143
EK055: Ammonia as N (QCLot: 2106559)								
EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	50 mg/kg	87.6	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2106555)								
EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	2.5 mg/kg	102	89	121
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2106557)								
EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	2.5 mg/kg	102	90	112
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2106553)								
EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20	1000 mg/kg	85.4	78	112
				<20	100 mg/kg	91.1	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2106552)								
EK067G: Total Phosphorus as P	----	2	mg/kg	<2	440 mg/kg	83.0	78	108
				<2	44 mg/kg	73.4	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2106556)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	<0.1	2.5 mg/kg	101	92	112
EP003: Total Organic Carbon (TOC) in Soil (QCLot: 2119510)								
EP003: Total Organic Carbon	----	0.02	%	<0.02	0.44 %	96.8	70	130
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2106892)								

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2106892) - continued								
EP080-SD: C6 - C9 Fraction	----	3	mg/kg	<3	32 mg/kg	98.6	70	130
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2106896)								
EP071-SD: C10 - C14 Fraction	----	3	mg/kg	<3	252 mg/kg	116	70	130
EP071-SD: C15 - C28 Fraction	----	3	mg/kg	<3	634 mg/kg	117	70	130
EP071-SD: C29 - C36 Fraction	----	5	mg/kg	<5	99 mg/kg	107	70	130
EP071-SD: C10 - C36 Fraction (sum)	----	3	mg/kg	<3	----	----	----	----
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 2106892)								
EP080-SD: C6 - C10 Fraction	C6_C10	3	mg/kg	<3	37 mg/kg	97.6	70	130
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 2106896)								
EP071-SD: >C10 - C16 Fraction	----	3	mg/kg	<3	404 mg/kg	119	70	130
EP071-SD: >C16 - C34 Fraction	----	3	mg/kg	<3	567 mg/kg	109	70	130
EP071-SD: >C34 - C40 Fraction	----	5	mg/kg	<5	33 mg/kg	101	70	130
EP071-SD: >C10 - C40 Fraction (sum)	----	3	mg/kg	<3	----	----	----	----
EP080-SD: BTEXN (QCLot: 2106892)								
EP080-SD: Benzene	71-43-2	0.2	mg/kg	<0.2	2 mg/kg	96.7	70	130
EP080-SD: Toluene	108-88-3	0.2	mg/kg	<0.2	2 mg/kg	100	70	130
EP080-SD: Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	2 mg/kg	99.0	70	130
EP080-SD: meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	4 mg/kg	99.8	70	130
EP080-SD: ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	2 mg/kg	94.9	70	130
EP080-SD: Total Xylenes	----	0.2	mg/kg	<0.2	----	----	----	----
EP080-SD: Sum of BTEX	----	0.2	mg/kg	<0.2	----	----	----	----
EP080-SD: Naphthalene	91-20-3	0.2	mg/kg	<0.2	0.5 mg/kg	89.5	70	130
EP090: Organotin Compounds (QCLot: 2109384)								
EP090: Monobutyltin	78763-54-9	1	µgSn/kg	<1	1.25 µgSn/kg	117	36	128
EP090: Dibutyltin	1002-53-5	1	µgSn/kg	<1	1.25 µgSn/kg	# 152	42	132
EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	1.25 µgSn/kg	128	52	139
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2106897)								
EP132B-SD: Naphthalene	91-20-3	5	µg/kg	<5	25 µg/kg	89.0	55	131
EP132B-SD: 2-Methylnaphthalene	91-57-6	5	µg/kg	<5	----	----	----	----
EP132B-SD: Acenaphthylene	208-96-8	4	µg/kg	<4	25 µg/kg	85.9	64	110
EP132B-SD: Acenaphthene	83-32-9	4	µg/kg	<4	25 µg/kg	85.7	62	112
EP132B-SD: Fluorene	86-73-7	4	µg/kg	<4	25 µg/kg	95.5	64	118
EP132B-SD: Phenanthrene	85-01-8	4	µg/kg	<4	25 µg/kg	69.8	59	117
EP132B-SD: Anthracene	120-12-7	4	µg/kg	<4	25 µg/kg	76.1	69	111
EP132B-SD: Fluoranthene	206-44-0	4	µg/kg	<4	25 µg/kg	82.2	66	118
EP132B-SD: Pyrene	129-00-0	4	µg/kg	<4	25 µg/kg	93.4	70	116
EP132B-SD: Benz(a)anthracene	56-55-3	4	µg/kg	<4	25 µg/kg	82.7	59	121

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2106897) - continued								
EP132B-SD: Chrysene	218-01-9	4	µg/kg	<4	25 µg/kg	80.7	68	116
EP132B-SD: Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	<4	25 µg/kg	73.7	51	107
EP132B-SD: Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	25 µg/kg	89.7	52	118
EP132B-SD: Benzo(e)pyrene	192-97-2	4	µg/kg	<4	----	----	----	----
EP132B-SD: Benzo(a)pyrene	50-32-8	4	µg/kg	<4	25 µg/kg	87.4	55	111
EP132B-SD: Perylene	198-55-0	4	µg/kg	<4	----	----	----	----
EP132B-SD: Benzo(g.h.i)perylene	191-24-2	4	µg/kg	<4	25 µg/kg	89.5	62	106
EP132B-SD: Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	25 µg/kg	97.3	35	141
EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	25 µg/kg	69.7	48	122
EP132B-SD: Coronene	191-07-1	5	µg/kg	<5	----	----	----	----
EP132B-SD: Sum of PAHs	----	4	µg/kg	<4	----	----	----	----
EP202A: Phenoxyacetic Acid Herbicides by LCMS (QCLot: 2108754)								
EP202: 4-Chlorophenoxy acetic acid	122-88-3	0.02	mg/kg	<0.02	0.1 mg/kg	97.7	54	128
EP202: 2.4-DB	94-82-6	0.02	mg/kg	<0.02	0.1 mg/kg	117	46	130
EP202: Dicamba	1918-00-9	0.02	mg/kg	<0.02	0.1 mg/kg	91.0	52	135
EP202: Mecoprop	93-65-2	0.02	mg/kg	<0.02	0.1 mg/kg	95.3	60	130
EP202: MCPA	94-74-6	0.02	mg/kg	<0.02	0.1 mg/kg	98.8	57	131
EP202: 2.4-DP	120-36-5	0.02	mg/kg	<0.02	0.1 mg/kg	135	50	141
EP202: 2.4-D	94-75-7	0.02	mg/kg	<0.02	0.1 mg/kg	106	69	131
EP202: Triclopyr	55335-06-3	0.02	mg/kg	<0.02	0.1 mg/kg	131	51	141
EP202: 2.4.5-TP (Silvex)	93-72-1	0.02	mg/kg	<0.02	0.1 mg/kg	108	41	126
EP202: 2.4.5-T	93-76-5	0.02	mg/kg	<0.02	0.1 mg/kg	122	57	139
EP202: MCPB	94-81-5	0.02	mg/kg	<0.02	0.1 mg/kg	103	39	137
EP202: Picloram	1918-02-1	0.02	mg/kg	<0.02	0.1 mg/kg	63.3	49	129
EP202: Clopyralid	1702-17-6	0.02	mg/kg	<0.02	0.1 mg/kg	62.6	49	106
EP202: Fluroxypyr	69377-81-7	0.02	mg/kg	<0.02	0.1 mg/kg	103	53	128

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Recovery Limits (%): Low	Recovery Limits (%): High
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QCLot: 2106549)							
EP1814856-002	TRIP-1	EG035T-LL: Mercury	7439-97-6	10 mg/kg	99.3	70	130
EG005-SD: Total Metals in Sediments by ICP-AES (QCLot: 2106550)							

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005-SD: Total Metals in Sediments by ICP-AES (QCLot: 2106550) - continued							
EP1814856-002	TRIP-1	EG005-SD: Aluminium	7429-90-5	50 mg/kg	# Not Determined	70	130
		EG005-SD: Iron	7439-89-6	50 mg/kg	# Not Determined	70	130
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2106551)							
EP1814856-002	TRIP-1	EG020-SD: Arsenic	7440-38-2	50 mg/kg	95.3	70	130
		EG020-SD: Cadmium	7440-43-9	50 mg/kg	96.9	70	130
		EG020-SD: Chromium	7440-47-3	50 mg/kg	101	70	130
		EG020-SD: Copper	7440-50-8	50 mg/kg	93.3	70	130
		EG020-SD: Nickel	7440-02-0	50 mg/kg	94.9	70	130
		EG020-SD: Zinc	7440-66-6	50 mg/kg	95.8	70	130
EK055: Ammonia as N (QCLot: 2106559)							
EP1814856-002	TRIP-1	EK055: Ammonia as N	7664-41-7	50 mg/kg	86.8	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2106555)							
EP1814856-002	TRIP-1	EK057G: Nitrite as N (Sol.)	14797-65-0	2.5 mg/kg	111	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2106557)							
EP1814856-002	TRIP-1	EK059G: Nitrite + Nitrate as N (Sol.)	----	2.5 mg/kg	107	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2106553)							
EP1814856-002	TRIP-1	EK061G: Total Kjeldahl Nitrogen as N	----	500 mg/kg	99.3	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2106552)							
EP1814856-002	TRIP-1	EK067G: Total Phosphorus as P	----	100 mg/kg	# 60.8	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2106556)							
EP1814856-002	TRIP-1	EK071G: Reactive Phosphorus as P	14265-44-2	2.5 mg/kg	108	70	130
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2106892)							
EP1814856-002	TRIP-1	EP080-SD: C6 - C9 Fraction	----	32 mg/kg	73.9	70	130
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2106896)							
EP1814856-002	TRIP-1	EP071-SD: C10 - C14 Fraction	----	252 mg/kg	111	70	130
		EP071-SD: C15 - C28 Fraction	----	634 mg/kg	112	70	130
		EP071-SD: C29 - C36 Fraction	----	99 mg/kg	93.6	70	130
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 2106892)							
EP1814856-002	TRIP-1	EP080-SD: C6 - C10 Fraction	C6_C10	37 mg/kg	71.1	70	130
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 2106896)							
EP1814856-002	TRIP-1	EP071-SD: >C10 - C16 Fraction	----	404 mg/kg	116	70	130
		EP071-SD: >C16 - C34 Fraction	----	567 mg/kg	102	70	130
		EP071-SD: >C34 - C40 Fraction	----	33 mg/kg	74.6	70	130

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EP080-SD: BTEXN (QCLot: 2106892)							
EP1814856-002	TRIP-1	EP080-SD: Benzene	71-43-2	2 mg/kg	87.2	70	130
		EP080-SD: Toluene	108-88-3	2 mg/kg	94.6	70	130
EP090: Organotin Compounds (QCLot: 2109384)							
EP1814856-001	SPLIT-P1	EP090: Monobutyltin	78763-54-9	1.25 µgSn/kg	36.1	35	130
		EP090: Dibutyltin	1002-53-5	1.25 µgSn/kg	121	20	130
		EP090: Tributyltin	56573-85-4	1.25 µgSn/kg	112	20	130
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2106897)							
EP1814856-002	TRIP-1	EP132B-SD: Naphthalene	91-20-3	25 µg/kg	104	70	130
		EP132B-SD: Acenaphthylene	208-96-8	25 µg/kg	76.5	70	130
		EP132B-SD: Acenaphthene	83-32-9	25 µg/kg	89.6	70	130
		EP132B-SD: Fluorene	86-73-7	25 µg/kg	87.9	70	130
		EP132B-SD: Phenanthrene	85-01-8	25 µg/kg	114	70	130
		EP132B-SD: Anthracene	120-12-7	25 µg/kg	104	70	130
		EP132B-SD: Fluoranthene	206-44-0	25 µg/kg	96.2	70	130
		EP132B-SD: Pyrene	129-00-0	25 µg/kg	101	70	130
		EP132B-SD: Benz(a)anthracene	56-55-3	25 µg/kg	86.6	70	130
		EP132B-SD: Chrysene	218-01-9	25 µg/kg	90.1	70	130
		EP132B-SD: Benzo(b+j)fluoranthene	205-99-2 205-82-3	25 µg/kg	93.0	70	130
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	25 µg/kg	88.4	70	130
		EP132B-SD: Benzo(a)pyrene	50-32-8	25 µg/kg	85.7	70	130
		EP132B-SD: Benzo(g.h.i)perylene	191-24-2	25 µg/kg	95.0	70	130
		EP132B-SD: Dibenz(a.h)anthracene	53-70-3	25 µg/kg	84.6	70	130
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	25 µg/kg	77.1	70	130
EP202A: Phenoxyacetic Acid Herbicides by LCMS (QCLot: 2108754)							
EB1830936-003	Anonymous	EP202: Mecoprop	93-65-2	0.1 mg/kg	75.4	60	140
		EP202: MCPA	94-74-6	0.1 mg/kg	72.5	57	143
		EP202: 2.4-D	94-75-7	0.1 mg/kg	73.6	68	139
		EP202: Triclopyr	55335-06-3	0.1 mg/kg	94.2	51	145
		EP202: 2.4.5-T	93-76-5	0.1 mg/kg	78.3	57	142
		EP202: Picloram	1918-02-1	0.1 mg/kg	73.6	49	138
		EP202: Clopyralid	1702-17-6	0.1 mg/kg	55.1	49	149

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EP1900623**	Page	: 1 of 22
Client	: **WA MARINE PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: Claudio Deldeo	Contact	: Marnie Thomsett
Address	: SUITE 5, 5/18 GRIFFON DRIVE PO BOX 1370 DUNSBOROUGH, PERTH WA, AUSTRALIA 6281	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1311
Project	: 18WAU-0002 Mardie Project: Sediment Sampling	Date Samples Received	: 22-Jan-2019
Order number	:	Date Analysis Commenced	: 22-Jan-2019
C-O-C number	: ----	Issue Date	: 08-Feb-2019
Sampler	: Claudio Deldeo		
Site	: ----		
Quote number	: EP/1145/18		
No. of samples received	: 29		
No. of samples analysed	: 29		

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

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

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Efua Wilson	Metals Chemist	Perth Inorganics, Wangara, WA
Franco Lentini		Sydney Organics, Smithfield, NSW
Indra Astuty	Instrument Chemist	Perth Inorganics, Wangara, WA
Leanne Carey	Acid Sulfate Soils Supervisor	Perth ASS, Wangara, WA
Minh Wills	2IC Organic Chemist	Brisbane Organics, Stafford, QLD
Vanessa Nguyen	Organic Chemist	Perth Organics, Wangara, WA

General Comments

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

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

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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QC Lot: 2158727)									
EP1900623-001	TRIP-2	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
EP1900623-013	TB7	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QC Lot: 2158732)									
EP1900623-024	O2	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
EA037: Ass Field Screening Analysis (QC Lot: 2159841)									
EP1900623-001	TRIP-2	EA037: pH (F)	----	0.1	pH Unit	8.4	8.4	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	7.7	7.5	2.62	0% - 20%
EP1900623-015	TB10	EA037: pH (F)	----	0.1	pH Unit	8.6	8.4	1.41	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	7.0	7.0	0.00	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 2155443)									
EP1900623-007	TRIPB TBS521	EA055: Moisture Content	----	0.1	%	17.6	17.9	1.68	0% - 50%
EP1900698-006	Anonymous	EA055: Moisture Content	----	0.1	%	1.7	2.1	17.2	No Limit
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 2155895)									
EP1900623-001	TRIP-2	EA055: Moisture Content	----	0.1	%	28.8	27.0	6.42	0% - 20%
EP1900623-013	TB7	EA055: Moisture Content	----	0.1	%	35.4	34.8	1.72	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 2155896)									
EP1900623-024	O2	EA055: Moisture Content	----	0.1	%	36.3	35.2	3.21	0% - 20%
EG005-SD: Total Metals in Sediments by ICP-AES (QC Lot: 2158728)									
EP1900623-001	TRIP-2	EG005-SD: Aluminium	7429-90-5	50	mg/kg	11800	11600	1.44	0% - 20%
		EG005-SD: Iron	7439-89-6	50	mg/kg	44500	43500	2.37	0% - 20%
EP1900623-013	TB7	EG005-SD: Aluminium	7429-90-5	50	mg/kg	9520	9220	3.15	0% - 20%
		EG005-SD: Iron	7439-89-6	50	mg/kg	38200	36700	3.88	0% - 20%
EG005-SD: Total Metals in Sediments by ICP-AES (QC Lot: 2158731)									

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG005-SD: Total Metals in Sediments by ICP-AES (QC Lot: 2158731) - continued									
EP1900623-024	O2	EG005-SD: Aluminium	7429-90-5	50	mg/kg	10700	10600	1.60	0% - 20%
		EG005-SD: Iron	7439-89-6	50	mg/kg	41700	41600	0.327	0% - 20%
EG020-SD: Total Metals in Sediments by ICPMS (QC Lot: 2158729)									
EP1900623-001	TRIP-2	EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
		EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
		EG020-SD: Antimony	7440-36-0	0.5	mg/kg	<0.50	<0.50	0.00	No Limit
		EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	11.2	10.9	2.48	0% - 20%
		EG020-SD: Arsenic	7440-38-2	1	mg/kg	15.1	15.0	0.397	0% - 50%
		EG020-SD: Chromium	7440-47-3	1	mg/kg	47.0	45.6	2.97	0% - 20%
		EG020-SD: Copper	7440-50-8	1	mg/kg	17.7	17.4	1.68	0% - 50%
		EG020-SD: Nickel	7440-02-0	1	mg/kg	23.7	23.4	1.57	0% - 20%
		EG020-SD: Zinc	7440-66-6	1	mg/kg	28.7	28.5	0.896	0% - 20%
		EG020-SD: Manganese	7439-96-5	10	mg/kg	271	269	0.800	0% - 20%
		EG020-SD: Vanadium	7440-62-2	2	mg/kg	63.3	61.1	3.53	0% - 20%
EP1900623-013	TB7	EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
		EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
		EG020-SD: Antimony	7440-36-0	0.5	mg/kg	<0.50	<0.50	0.00	No Limit
		EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	10.5	9.5	10.0	0% - 20%
		EG020-SD: Arsenic	7440-38-2	1	mg/kg	17.0	15.9	7.00	0% - 50%
		EG020-SD: Chromium	7440-47-3	1	mg/kg	40.3	37.7	6.59	0% - 20%
		EG020-SD: Copper	7440-50-8	1	mg/kg	12.5	11.5	8.90	0% - 50%
		EG020-SD: Nickel	7440-02-0	1	mg/kg	20.0	18.6	7.06	0% - 50%
		EG020-SD: Zinc	7440-66-6	1	mg/kg	24.6	23.1	6.17	0% - 20%
		EG020-SD: Manganese	7439-96-5	10	mg/kg	264	252	4.28	0% - 20%
		EG020-SD: Vanadium	7440-62-2	2	mg/kg	54.7	50.8	7.38	0% - 20%
EG020-SD: Total Metals in Sediments by ICPMS (QC Lot: 2158730)									
EP1900623-024	O2	EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
		EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
		EG020-SD: Antimony	7440-36-0	0.5	mg/kg	<0.50	<0.50	0.00	No Limit
		EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	11.6	11.1	4.29	0% - 20%
		EG020-SD: Arsenic	7440-38-2	1	mg/kg	17.8	17.9	0.774	0% - 50%
		EG020-SD: Chromium	7440-47-3	1	mg/kg	44.3	43.7	1.33	0% - 20%
		EG020-SD: Copper	7440-50-8	1	mg/kg	13.5	13.3	1.68	0% - 50%
		EG020-SD: Nickel	7440-02-0	1	mg/kg	21.8	21.7	0.00	0% - 20%
		EG020-SD: Zinc	7440-66-6	1	mg/kg	27.8	26.8	3.41	0% - 20%
		EG020-SD: Manganese	7439-96-5	10	mg/kg	284	273	3.93	0% - 20%
		EG020-SD: Vanadium	7440-62-2	2	mg/kg	59.8	58.7	1.84	0% - 20%
EK055: Ammonia as N (QC Lot: 2161190)									
EP1900623-001	TRIP-2	EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.00	No Limit
EP1900623-012	TB6	EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EK055: Ammonia as N (QC Lot: 2161191)									
EP1900623-024	O2	EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.00	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2161514)									
EP1900623-012	TB6	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP1900623-001	TRIP-2	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2161518)									
EP1900623-024	O2	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2161516)									
EP1900623-012	TB6	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.2	0.1	0.00	No Limit
EP1900623-001	TRIP-2	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2161517)									
EP1900623-024	O2	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2154658)									
EP1900623-001	TRIP-2	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	310	330	3.95	0% - 50%
EP1900623-013	TB7	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	360	390	9.48	0% - 50%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2154660)									
EP1900623-024	O2	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	500	440	12.6	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2154657)									
EP1900623-001	TRIP-2	EK067G: Total Phosphorus as P	----	2	mg/kg	258	277	7.28	0% - 20%
EP1900623-013	TB7	EK067G: Total Phosphorus as P	----	2	mg/kg	282	324	14.0	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2154659)									
EP1900623-024	O2	EK067G: Total Phosphorus as P	----	2	mg/kg	321	289	10.4	0% - 20%
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2161515)									
EP1900623-013	TB7	EK071G: Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP1900623-001	TRIP-2	EK071G: Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	0.1	0.1	0.00	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2161519)									
EP1900623-024	O2	EK071G: Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP003: Total Organic Carbon (TOC) in Soil (QC Lot: 2163031)									
EP1900623-001	TRIP-2	EP003: Total Organic Carbon	----	0.02	%	0.19	0.22	15.8	0% - 50%
EP1900623-015	TB10	EP003: Total Organic Carbon	----	0.02	%	0.26	0.27	0.00	0% - 50%
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QC Lot: 2151737)									
EP1900623-001	TRIP-2	EP080-SD: C6 - C9 Fraction	----	3	mg/kg	<3	<3	0.00	0% - 3%
EP1900623-013	TB7	EP080-SD: C6 - C9 Fraction	----	3	mg/kg	<3	<3	0.00	0% - 3%
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QC Lot: 2151738)									
EP1900623-024	O2	EP080-SD: C6 - C9 Fraction	----	3	mg/kg	<3	<3	0.00	0% - 3%
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QC Lot: 2151740)									
EP1900623-001	TRIP-2	EP071-SD: C10 - C14 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: C15 - C28 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QC Lot: 2151740) - continued									
EP1900623-001	TRIP-2	EP071-SD: C10 - C36 Fraction (sum)	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: C29 - C36 Fraction	----	5	mg/kg	<5	<5	0.00	No Limit
EP1900623-013	TB7	EP071-SD: C10 - C14 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: C15 - C28 Fraction	----	3	mg/kg	4	3	0.00	No Limit
		EP071-SD: C10 - C36 Fraction (sum)	----	3	mg/kg	4	3	28.6	No Limit
		EP071-SD: C29 - C36 Fraction	----	5	mg/kg	<5	<5	0.00	No Limit
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QC Lot: 2151742)									
EP1900623-024	O2	EP071-SD: C10 - C14 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: C15 - C28 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: C10 - C36 Fraction (sum)	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: C29 - C36 Fraction	----	5	mg/kg	<5	<5	0.00	No Limit
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QC Lot: 2151737)									
EP1900623-001	TRIP-2	EP080-SD: C6 - C10 Fraction	C6_C10	3	mg/kg	<3	<3	0.00	0% - 3%
EP1900623-013	TB7	EP080-SD: C6 - C10 Fraction	C6_C10	3	mg/kg	<3	<3	0.00	0% - 3%
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QC Lot: 2151738)									
EP1900623-024	O2	EP080-SD: C6 - C10 Fraction	C6_C10	3	mg/kg	<3	<3	0.00	0% - 3%
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QC Lot: 2151740)									
EP1900623-001	TRIP-2	EP071-SD: >C10 - C16 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: >C16 - C34 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: >C10 - C40 Fraction (sum)	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: >C34 - C40 Fraction	----	5	mg/kg	<5	<5	0.00	No Limit
EP1900623-013	TB7	EP071-SD: >C10 - C16 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: >C16 - C34 Fraction	----	3	mg/kg	7	5	43.6	No Limit
		EP071-SD: >C10 - C40 Fraction (sum)	----	3	mg/kg	7	5	33.3	No Limit
		EP071-SD: >C34 - C40 Fraction	----	5	mg/kg	<5	<5	0.00	No Limit
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QC Lot: 2151742)									
EP1900623-024	O2	EP071-SD: >C10 - C16 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: >C16 - C34 Fraction	----	3	mg/kg	<3	4	35.0	No Limit
		EP071-SD: >C10 - C40 Fraction (sum)	----	3	mg/kg	<3	4	28.6	No Limit
		EP071-SD: >C34 - C40 Fraction	----	5	mg/kg	<5	<5	0.00	No Limit
EP080-SD: BTEXN (QC Lot: 2151737)									
EP1900623-001	TRIP-2	EP080-SD: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Toluene	108-88-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Total Xylenes	----	0.2	mg/kg	<0.5	<0.5	0.00	0% - .2%
		EP080-SD: Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP080-SD: BTEXN (QC Lot: 2151737) - continued									
EP1900623-001	TRIP-2	EP080-SD: Naphthalene	91-20-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
EP1900623-013	TB7	EP080-SD: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Toluene	108-88-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Total Xylenes	----	0.2	mg/kg	<0.5	<0.5	0.00	0% - .2%
		EP080-SD: Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Naphthalene	91-20-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
EP080-SD: BTEXN (QC Lot: 2151738)									
EP1900623-024	O2	EP080-SD: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Toluene	108-88-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Total Xylenes	----	0.2	mg/kg	<0.5	<0.5	0.00	0% - .2%
		EP080-SD: Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Naphthalene	91-20-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
EP090: Organotin Compounds (QC Lot: 2153396)									
EP1900623-001	TRIP-2	EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	0.00	No Limit
EP132B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2151739)									
EP1900623-001	TRIP-2	EP132B-SD: Acenaphthylene	208-96-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Acenaphthene	83-32-9	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Fluorene	86-73-7	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Phenanthrene	85-01-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Anthracene	120-12-7	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Fluoranthene	206-44-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Pyrene	129-00-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benz(a)anthracene	56-55-3	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Chrysene	218-01-9	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(e)pyrene	192-97-2	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(a)pyrene	50-32-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Perylene	198-55-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(g.h.i)perylene	191-24-2	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	<4	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP132B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2151739) - continued									
EP1900623-001	TRIP-2	EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Sum of PAHs	----	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Naphthalene	91-20-3	5	µg/kg	<5	<5	0.00	No Limit
		EP132B-SD: 2-Methylnaphthalene	91-57-6	5	µg/kg	<5	<5	0.00	No Limit
		EP132B-SD: Coronene	191-07-1	5	µg/kg	<5	<5	0.00	No Limit
EP1900623-013	TB7	EP132B-SD: Acenaphthylene	208-96-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Acenaphthene	83-32-9	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Fluorene	86-73-7	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Phenanthrene	85-01-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Anthracene	120-12-7	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Fluoranthene	206-44-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Pyrene	129-00-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benz(a)anthracene	56-55-3	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Chrysene	218-01-9	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(e)pyrene	192-97-2	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(a)pyrene	50-32-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Perylene	198-55-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(g.h.i)perylene	191-24-2	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Sum of PAHs	----	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Naphthalene	91-20-3	5	µg/kg	<5	<5	0.00	No Limit
		EP132B-SD: 2-Methylnaphthalene	91-57-6	5	µg/kg	<5	<5	0.00	No Limit
		EP132B-SD: Coronene	191-07-1	5	µg/kg	<5	<5	0.00	No Limit
EP132B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2151741)									
EP1900623-024	O2	EP132B-SD: Acenaphthylene	208-96-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Acenaphthene	83-32-9	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Fluorene	86-73-7	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Phenanthrene	85-01-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Anthracene	120-12-7	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Fluoranthene	206-44-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Pyrene	129-00-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benz(a)anthracene	56-55-3	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Chrysene	218-01-9	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	<4	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP132B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2151741) - continued									
EP1900623-024	O2	EP132B-SD: Benzo(e)pyrene	192-97-2	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(a)pyrene	50-32-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Perylene	198-55-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(g.h.i)perylene	191-24-2	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Sum of PAHs	----	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Naphthalene	91-20-3	5	µg/kg	<5	<5	0.00	No Limit
		EP132B-SD: 2-Methylnaphthalene	91-57-6	5	µg/kg	<5	<5	0.00	No Limit
		EP132B-SD: Coronene	191-07-1	5	µg/kg	<5	<5	0.00	No Limit
EP202A: Phenoxyacetic Acid Herbicides by LCMS (QC Lot: 2154996)									
EP1900623-001	TRIP-2	EP202: 4-Chlorophenoxy acetic acid	122-88-3	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: 2.4-DB	94-82-6	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Dicamba	1918-00-9	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Mecoprop	93-65-2	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: MCPA	94-74-6	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: 2.4-DP	120-36-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: 2.4-D	94-75-7	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Triclopyr	55335-06-3	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: 2.4.5-TP (Silvex)	93-72-1	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: 2.4.5-T	93-76-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: MCPB	94-81-5	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Picloram	1918-02-1	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Clopyralid	1702-17-6	0.02	mg/kg	<0.02	<0.02	0.00	No Limit
		EP202: Fluroxypyr	69377-81-7	0.02	mg/kg	<0.02	<0.02	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG020T: Total Metals by ICP-MS (QC Lot: 2160693)									
EP1900615-009	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG020T: Total Metals by ICP-MS (QC Lot: 2160693) - continued									
EP1900623-006	RINS MET 1	EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.05	0.04	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	0.07	0.07	0.00	No Limit
EP1900623-006	RINS MET 1	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.002	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 2160694)									
EP1900623-006	RINS MET 1	EG020B-T: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2158881)									
EP1900623-006	RINS MET 1	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EP1900720-005	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2151781)									
EP1900623-026	RINS MET 2	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.01	0.00	No Limit
EP1900650-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.01	0.02	0.00	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2151972)									
EP1900623-026	RINS MET 2	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2151782)									
EP1900623-026	RINS MET 2	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EP1900650-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	9.69	9.55	1.45	0% - 20%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2153292)									
EP1900588-004	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	1.4	1.6	10.8	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2153291)									
EP1900588-004	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.27	0.32	18.5	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2151973)									
EP1900623-026	RINS MET 2	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2151642)									
EP1900623-006	RINS MET 1	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 2151642)									
EP1900623-006	RINS MET 1	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EP080: BTEXN (QC Lot: 2151642)									
EP1900623-006	RINS MET 1	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP080: BTEXN (QC Lot: 2151642) - continued									
EP1900623-006	RINS MET 1	EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QCLot: 2158727)								
EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	2.154 mg/kg	109	80	120
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QCLot: 2158732)								
EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	2.154 mg/kg	106	80	120
EG005-SD: Total Metals in Sediments by ICP-AES (QCLot: 2158728)								
EG005-SD: Aluminium	7429-90-5	50	mg/kg	<50	----	----	----	----
EG005-SD: Iron	7439-89-6	50	mg/kg	<50	----	----	----	----
EG005-SD: Total Metals in Sediments by ICP-AES (QCLot: 2158731)								
EG005-SD: Aluminium	7429-90-5	50	mg/kg	<50	----	----	----	----
EG005-SD: Iron	7439-89-6	50	mg/kg	<50	----	----	----	----
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2158729)								
EG020-SD: Antimony	7440-36-0	0.5	mg/kg	<0.50	----	----	----	----
EG020-SD: Arsenic	7440-38-2	1	mg/kg	<1.00	21.62091 mg/kg	109	74	130
EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	4.6838 mg/kg	105	97	113
EG020-SD: Chromium	7440-47-3	1	mg/kg	<1.0	33.904 mg/kg	128	72	152
EG020-SD: Copper	7440-50-8	1	mg/kg	<1.0	33.782 mg/kg	99.6	76	116
EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	<0.5	----	----	----	----
EG020-SD: Manganese	7439-96-5	10	mg/kg	<10	----	----	----	----
EG020-SD: Nickel	7440-02-0	1	mg/kg	<1.0	51.10088 mg/kg	113	81	135
EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	----	----	----	----
EG020-SD: Vanadium	7440-62-2	2	mg/kg	<2.0	----	----	----	----
EG020-SD: Zinc	7440-66-6	1	mg/kg	<1.0	61.70999 mg/kg	120	81	143
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2158730)								
EG020-SD: Antimony	7440-36-0	0.5	mg/kg	<0.50	----	----	----	----
EG020-SD: Arsenic	7440-38-2	1	mg/kg	<1.00	21.62091 mg/kg	110	74	130
EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	4.6838 mg/kg	106	97	113
EG020-SD: Chromium	7440-47-3	1	mg/kg	<1.0	33.904 mg/kg	133	72	152
EG020-SD: Copper	7440-50-8	1	mg/kg	<1.0	33.782 mg/kg	102	76	116
EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	<0.5	----	----	----	----
EG020-SD: Manganese	7439-96-5	10	mg/kg	<10	----	----	----	----
EG020-SD: Nickel	7440-02-0	1	mg/kg	<1.0	51.10088 mg/kg	115	81	135
EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	----	----	----	----
EG020-SD: Vanadium	7440-62-2	2	mg/kg	<2.0	----	----	----	----
EG020-SD: Zinc	7440-66-6	1	mg/kg	<1.0	61.70999 mg/kg	118	81	143
EK055: Ammonia as N (QCLot: 2161190)								

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EK055: Ammonia as N (QCLot: 2161190) - continued								
EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	50 mg/kg	77.2	70	130
EK055: Ammonia as N (QCLot: 2161191)								
EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	5 mg/kg	109	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2161514)								
EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	2.5 mg/kg	100	89	121
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2161518)								
EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	2.5 mg/kg	101	89	121
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2161516)								
EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	2.5 mg/kg	101	90	112
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2161517)								
EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	2.5 mg/kg	101	90	112
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2154658)								
EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20	1000 mg/kg	86.2	78	112
				<20	100 mg/kg	73.4	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2154660)								
EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20	1000 mg/kg	86.8	78	112
				<20	100 mg/kg	85.5	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2154657)								
EK067G: Total Phosphorus as P	----	2	mg/kg	<2	440 mg/kg	94.4	78	108
				<2	44 mg/kg	79.1	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2154659)								
EK067G: Total Phosphorus as P	----	2	mg/kg	<2	440 mg/kg	94.3	78	108
				<2	44 mg/kg	70.7	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2161515)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	<0.1	2.5 mg/kg	97.7	92	112
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2161519)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	<0.1	2.5 mg/kg	96.1	92	112
EP003: Total Organic Carbon (TOC) in Soil (QCLot: 2163031)								
EP003: Total Organic Carbon	----	0.02	%	<0.02	0.44 %	87.0	70	130
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2151737)								
EP080-SD: C6 - C9 Fraction	----	3	mg/kg	<3	32 mg/kg	107	70	130
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2151738)								
EP080-SD: C6 - C9 Fraction	----	3	mg/kg	<3	32 mg/kg	110	70	130
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2151740)								
EP071-SD: C10 - C14 Fraction	----	3	mg/kg	<3	252 mg/kg	102	70	130
EP071-SD: C15 - C28 Fraction	----	3	mg/kg	<3	634 mg/kg	99.7	70	130

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2151740) - continued								
EP071-SD: C29 - C36 Fraction	----	5	mg/kg	<5	99 mg/kg	92.0	70	130
EP071-SD: C10 - C36 Fraction (sum)	----	3	mg/kg	<3	----	----	----	----
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2151742)								
EP071-SD: C10 - C14 Fraction	----	3	mg/kg	<3	252 mg/kg	111	70	130
EP071-SD: C15 - C28 Fraction	----	3	mg/kg	<3	634 mg/kg	112	70	130
EP071-SD: C29 - C36 Fraction	----	5	mg/kg	<5	99 mg/kg	94.9	70	130
EP071-SD: C10 - C36 Fraction (sum)	----	3	mg/kg	<3	----	----	----	----
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 2151737)								
EP080-SD: C6 - C10 Fraction	C6_C10	3	mg/kg	<3	37 mg/kg	111	70	130
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 2151738)								
EP080-SD: C6 - C10 Fraction	C6_C10	3	mg/kg	<3	37 mg/kg	113	70	130
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 2151740)								
EP071-SD: >C10 - C16 Fraction	----	3	mg/kg	<3	404 mg/kg	103	70	130
EP071-SD: >C16 - C34 Fraction	----	3	mg/kg	<3	567 mg/kg	92.5	70	130
EP071-SD: >C34 - C40 Fraction	----	5	mg/kg	<5	33 mg/kg	97.9	70	130
EP071-SD: >C10 - C40 Fraction (sum)	----	3	mg/kg	<3	----	----	----	----
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 2151742)								
EP071-SD: >C10 - C16 Fraction	----	3	mg/kg	<3	404 mg/kg	115	70	130
EP071-SD: >C16 - C34 Fraction	----	3	mg/kg	<3	567 mg/kg	103	70	130
EP071-SD: >C34 - C40 Fraction	----	5	mg/kg	<5	33 mg/kg	83.7	70	130
EP071-SD: >C10 - C40 Fraction (sum)	----	3	mg/kg	<3	----	----	----	----
EP080-SD: BTEXN (QCLot: 2151737)								
EP080-SD: Benzene	71-43-2	0.2	mg/kg	<0.2	2 mg/kg	105	70	130
EP080-SD: Toluene	108-88-3	0.2	mg/kg	<0.2	2 mg/kg	112	70	130
EP080-SD: Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	2 mg/kg	115	70	130
EP080-SD: meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	4 mg/kg	115	70	130
EP080-SD: ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	2 mg/kg	109	70	130
EP080-SD: Total Xylenes	----	0.2	mg/kg	<0.2	----	----	----	----
EP080-SD: Sum of BTEX	----	0.2	mg/kg	<0.2	----	----	----	----
EP080-SD: Naphthalene	91-20-3	0.2	mg/kg	<0.2	0.5 mg/kg	100	70	130
EP080-SD: BTEXN (QCLot: 2151738)								
EP080-SD: Benzene	71-43-2	0.2	mg/kg	<0.2	2 mg/kg	107	70	130
EP080-SD: Toluene	108-88-3	0.2	mg/kg	<0.2	2 mg/kg	115	70	130
EP080-SD: Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	2 mg/kg	115	70	130
EP080-SD: meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	4 mg/kg	116	70	130
EP080-SD: ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	2 mg/kg	111	70	130

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP080-SD: BTEXN (QCLot: 2151738) - continued								
EP080-SD: Total Xylenes	----	0.2	mg/kg	<0.2	----	----	----	----
EP080-SD: Sum of BTEX	----	0.2	mg/kg	<0.2	----	----	----	----
EP080-SD: Naphthalene	91-20-3	0.2	mg/kg	<0.2	0.5 mg/kg	108	70	130
EP090: Organotin Compounds (QCLot: 2153396)								
EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	1.25 µgSn/kg	95.4	52	139
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2151739)								
EP132B-SD: Naphthalene	91-20-3	5	µg/kg	<5	25 µg/kg	83.8	55	131
EP132B-SD: 2-Methylnaphthalene	91-57-6	5	µg/kg	<5	----	----	----	----
EP132B-SD: Acenaphthylene	208-96-8	4	µg/kg	<4	25 µg/kg	88.5	64	110
EP132B-SD: Acenaphthene	83-32-9	4	µg/kg	<4	25 µg/kg	82.3	62	112
EP132B-SD: Fluorene	86-73-7	4	µg/kg	<4	25 µg/kg	89.1	64	118
EP132B-SD: Phenanthrene	85-01-8	4	µg/kg	<4	25 µg/kg	94.5	59	117
EP132B-SD: Anthracene	120-12-7	4	µg/kg	<4	25 µg/kg	95.4	69	111
EP132B-SD: Fluoranthene	206-44-0	4	µg/kg	<4	25 µg/kg	94.9	66	118
EP132B-SD: Pyrene	129-00-0	4	µg/kg	<4	25 µg/kg	94.1	70	116
EP132B-SD: Benz(a)anthracene	56-55-3	4	µg/kg	<4	25 µg/kg	94.7	59	121
EP132B-SD: Chrysene	218-01-9	4	µg/kg	<4	25 µg/kg	85.3	68	116
EP132B-SD: Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	<4	25 µg/kg	96.7	51	107
EP132B-SD: Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	25 µg/kg	102	52	118
EP132B-SD: Benzo(e)pyrene	192-97-2	4	µg/kg	<4	----	----	----	----
EP132B-SD: Benzo(a)pyrene	50-32-8	4	µg/kg	<4	25 µg/kg	99.9	55	111
EP132B-SD: Perylene	198-55-0	4	µg/kg	<4	----	----	----	----
EP132B-SD: Benzo(g.h.i)perylene	191-24-2	4	µg/kg	<4	25 µg/kg	83.1	62	106
EP132B-SD: Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	25 µg/kg	96.2	35	141
EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	25 µg/kg	105	48	122
EP132B-SD: Coronene	191-07-1	5	µg/kg	<5	----	----	----	----
EP132B-SD: Sum of PAHs	----	4	µg/kg	<4	----	----	----	----
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2151741)								
EP132B-SD: Naphthalene	91-20-3	5	µg/kg	<5	25 µg/kg	87.2	55	131
EP132B-SD: 2-Methylnaphthalene	91-57-6	5	µg/kg	<5	----	----	----	----
EP132B-SD: Acenaphthylene	208-96-8	4	µg/kg	<4	25 µg/kg	89.4	64	110
EP132B-SD: Acenaphthene	83-32-9	4	µg/kg	<4	25 µg/kg	89.2	62	112
EP132B-SD: Fluorene	86-73-7	4	µg/kg	<4	25 µg/kg	93.0	64	118
EP132B-SD: Phenanthrene	85-01-8	4	µg/kg	<4	25 µg/kg	83.8	59	117
EP132B-SD: Anthracene	120-12-7	4	µg/kg	<4	25 µg/kg	83.0	69	111
EP132B-SD: Fluoranthene	206-44-0	4	µg/kg	<4	25 µg/kg	97.4	66	118
EP132B-SD: Pyrene	129-00-0	4	µg/kg	<4	25 µg/kg	110	70	116

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2151741) - continued								
EP132B-SD: Benz(a)anthracene	56-55-3	4	µg/kg	<4	25 µg/kg	82.3	59	121
EP132B-SD: Chrysene	218-01-9	4	µg/kg	<4	25 µg/kg	93.9	68	116
EP132B-SD: Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	<4	25 µg/kg	98.0	51	107
EP132B-SD: Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	25 µg/kg	79.2	52	118
EP132B-SD: Benzo(e)pyrene	192-97-2	4	µg/kg	<4	----	----	----	----
EP132B-SD: Benzo(a)pyrene	50-32-8	4	µg/kg	<4	25 µg/kg	69.3	55	111
EP132B-SD: Perylene	198-55-0	4	µg/kg	<4	----	----	----	----
EP132B-SD: Benzo(g.h.i)perylene	191-24-2	4	µg/kg	<4	25 µg/kg	66.3	62	106
EP132B-SD: Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	25 µg/kg	54.2	35	141
EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	25 µg/kg	63.4	48	122
EP132B-SD: Coronene	191-07-1	5	µg/kg	<5	----	----	----	----
EP132B-SD: Sum of PAHs	----	4	µg/kg	<4	----	----	----	----
EP202A: Phenoxyacetic Acid Herbicides by LCMS (QCLot: 2154996)								
EP202: 4-Chlorophenoxy acetic acid	122-88-3	0.02	mg/kg	<0.02	0.1 mg/kg	66.2	54	128
EP202: 2.4-DB	94-82-6	0.02	mg/kg	<0.02	0.1 mg/kg	93.9	46	130
EP202: Dicamba	1918-00-9	0.02	mg/kg	<0.02	0.1 mg/kg	60.2	52	135
EP202: Mecoprop	93-65-2	0.02	mg/kg	<0.02	0.1 mg/kg	79.8	60	130
EP202: MCPA	94-74-6	0.02	mg/kg	<0.02	0.1 mg/kg	71.0	57	131
EP202: 2.4-DP	120-36-5	0.02	mg/kg	<0.02	0.1 mg/kg	118	50	141
EP202: 2.4-D	94-75-7	0.02	mg/kg	<0.02	0.1 mg/kg	71.0	69	131
EP202: Triclopyr	55335-06-3	0.02	mg/kg	<0.02	0.1 mg/kg	93.0	51	141
EP202: 2.4.5-TP (Silvex)	93-72-1	0.02	mg/kg	<0.02	0.1 mg/kg	81.5	41	126
EP202: 2.4.5-T	93-76-5	0.02	mg/kg	<0.02	0.1 mg/kg	88.8	57	139
EP202: MCPB	94-81-5	0.02	mg/kg	<0.02	0.1 mg/kg	64.3	39	137
EP202: Picloram	1918-02-1	0.02	mg/kg	<0.02	0.1 mg/kg	63.9	49	129
EP202: Clopyralid	1702-17-6	0.02	mg/kg	<0.02	0.1 mg/kg	60.2	49	106
EP202: Fluroxypyr	69377-81-7	0.02	mg/kg	<0.02	0.1 mg/kg	67.1	53	128

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EG020T: Total Metals by ICP-MS (QCLot: 2160693)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	102	84	120
EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	0.02 mg/L	99.4	83	120
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	101	85	120
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	98.8	84	120
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	96.7	85	120
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	101	84	120

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EG020T: Total Metals by ICP-MS (QCLot: 2160693) - continued								
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	98.2	83	120
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	101	85	120
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	96.9	83	120
EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	99.1	86	120
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	99.1	84	120
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	99.5	77	120
EG020T: Total Metals by ICP-MS (QCLot: 2160694)								
EG020B-T: Silver	7440-22-4	0.001	mg/L	<0.001	0.02 mg/L	104	52	120
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2158881)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	104	87	115
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2151781)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	1 mg/L	92.4	87	115
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2151972)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	102	86	112
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2151782)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	95.6	92	112
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2153292)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	89.6	82	110
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2153291)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	88.5	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2151973)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	102	87	115
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 2151720)								
EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	10 µg/L	44.3	42	99
EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	10 µg/L	48.2	36	113
EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	10 µg/L	46.4	36	102
EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	10 µg/L	49.4	34	113
EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	10 µg/L	58.2	37	115
EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	10 µg/L	51.8	46	109
EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	10 µg/L	60.6	40	124
EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	10 µg/L	61.9	40	123
EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	10 µg/L	53.4	40	126
EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	10 µg/L	58.6	46	121
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	10 µg/L	51.9	43	123
EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	10 µg/L	51.6	47	121
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	10 µg/L	57.1	45	123

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 2151720) - continued								
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	10 µg/L	59.8	39	120
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	1	µg/L	<1.0	10 µg/L	58.5	39	119
EP075(SIM): Benzo(g.h.i)perylene	191-24-2	1	µg/L	<1.0	10 µg/L	58.5	40	123
EP075(SIM): Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2151642)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	320 µg/L	110	74	113
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2151721)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	385 µg/L	60.0	35	95
EP071: C15 - C28 Fraction	----	100	µg/L	<100	385 µg/L	71.5	34	111
EP071: C29 - C36 Fraction	----	50	µg/L	<50	380 µg/L	71.5	34	105
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2151642)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	370 µg/L	113	74	115
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2151721)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	398 µg/L	63.4	37	99
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	597 µg/L	70.4	35	108
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	168 µg/L	67.9	11	117
EP080: BTEXN (QCLot: 2151642)								
EP080: Benzene	71-43-2	1	µg/L	<1	20 µg/L	108	84	114
EP080: Toluene	108-88-3	2	µg/L	<2	20 µg/L	108	81	115
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	20 µg/L	106	84	113
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	40 µg/L	104	84	114
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	20 µg/L	102	87	111
EP080: Naphthalene	91-20-3	5	µg/L	<5	5 µg/L	95.3	77	118

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Recovery Limits (%): Low	Recovery Limits (%): High
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QCLot: 2158727)							
EP1900623-002	TRIP-3	EG035T-LL: Mercury	7439-97-6	10 mg/kg	96.7	70	130
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QCLot: 2158732)							
EP1900623-025	O3	EG035T-LL: Mercury	7439-97-6	10 mg/kg	93.8	70	130
EG005-SD: Total Metals in Sediments by ICP-AES (QCLot: 2158728)							

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005-SD: Total Metals in Sediments by ICP-AES (QCLot: 2158728) - continued							
EP1900623-002	TRIP-3	EG005-SD: Aluminium	7429-90-5	50 mg/kg	# Not Determined	70	130
		EG005-SD: Iron	7439-89-6	50 mg/kg	# Not Determined	70	130
EG005-SD: Total Metals in Sediments by ICP-AES (QCLot: 2158731)							
EP1900623-025	O3	EG005-SD: Aluminium	7429-90-5	50 mg/kg	# Not Determined	70	130
		EG005-SD: Iron	7439-89-6	50 mg/kg	# Not Determined	70	130
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2158729)							
EP1900623-002	TRIP-3	EG020-SD: Arsenic	7440-38-2	50 mg/kg	96.3	70	130
		EG020-SD: Cadmium	7440-43-9	50 mg/kg	97.4	70	130
		EG020-SD: Chromium	7440-47-3	50 mg/kg	99.1	70	130
		EG020-SD: Copper	7440-50-8	50 mg/kg	91.0	70	130
		EG020-SD: Nickel	7440-02-0	50 mg/kg	88.8	70	130
		EG020-SD: Zinc	7440-66-6	50 mg/kg	98.7	70	130
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2158730)							
EP1900623-025	O3	EG020-SD: Arsenic	7440-38-2	50 mg/kg	98.2	70	130
		EG020-SD: Cadmium	7440-43-9	50 mg/kg	97.2	70	130
		EG020-SD: Chromium	7440-47-3	50 mg/kg	96.7	70	130
		EG020-SD: Copper	7440-50-8	50 mg/kg	90.8	70	130
		EG020-SD: Nickel	7440-02-0	50 mg/kg	90.9	70	130
		EG020-SD: Zinc	7440-66-6	50 mg/kg	95.1	70	130
EK055: Ammonia as N (QCLot: 2161190)							
EP1900623-002	TRIP-3	EK055: Ammonia as N	7664-41-7	50 mg/kg	112	70	130
EK055: Ammonia as N (QCLot: 2161191)							
EP1900623-025	O3	EK055: Ammonia as N	7664-41-7	50 mg/kg	78.3	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2161514)							
EP1900623-002	TRIP-3	EK057G: Nitrite as N (Sol.)	14797-65-0	2.5 mg/kg	98.4	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2161518)							
EP1900623-025	O3	EK057G: Nitrite as N (Sol.)	14797-65-0	2.5 mg/kg	105	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2161516)							
EP1900623-002	TRIP-3	EK059G: Nitrite + Nitrate as N (Sol.)	----	2.5 mg/kg	95.5	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2161517)							
EP1900623-025	O3	EK059G: Nitrite + Nitrate as N (Sol.)	----	2.5 mg/kg	104	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2154658)							

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2154658) - continued							
EP1900623-002	TRIP-3	EK061G: Total Kjeldahl Nitrogen as N	----	500 mg/kg	110	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2154660)							
EP1900623-025	O3	EK061G: Total Kjeldahl Nitrogen as N	----	500 mg/kg	81.5	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2154657)							
EP1900623-002	TRIP-3	EK067G: Total Phosphorus as P	----	100 mg/kg	88.3	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2154659)							
EP1900623-025	O3	EK067G: Total Phosphorus as P	----	100 mg/kg	88.2	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2161515)							
EP1900623-002	TRIP-3	EK071G: Reactive Phosphorus as P	14265-44-2	2.5 mg/kg	98.4	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2161519)							
EP1900623-025	O3	EK071G: Reactive Phosphorus as P	14265-44-2	2.5 mg/kg	99.4	70	130
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2151737)							
EP1900623-002	TRIP-3	EP080-SD: C6 - C9 Fraction	----	32 mg/kg	71.8	70	130
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2151738)							
EP1900623-025	O3	EP080-SD: C6 - C9 Fraction	----	32 mg/kg	72.2	70	130
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2151740)							
EP1900623-002	TRIP-3	EP071-SD: C10 - C14 Fraction	----	252 mg/kg	105	70	130
		EP071-SD: C15 - C28 Fraction	----	634 mg/kg	105	70	130
		EP071-SD: C29 - C36 Fraction	----	99 mg/kg	87.3	70	130
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2151742)							
EP1900623-025	O3	EP071-SD: C10 - C14 Fraction	----	252 mg/kg	102	70	130
		EP071-SD: C15 - C28 Fraction	----	634 mg/kg	97.5	70	130
		EP071-SD: C29 - C36 Fraction	----	99 mg/kg	88.8	70	130
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 2151737)							
EP1900623-002	TRIP-3	EP080-SD: C6 - C10 Fraction	C6_C10	37 mg/kg	70.6	70	130
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 2151738)							
EP1900623-025	O3	EP080-SD: C6 - C10 Fraction	C6_C10	37 mg/kg	70.4	70	130
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 2151740)							
EP1900623-002	TRIP-3	EP071-SD: >C10 - C16 Fraction	----	404 mg/kg	109	70	130
		EP071-SD: >C16 - C34 Fraction	----	567 mg/kg	95.4	70	130
		EP071-SD: >C34 - C40 Fraction	----	33 mg/kg	74.9	70	130
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 2151742)							
EP1900623-025	O3	EP071-SD: >C10 - C16 Fraction	----	404 mg/kg	102	70	130
		EP071-SD: >C16 - C34 Fraction	----	567 mg/kg	90.2	70	130

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 2151742) - continued							
EP1900623-025	O3	EP071-SD: >C34 - C40 Fraction	----	33 mg/kg	92.6	70	130
EP080-SD: BTEXN (QCLot: 2151737)							
EP1900623-002	TRIP-3	EP080-SD: Benzene	71-43-2	2 mg/kg	93.0	70	130
		EP080-SD: Toluene	108-88-3	2 mg/kg	101	70	130
EP080-SD: BTEXN (QCLot: 2151738)							
EP1900623-025	O3	EP080-SD: Benzene	71-43-2	2 mg/kg	90.5	70	130
		EP080-SD: Toluene	108-88-3	2 mg/kg	94.9	70	130
EP090: Organotin Compounds (QCLot: 2153396)							
EP1900623-002	TRIP-3	EP090: Tributyltin	56573-85-4	1.25 µgSn/kg	98.5	20	130
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2151739)							
EP1900623-002	TRIP-3	EP132B-SD: Naphthalene	91-20-3	25 µg/kg	122	70	130
		EP132B-SD: Acenaphthylene	208-96-8	25 µg/kg	90.7	70	130
		EP132B-SD: Acenaphthene	83-32-9	25 µg/kg	94.2	70	130
		EP132B-SD: Fluorene	86-73-7	25 µg/kg	95.5	70	130
		EP132B-SD: Phenanthrene	85-01-8	25 µg/kg	123	70	130
		EP132B-SD: Anthracene	120-12-7	25 µg/kg	81.5	70	130
		EP132B-SD: Fluoranthene	206-44-0	25 µg/kg	120	70	130
		EP132B-SD: Pyrene	129-00-0	25 µg/kg	116	70	130
		EP132B-SD: Benz(a)anthracene	56-55-3	25 µg/kg	116	70	130
		EP132B-SD: Chrysene	218-01-9	25 µg/kg	82.8	70	130
		EP132B-SD: Benzo(b+j)fluoranthene	205-99-2 205-82-3	25 µg/kg	90.8	70	130
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	25 µg/kg	81.9	70	130
		EP132B-SD: Benzo(a)pyrene	50-32-8	25 µg/kg	102	70	130
		EP132B-SD: Benzo(g.h.i)perylene	191-24-2	25 µg/kg	92.0	70	130
		EP132B-SD: Dibenz(a.h)anthracene	53-70-3	25 µg/kg	92.3	70	130
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	25 µg/kg	107	70	130
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2151741)							
EP1900623-025	O3	EP132B-SD: Naphthalene	91-20-3	25 µg/kg	74.7	70	130
		EP132B-SD: Acenaphthylene	208-96-8	25 µg/kg	95.9	70	130
		EP132B-SD: Acenaphthene	83-32-9	25 µg/kg	96.7	70	130
		EP132B-SD: Fluorene	86-73-7	25 µg/kg	103	70	130
		EP132B-SD: Phenanthrene	85-01-8	25 µg/kg	102	70	130
		EP132B-SD: Anthracene	120-12-7	25 µg/kg	96.9	70	130
		EP132B-SD: Fluoranthene	206-44-0	25 µg/kg	126	70	130
		EP132B-SD: Pyrene	129-00-0	25 µg/kg	108	70	130
		EP132B-SD: Benz(a)anthracene	56-55-3	25 µg/kg	83.6	70	130
		EP132B-SD: Chrysene	218-01-9	25 µg/kg	71.0	70	130

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	Matrix Spike (MS) Report: SpikeRecovery(%) MS	Recovery Limits (%) Low	Recovery Limits (%) High
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2151741) - continued							
EP1900623-025	O3	EP132B-SD: Benzo(b+j)fluoranthene	205-99-2 205-82-3	25 µg/kg	81.3	70	130
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	25 µg/kg	74.6	70	130
		EP132B-SD: Benzo(a)pyrene	50-32-8	25 µg/kg	106	70	130
		EP132B-SD: Benzo(g.h.i)perylene	191-24-2	25 µg/kg	89.6	70	130
		EP132B-SD: Dibenz(a.h)anthracene	53-70-3	25 µg/kg	72.6	70	130
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	25 µg/kg	76.3	70	130
EP202A: Phenoxyacetic Acid Herbicides by LCMS (QCLot: 2154996)							
EP1900623-001	TRIP-2	EP202: Mecoprop	93-65-2	0.1 mg/kg	78.7	60	140
		EP202: MCPA	94-74-6	0.1 mg/kg	75.3	57	143
		EP202: 2.4-D	94-75-7	0.1 mg/kg	75.6	68	139
		EP202: Triclopyr	55335-06-3	0.1 mg/kg	92.1	51	145
		EP202: 2.4.5-T	93-76-5	0.1 mg/kg	88.7	57	142
		EP202: Picloram	1918-02-1	0.1 mg/kg	75.0	49	138
		EP202: Clopyralid	1702-17-6	0.1 mg/kg	68.2	49	149

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	Matrix Spike (MS) Report: SpikeRecovery(%) MS	Recovery Limits (%) Low	Recovery Limits (%) High
EG020T: Total Metals by ICP-MS (QCLot: 2160693)							
EP1900671-001	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	117	70	130
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	118	70	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	109	70	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	118	70	130
		EG020A-T: Copper	7440-50-8	1 mg/L	114	70	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	116	70	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	112	70	130
		EG020A-T: Vanadium	7440-62-2	1 mg/L	110	70	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	118	70	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2158881)							
EP1900623-026	RINS MET 2	EG035T: Mercury	7439-97-6	0.01 mg/L	109	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2151781)							
EP1900625-001	Anonymous	EK055G: Ammonia as N	7664-41-7	1 mg/L	89.6	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2151972)							
EP1900623-006	RINS MET 1	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	105	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2151782)							
EP1900625-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	96.2	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2153292)							
EP1900588-004	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	25 mg/L	97.6	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2153291)							
EP1900588-004	Anonymous	EK067G: Total Phosphorus as P	----	5 mg/L	114	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2151973)							
EP1900623-006	RINS MET 1	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	102	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2151642)							
EP1900623-027	RINS VOL 2	EP080: C6 - C9 Fraction	----	240 µg/L	88.9	77	137
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2151642)							
EP1900623-027	RINS VOL 2	EP080: C6 - C10 Fraction	C6_C10	290 µg/L	77.1	77	137
EP080: BTEXN (QCLot: 2151642)							
EP1900623-027	RINS VOL 2	EP080: Benzene	71-43-2	20 µg/L	99.2	77	122
		EP080: Toluene	108-88-3	20 µg/L	98.9	74	126

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EP1902034**	Page	: 1 of 11
Client	: **WA MARINE PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: Claudio Deldeo	Contact	: Marnie Thomsett
Address	: SUITE 5, 5/18 GRIFFON DRIVE PO BOX 1370 DUNSBOROUGH, PERTH WA, AUSTRALIA 6281	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1311
Project	: 18WAU-0002 Mardie Project: Sediment Sampling	Date Samples Received	: 06-Mar-2019
Order number	:	Date Analysis Commenced	: 07-Mar-2019
C-O-C number	: ----	Issue Date	: 14-Mar-2019
Sampler	: ----		
Site	: ----		
Quote number	: EP/1145/18		
No. of samples received	: 9		
No. of samples analysed	: 8		

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

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

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA
Dianne Blane	Laboratory Coordinator (2IC)	Newcastle - Inorganics, Mayfield West, NSW
Efua Wilson	Metals Chemist	Perth Inorganics, Wangara, WA
Franco Lentini		Sydney Organics, Smithfield, NSW
Indra Astuty	Instrument Chemist	Perth Inorganics, Wangara, WA
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Santusha Pandra	Organic Chemist	Brisbane Organics, Stafford, QLD
Vanessa Nguyen	Organic Chemist	Perth Organics, Wangara, WA

General Comments

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

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

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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES (QC Lot: 2226450)									
EP1902034-002	RF2	EG005-SD: Aluminium	7429-90-5	50	mg/kg	7840	8110	3.38	0% - 20%
		EG005-SD: Iron	7439-89-6	50	mg/kg	36000	34100	5.32	0% - 20%
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QC Lot: 2226449)									
EP1902034-002	RF2	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
EA026 : Chromium Reducible Sulfur (QC Lot: 2232756)									
EP1902034-002	RF2	EA026: Chromium Reducible Sulphur	----	0.005	%	0.023	0.024	0.00	No Limit
EA037: Ass Field Screening Analysis (QC Lot: 2232780)									
EP1902034-002	RF2	EA037: pH (F)	----	0.1	pH Unit	8.0	7.9	1.76	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	7.0	7.0	0.00	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 2221515)									
EP1901980-001	Anonymous	EA055: Moisture Content	----	0.1	%	0.9	0.8	0.00	No Limit
EG020-SD: Total Metals in Sediments by ICPMS (QC Lot: 2226451)									
EP1902034-002	RF2	EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	0.1	<0.1	0.00	No Limit
		EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
		EG020-SD: Antimony	7440-36-0	0.5	mg/kg	<0.50	<0.50	0.00	No Limit
		EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	8.3	7.9	4.62	0% - 50%
		EG020-SD: Arsenic	7440-38-2	1	mg/kg	23.8	19.6	19.6	0% - 20%
		EG020-SD: Chromium	7440-47-3	1	mg/kg	31.2	32.0	2.78	0% - 20%
		EG020-SD: Copper	7440-50-8	1	mg/kg	8.2	8.3	1.51	No Limit
		EG020-SD: Nickel	7440-02-0	1	mg/kg	14.1	14.0	1.23	0% - 50%
		EG020-SD: Zinc	7440-66-6	1	mg/kg	16.7	17.0	1.46	0% - 50%
		EG020-SD: Manganese	7439-96-5	10	mg/kg	291	354	19.3	0% - 20%
		EG020-SD: Vanadium	7440-62-2	2	mg/kg	44.7	42.3	5.51	0% - 20%
EK055: Ammonia as N (QC Lot: 2221495)									

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EK055: Ammonia as N (QC Lot: 2221495) - continued									
EP1901901-005	Anonymous	EK055: Ammonia as N	7664-41-7	20	mg/kg	720	730	0.00	0% - 20%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2221520)									
EP1902034-002	RF2	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2221522)									
EP1902034-002	RF2	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.1	0.3	83.1	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2227872)									
EP1902034-002	RF2	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	380	440	13.1	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2227871)									
EP1902034-002	RF2	EK067G: Total Phosphorus as P	----	2	mg/kg	466	417	11.2	0% - 20%
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2221521)									
EP1902034-002	RF2	EK071G: Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP003: Total Organic Carbon (TOC) in Soil (QC Lot: 2229484)									
EB1905698-001	Anonymous	EP003: Total Organic Carbon	----	0.02	%	1.04	1.01	2.67	0% - 20%
EB1905698-011	Anonymous	EP003: Total Organic Carbon	----	0.02	%	2.25	2.30	2.27	0% - 20%
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2221904)									
EP1902034-008	TBS36	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 2221904)									
EP1902034-008	TBS36	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
EP080: BTEXN (QC Lot: 2221904)									
EP1902034-008	TBS36	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QC Lot: 2221903)									
EP1902034-002	RF2	EP080-SD: C6 - C9 Fraction	----	3	mg/kg	<3	<3	0.00	0% - 3%
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QC Lot: 2221905)									
EP1902034-002	RF2	EP071-SD: C10 - C14 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: C15 - C28 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: C10 - C36 Fraction (sum)	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: C29 - C36 Fraction	----	5	mg/kg	<5	<5	0.00	No Limit
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QC Lot: 2221903)									
EP1902034-002	RF2	EP080-SD: C6 - C10 Fraction	C6_C10	3	mg/kg	<3	<3	0.00	0% - 3%
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QC Lot: 2221905)									
EP1902034-002	RF2	EP071-SD: >C10 - C16 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: >C16 - C34 Fraction	----	3	mg/kg	<3	<3	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QC Lot: 2221905) - continued									
EP1902034-002	RF2	EP071-SD: >C10 - C40 Fraction (sum)	----	3	mg/kg	<3	<3	0.00	No Limit
		EP071-SD: >C34 - C40 Fraction	----	5	mg/kg	<5	<5	0.00	No Limit
EP080-SD: BTEXN (QC Lot: 2221903)									
EP1902034-002	RF2	EP080-SD: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Toluene	108-88-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Total Xylenes	----	0.2	mg/kg	<0.5	<0.5	0.00	0% - .2%
		EP080-SD: Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
		EP080-SD: Naphthalene	91-20-3	0.2	mg/kg	<0.2	<0.2	0.00	0% - .2%
EP090: Organotin Compounds (QC Lot: 2222229)									
EP1902034-002	RF2	EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	0.00	No Limit
		EP090: Monobutyltin	78763-54-9	1	µgSn/kg	<1	<1	0.00	No Limit
		EP090: Dibutyltin	1002-53-5	1	µgSn/kg	<1	<1	0.00	No Limit
EP132B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2221906)									
EP1902034-002	RF2	EP132B-SD: Acenaphthylene	208-96-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Acenaphthene	83-32-9	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Fluorene	86-73-7	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Phenanthrene	85-01-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Anthracene	120-12-7	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Fluoranthene	206-44-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Pyrene	129-00-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benz(a)anthracene	56-55-3	4	µg/kg	<4	7	54.1	No Limit
		EP132B-SD: Chrysene	218-01-9	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	<4	6	36.8	No Limit
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(e)pyrene	192-97-2	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(a)pyrene	50-32-8	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Perylene	198-55-0	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Benzo(g.h.i)perylene	191-24-2	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	0.00	No Limit
		EP132B-SD: Sum of PAHs	----	4	µg/kg	<4	13	106	No Limit
		EP132B-SD: Naphthalene	91-20-3	5	µg/kg	<5	<5	0.00	No Limit
		EP132B-SD: 2-Methylnaphthalene	91-57-6	5	µg/kg	<5	<5	0.00	No Limit
		EP132B-SD: Coronene	191-07-1	5	µg/kg	<5	<5	0.00	No Limit
EP202A: Phenoxyacetic Acid Herbicides by LCMS (QC Lot: 2223949)									

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP202A: Phenoxyacetic Acid Herbicides by LCMS (QC Lot: 2223949) - continued									
EP1901901-005	Anonymous	EP202: 4-Chlorophenoxy acetic acid	122-88-3	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP202: 2.4-DB	94-82-6	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP202: Dicamba	1918-00-9	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP202: Mecoprop	93-65-2	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP202: MCPA	94-74-6	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP202: 2.4-DP	120-36-5	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP202: 2.4-D	94-75-7	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP202: Triclopyr	55335-06-3	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP202: 2.4.5-TP (Silvex)	93-72-1	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP202: 2.4.5-T	93-76-5	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP202: MCPB	94-81-5	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP202: Picloram	1918-02-1	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP202: Clopyralid	1702-17-6	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP202: Fluroxypyr	69377-81-7	0.02	mg/kg	<0.04	<0.04	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES (QCLot: 2226450)								
EG005-SD: Aluminium	7429-90-5	50	mg/kg	<50	----	----	----	----
EG005-SD: Iron	7439-89-6	50	mg/kg	<50	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QCLot: 2226449)								
EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	2.154 mg/kg	104	80	120
EA026 : Chromium Reducible Sulfur (QCLot: 2232756)								
EA026: Chromium Reducible Sulphur	----	0.005	%	<0.005	0.202 %	96.8	70	130
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2226451)								
EG020-SD: Antimony	7440-36-0	0.5	mg/kg	<0.50	----	----	----	----
EG020-SD: Arsenic	7440-38-2	1	mg/kg	<1.00	21.62091 mg/kg	102	74	130
EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	4.6838 mg/kg	101	97	113
EG020-SD: Chromium	7440-47-3	1	mg/kg	<1.0	42.22 mg/kg	95.9	72	152
EG020-SD: Copper	7440-50-8	1	mg/kg	<1.0	33.782 mg/kg	84.3	76	116
EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	<0.5	----	----	----	----
EG020-SD: Manganese	7439-96-5	10	mg/kg	<10	----	----	----	----
EG020-SD: Nickel	7440-02-0	1	mg/kg	<1.0	51.10088 mg/kg	114	81	135
EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	----	----	----	----
EG020-SD: Vanadium	7440-62-2	2	mg/kg	<2.0	----	----	----	----
EG020-SD: Zinc	7440-66-6	1	mg/kg	<1.0	61.70999 mg/kg	103	81	143
EK055: Ammonia as N (QCLot: 2221495)								
EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	50 mg/kg	93.6	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2221520)								
EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	2.5 mg/kg	97.5	89	121
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2221522)								
EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	2.5 mg/kg	96.4	90	112
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2227872)								
EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20	1000 mg/kg	85.1	78	112
				<20	100 mg/kg	91.8	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2227871)								
EK067G: Total Phosphorus as P	----	2	mg/kg	<2	440 mg/kg	81.0	78	108
				<2	44 mg/kg	70.2	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2221521)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	<0.1	2.5 mg/kg	96.9	92	112
EP003: Total Organic Carbon (TOC) in Soil (QCLot: 2229484)								

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EP003: Total Organic Carbon (TOC) in Soil (QCLot: 2229484) - continued								
EP003: Total Organic Carbon	----	0.02	%	<0.02	1.94 %	90.1	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2221904)								
EP080: C6 - C9 Fraction	----	10	mg/kg	<10	32 mg/kg	91.4	66	122
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2221904)								
EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	37 mg/kg	88.0	66	122
EP080: BTEXN (QCLot: 2221904)								
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	2 mg/kg	89.9	72	122
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	2 mg/kg	95.9	75	119
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	2 mg/kg	93.2	73	121
EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	4 mg/kg	91.9	74	122
EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	2 mg/kg	89.1	75	121
EP080: Naphthalene	91-20-3	1	mg/kg	<1	0.5 mg/kg	121	64	126
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2221903)								
EP080-SD: C6 - C9 Fraction	----	3	mg/kg	<3	32 mg/kg	105	70	130
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2221905)								
EP071-SD: C10 - C14 Fraction	----	3	mg/kg	<3	252 mg/kg	86.3	70	130
EP071-SD: C15 - C28 Fraction	----	3	mg/kg	<3	634 mg/kg	84.2	70	130
EP071-SD: C29 - C36 Fraction	----	5	mg/kg	<5	99 mg/kg	77.6	70	130
EP071-SD: C10 - C36 Fraction (sum)	----	3	mg/kg	<3	----	----	----	----
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 2221903)								
EP080-SD: C6 - C10 Fraction	C6_C10	3	mg/kg	<3	37 mg/kg	104	70	130
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 2221905)								
EP071-SD: >C10 - C16 Fraction	----	3	mg/kg	<3	404 mg/kg	87.2	70	130
EP071-SD: >C16 - C34 Fraction	----	3	mg/kg	<3	567 mg/kg	78.4	70	130
EP071-SD: >C34 - C40 Fraction	----	5	mg/kg	<5	33 mg/kg	72.3	70	130
EP071-SD: >C10 - C40 Fraction (sum)	----	3	mg/kg	<3	----	----	----	----
EP080-SD: BTEXN (QCLot: 2221903)								
EP080-SD: Benzene	71-43-2	0.2	mg/kg	<0.2	2 mg/kg	122	70	130
EP080-SD: Toluene	108-88-3	0.2	mg/kg	<0.2	2 mg/kg	106	70	130
EP080-SD: Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	2 mg/kg	106	70	130
EP080-SD: meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	4 mg/kg	106	70	130
EP080-SD: ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	2 mg/kg	103	70	130
EP080-SD: Total Xylenes	----	0.2	mg/kg	<0.2	----	----	----	----
EP080-SD: Sum of BTEX	----	0.2	mg/kg	<0.2	----	----	----	----
EP080-SD: Naphthalene	91-20-3	0.2	mg/kg	<0.2	0.5 mg/kg	102	70	130

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP090: Organotin Compounds (QCLot: 2222229)								
EP090: Monobutyltin	78763-54-9	1	µgSn/kg	<1	1.25 µgSn/kg	# 182	36	128
EP090: Dibutyltin	1002-53-5	1	µgSn/kg	<1	1.25 µgSn/kg	# 145	42	132
EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	1.25 µgSn/kg	95.7	52	139
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2221906)								
EP132B-SD: Naphthalene	91-20-3	5	µg/kg	<5	25 µg/kg	78.9	55	131
EP132B-SD: 2-Methylnaphthalene	91-57-6	5	µg/kg	<5	----	----	----	----
EP132B-SD: Acenaphthylene	208-96-8	4	µg/kg	<4	25 µg/kg	76.3	64	110
EP132B-SD: Acenaphthene	83-32-9	4	µg/kg	<4	25 µg/kg	77.8	62	112
EP132B-SD: Fluorene	86-73-7	4	µg/kg	<4	25 µg/kg	75.0	64	118
EP132B-SD: Phenanthrene	85-01-8	4	µg/kg	<4	25 µg/kg	87.8	59	117
EP132B-SD: Anthracene	120-12-7	4	µg/kg	<4	25 µg/kg	72.4	69	111
EP132B-SD: Fluoranthene	206-44-0	4	µg/kg	<4	25 µg/kg	87.0	66	118
EP132B-SD: Pyrene	129-00-0	4	µg/kg	<4	25 µg/kg	86.0	70	116
EP132B-SD: Benz(a)anthracene	56-55-3	4	µg/kg	<4	25 µg/kg	60.5	59	121
EP132B-SD: Chrysene	218-01-9	4	µg/kg	<4	25 µg/kg	108	68	116
EP132B-SD: Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	<4	25 µg/kg	73.8	51	107
EP132B-SD: Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	25 µg/kg	100	52	118
EP132B-SD: Benzo(e)pyrene	192-97-2	4	µg/kg	<4	----	----	----	----
EP132B-SD: Benzo(a)pyrene	50-32-8	4	µg/kg	<4	25 µg/kg	59.6	55	111
EP132B-SD: Perylene	198-55-0	4	µg/kg	<4	----	----	----	----
EP132B-SD: Benzo(g.h.i)perylene	191-24-2	4	µg/kg	<4	25 µg/kg	76.6	62	106
EP132B-SD: Dibenz(a.h)anthracene	53-70-3	4	µg/kg	<4	25 µg/kg	42.2	35	141
EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	25 µg/kg	58.9	48	122
EP132B-SD: Coronene	191-07-1	5	µg/kg	<5	----	----	----	----
EP132B-SD: Sum of PAHs	----	4	µg/kg	<4	----	----	----	----
EP202A: Phenoxyacetic Acid Herbicides by LCMS (QCLot: 2223949)								
EP202: 4-Chlorophenoxy acetic acid	122-88-3	0.02	mg/kg	<0.02	0.1 mg/kg	71.5	54	128
EP202: 2.4-DB	94-82-6	0.02	mg/kg	<0.02	0.1 mg/kg	104	46	130
EP202: Dicamba	1918-00-9	0.02	mg/kg	<0.02	0.1 mg/kg	73.4	52	135
EP202: Mecoprop	93-65-2	0.02	mg/kg	<0.02	0.1 mg/kg	88.0	60	130
EP202: MCPA	94-74-6	0.02	mg/kg	<0.02	0.1 mg/kg	77.4	57	131
EP202: 2.4-DP	120-36-5	0.02	mg/kg	<0.02	0.1 mg/kg	116	50	141
EP202: 2.4-D	94-75-7	0.02	mg/kg	<0.02	0.1 mg/kg	84.9	69	131
EP202: Triclopyr	55335-06-3	0.02	mg/kg	<0.02	0.1 mg/kg	109	51	141
EP202: 2.4.5-TP (Silvex)	93-72-1	0.02	mg/kg	<0.02	0.1 mg/kg	111	41	126
EP202: 2.4.5-T	93-76-5	0.02	mg/kg	<0.02	0.1 mg/kg	104	57	139
EP202: MCPB	94-81-5	0.02	mg/kg	<0.02	0.1 mg/kg	81.0	39	137
EP202: Picloram	1918-02-1	0.02	mg/kg	<0.02	0.1 mg/kg	64.1	49	129

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EP202A: Phenoxyacetic Acid Herbicides by LCMS (QCLot: 2223949) - continued								
EP202: Clopyralid	1702-17-6	0.02	mg/kg	<0.02	0.1 mg/kg	69.2	49	106
EP202: Fluroxypyr	69377-81-7	0.02	mg/kg	<0.02	0.1 mg/kg	74.7	53	128

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Recovery Limits (%): Low	Recovery Limits (%): High
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES (QCLot: 2226450)							
EP1902034-003	RF3	EG005-SD: Aluminium	7429-90-5	50 mg/kg	# Not Determined	70	130
		EG005-SD: Iron	7439-89-6	50 mg/kg	# Not Determined	70	130
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QCLot: 2226449)							
EP1902034-003	RF3	EG035T-LL: Mercury	7439-97-6	10 mg/kg	113	70	130
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2226451)							
EP1902034-003	RF3	EG020-SD: Arsenic	7440-38-2	50 mg/kg	85.2	70	130
		EG020-SD: Cadmium	7440-43-9	50 mg/kg	94.3	70	130
		EG020-SD: Chromium	7440-47-3	50 mg/kg	84.7	70	130
		EG020-SD: Copper	7440-50-8	50 mg/kg	79.1	70	130
		EG020-SD: Nickel	7440-02-0	50 mg/kg	91.2	70	130
		EG020-SD: Zinc	7440-66-6	50 mg/kg	86.2	70	130
EK055: Ammonia as N (QCLot: 2221495)							
EP1901901-006	Anonymous	EK055: Ammonia as N	7664-41-7	50 mg/kg	# Not Determined	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2221520)							
EP1902034-003	RF3	EK057G: Nitrite as N (Sol.)	14797-65-0	2.5 mg/kg	105	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2221522)							
EP1902034-003	RF3	EK059G: Nitrite + Nitrate as N (Sol.)	----	2.5 mg/kg	116	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2227872)							
EP1902034-003	RF3	EK061G: Total Kjeldahl Nitrogen as N	----	500 mg/kg	101	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2227871)							
EP1902034-003	RF3	EK067G: Total Phosphorus as P	----	100 mg/kg	96.7	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2221521)							

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2221521) - continued							
EP1902034-003	RF3	EK071G: Reactive Phosphorus as P	14265-44-2	2.5 mg/kg	99.2	70	130
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2221903)							
EP1902034-003	RF3	EP080-SD: C6 - C9 Fraction	----	32 mg/kg	78.9	70	130
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 2221905)							
EP1902034-003	RF3	EP071-SD: C10 - C14 Fraction	----	252 mg/kg	77.2	70	130
		EP071-SD: C15 - C28 Fraction	----	634 mg/kg	86.5	70	130
		EP071-SD: C29 - C36 Fraction	----	99 mg/kg	82.2	70	130
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 2221903)							
EP1902034-003	RF3	EP080-SD: C6 - C10 Fraction	C6_C10	37 mg/kg	73.7	70	130
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 2221905)							
EP1902034-003	RF3	EP071-SD: >C10 - C16 Fraction	----	404 mg/kg	82.3	70	130
		EP071-SD: >C16 - C34 Fraction	----	567 mg/kg	81.6	70	130
		EP071-SD: >C34 - C40 Fraction	----	33 mg/kg	81.8	70	130
EP080-SD: BTEXN (QCLot: 2221903)							
EP1902034-003	RF3	EP080-SD: Benzene	71-43-2	2 mg/kg	99.7	70	130
		EP080-SD: Toluene	108-88-3	2 mg/kg	84.4	70	130
EP090: Organotin Compounds (QCLot: 2222229)							
EP1902034-003	RF3	EP090: Monobutyltin	78763-54-9	1.25 µgSn/kg	67.2	35	130
		EP090: Dibutyltin	1002-53-5	1.25 µgSn/kg	120	20	130
		EP090: Tributyltin	56573-85-4	1.25 µgSn/kg	103	20	130
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2221906)							
EP1902034-003	RF3	EP132B-SD: Naphthalene	91-20-3	25 µg/kg	76.7	70	130
		EP132B-SD: Acenaphthylene	208-96-8	25 µg/kg	70.6	70	130
		EP132B-SD: Acenaphthene	83-32-9	25 µg/kg	76.4	70	130
		EP132B-SD: Fluorene	86-73-7	25 µg/kg	76.5	70	130
		EP132B-SD: Phenanthrene	85-01-8	25 µg/kg	81.3	70	130
		EP132B-SD: Anthracene	120-12-7	25 µg/kg	77.0	70	130
		EP132B-SD: Fluoranthene	206-44-0	25 µg/kg	92.4	70	130
		EP132B-SD: Pyrene	129-00-0	25 µg/kg	94.1	70	130
		EP132B-SD: Benz(a)anthracene	56-55-3	25 µg/kg	95.4	70	130
		EP132B-SD: Chrysene	218-01-9	25 µg/kg	98.3	70	130
		EP132B-SD: Benzo(b+j)fluoranthene	205-99-2 205-82-3	25 µg/kg	80.8	70	130
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	25 µg/kg	119	70	130
		EP132B-SD: Benzo(a)pyrene	50-32-8	25 µg/kg	85.3	70	130
		EP132B-SD: Benzo(g.h.i)perylene	191-24-2	25 µg/kg	96.9	70	130
		EP132B-SD: Dibenz(a.h)anthracene	53-70-3	25 µg/kg	91.4	70	130

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 2221906) - continued							
EP1902034-003	RF3	EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	25 µg/kg	74.4	70	130
EP202A: Phenoxyacetic Acid Herbicides by LCMS (QCLot: 2223949)							
EP1901901-005	Anonymous	EP202: Mecoprop	93-65-2	0.1 mg/kg	71.0	60	140
		EP202: MCPA	94-74-6	0.1 mg/kg	80.0	57	143
		EP202: 2.4-D	94-75-7	0.1 mg/kg	70.0	68	139
		EP202: Triclopyr	55335-06-3	0.1 mg/kg	83.0	51	145
		EP202: 2.4.5-T	93-76-5	0.1 mg/kg	74.8	57	142
		EP202: Picloram	1918-02-1	0.1 mg/kg	55.5	49	138
		EP202: Clopyralid	1702-17-6	0.1 mg/kg	62.2	49	149

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP1814856**	Page	: 1 of 13
Client	: **WA MARINE PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: Claudio Deldeo	Telephone	: 08 9406 1311
Project	: 18WAU-0002 Mardie Project: Sediment Sampling	Date Samples Received	: 19-Dec-2018
Site	: ----	Issue Date	: 07-Jan-2019
Sampler	: Claudio Deldeo	No. of samples received	: 13
Order number	:	No. of samples analysed	: 13

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

Outliers : Analysis Holding Time Compliance

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

Outliers : Frequency of Quality Control Samples

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

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Laboratory Control Spike (LCS) Recoveries							
EP090: Organotin Compounds	QC-2109384-002	----	**Dibutyltin**	1002-53-5	152 %	42-132%	**Recovery greater than upper control limit**
Matrix Spike (MS) Recoveries							
EG005-SD: Total Metals in Sediments by ICP-AES	EP1814856--002	TRIP-1	**Aluminium**	7429-90-5	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
EG005-SD: Total Metals in Sediments by ICP-AES	EP1814856--002	TRIP-1	**Iron**	7439-89-6	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
EK067G: Total Phosphorus as P by Discrete Analyser	EP1814856--002	TRIP-1	**Total Phosphorus as P**	----	60.8 %	70-130%	**Recovery less than lower data quality objective**

Analysis Holding Time Compliance

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

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

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

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

Matrix: **SOIL**

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

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA037: Ass Field Screening Analysis							
Snap Lock Bag - frozen on receipt at ALS (EA037)							
SPLIT-P1, TB2, TB3, C1-1, C2, C3-1, C3-2, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**20-Dec-2018**	10-Jun-2019	✓	**20-Dec-2018**	10-Jun-2019	✓
Snap Lock Bag - frozen on receipt at ALS (EA037)							
TRIP-1	**15-Dec-2018**	**20-Dec-2018**	13-Jun-2019	✓	**20-Dec-2018**	13-Jun-2019	✓

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)							
SPLIT-P1, TB2, TB3, C1-1, C2, C3-1, C3-2, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**----**	----	----	**20-Dec-2018**	26-Dec-2018	✓
Soil Glass Jar - Unpreserved (EA055)							
TRIP-1	**15-Dec-2018**	**----**	----	----	**20-Dec-2018**	29-Dec-2018	✓
EA150: Particle Sizing							
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H)							
TB2, TB3, C1-1, C2, C3-1, C3-2, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**----**	----	----	**03-Jan-2019**	10-Jun-2019	✓
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H)							
TRIP-1	**15-Dec-2018**	**----**	----	----	**03-Jan-2019**	13-Jun-2019	✓
EA150: Soil Classification based on Particle Size							
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H)							
TB2, TB3, C1-1, C2, C3-1, C3-2, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**----**	----	----	**03-Jan-2019**	10-Jun-2019	✓
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H)							
TRIP-1	**15-Dec-2018**	**----**	----	----	**03-Jan-2019**	13-Jun-2019	✓
EA152: Soil Particle Density							
Snap Lock Bag - Friable Asbestos/PSD Bag (EA152)							
TB2, TB3, C1-1, C2, C3-1, C3-2, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**----**	----	----	**03-Jan-2019**	10-Jun-2019	✓
Snap Lock Bag - Friable Asbestos/PSD Bag (EA152)							
TRIP-1	**15-Dec-2018**	**----**	----	----	**03-Jan-2019**	13-Jun-2019	✓

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-SD: Total Metals in Sediments by ICP-AES							
Soil Glass Jar - Unpreserved (EG005-SD)							
SPLIT-P1, TB2, TB3, C1-1, C2, C3-1, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**20-Dec-2018**	10-Jun-2019	✓	**21-Dec-2018**	10-Jun-2019	✓
Soil Glass Jar - Unpreserved (EG005-SD)							
TRIP-1	**15-Dec-2018**	**20-Dec-2018**	13-Jun-2019	✓	**21-Dec-2018**	13-Jun-2019	✓
EG020-SD: Total Metals in Sediments by ICPMS							
Soil Glass Jar - Unpreserved (EG020-SD)							
SPLIT-P1, TB2, TB3, C1-1, C2, C3-1, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**20-Dec-2018**	10-Jun-2019	✓	**21-Dec-2018**	10-Jun-2019	✓
Soil Glass Jar - Unpreserved (EG020-SD)							
TRIP-1	**15-Dec-2018**	**20-Dec-2018**	13-Jun-2019	✓	**21-Dec-2018**	13-Jun-2019	✓
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T-LL)							
SPLIT-P1, TB2, TB3, C1-1, C2, C3-1, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**20-Dec-2018**	09-Jan-2019	✓	**21-Dec-2018**	09-Jan-2019	✓
Soil Glass Jar - Unpreserved (EG035T-LL)							
TRIP-1	**15-Dec-2018**	**20-Dec-2018**	12-Jan-2019	✓	**21-Dec-2018**	12-Jan-2019	✓
EK055: Ammonia as N							
Soil Glass Jar - Unpreserved (EK055)							
SPLIT-P1, TB2, TB3, C1-1, C2, C3-1, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**----**	----	----	**20-Dec-2018**	10-Jun-2019	✓
Soil Glass Jar - Unpreserved (EK055)							
TRIP-1	**15-Dec-2018**	**----**	----	----	**20-Dec-2018**	13-Jun-2019	✓

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
EK057G: Nitrite as N by Discrete Analyser							
Soil Glass Jar - Unpreserved (EK057G)							
SPLIT-P1, TB2, TB3, C1-1, C2, C3-1, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**24-Dec-2018**	10-Jun-2019	✓	**24-Dec-2018**	10-Jun-2019	✓
Soil Glass Jar - Unpreserved (EK057G)							
TRIP-1	**15-Dec-2018**	**24-Dec-2018**	13-Jun-2019	✓	**24-Dec-2018**	13-Jun-2019	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Soil Glass Jar - Unpreserved (EK059G)							
SPLIT-P1, TB2, TB3, C1-1, C2, C3-1, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**24-Dec-2018**	10-Jun-2019	✓	**24-Dec-2018**	10-Jun-2019	✓
Soil Glass Jar - Unpreserved (EK059G)							
TRIP-1	**15-Dec-2018**	**24-Dec-2018**	13-Jun-2019	✓	**24-Dec-2018**	13-Jun-2019	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Soil Glass Jar - Unpreserved (EK061G)							
SPLIT-P1, TB2, TB3, C1-1, C2, C3-1, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**20-Dec-2018**	10-Jun-2019	✓	**24-Dec-2018**	10-Jun-2019	✓
Soil Glass Jar - Unpreserved (EK061G)							
TRIP-1	**15-Dec-2018**	**20-Dec-2018**	13-Jun-2019	✓	**24-Dec-2018**	13-Jun-2019	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Soil Glass Jar - Unpreserved (EK067G)							
SPLIT-P1, TB2, TB3, C1-1, C2, C3-1, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**20-Dec-2018**	10-Jun-2019	✓	**24-Dec-2018**	10-Jun-2019	✓
Soil Glass Jar - Unpreserved (EK067G)							
TRIP-1	**15-Dec-2018**	**20-Dec-2018**	13-Jun-2019	✓	**24-Dec-2018**	13-Jun-2019	✓

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
EK071G: Reactive Phosphorus as P by discrete analyser							
Soil Glass Jar - Unpreserved (EK071G)							
SPLIT-P1, TB2, TB3, C1-1, C2, C3-1, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**24-Dec-2018**	10-Jun-2019	✓	**24-Dec-2018**	10-Jun-2019	✓
Soil Glass Jar - Unpreserved (EK071G)							
TRIP-1	**15-Dec-2018**	**24-Dec-2018**	13-Jun-2019	✓	**24-Dec-2018**	13-Jun-2019	✓
EP003: Total Organic Carbon (TOC) in Soil							
Snap Lock Bag - frozen on receipt at ALS (EP003)							
TB3, C1-1, C2, C5, OC2, OC3	**12-Dec-2018**	**02-Jan-2019**	09-Jan-2019	✓	**02-Jan-2019**	09-Jan-2019	✓
Soil Glass Jar - Unpreserved (EP003)							
SPLIT-P1, TB2, C3-1, C4, C6-1	**12-Dec-2018**	**02-Jan-2019**	09-Jan-2019	✓	**02-Jan-2019**	09-Jan-2019	✓
Soil Glass Jar - Unpreserved (EP003)							
TRIP-1	**15-Dec-2018**	**02-Jan-2019**	12-Jan-2019	✓	**02-Jan-2019**	12-Jan-2019	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Soil Glass Jar - Unpreserved (EP071-SD)							
SPLIT-P1, TB2, TB3, C1-1, C2, C3-1, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**20-Dec-2018**	26-Dec-2018	✓	**20-Dec-2018**	29-Jan-2019	✓
Soil Glass Jar - Unpreserved (EP071-SD)							
TRIP-1	**15-Dec-2018**	**20-Dec-2018**	29-Dec-2018	✓	**20-Dec-2018**	29-Jan-2019	✓

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 (EP071-SD)							
SPLIT-P1, TB2, TB3, C1-1, C2, C3-1, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**20-Dec-2018**	26-Dec-2018	✓	**20-Dec-2018**	29-Jan-2019	✓
Soil Glass Jar - Unpreserved (EP080-SD)							
SPLIT-P1, TB2, TB3, C1-1, C2, C3-1, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**21-Dec-2018**	26-Dec-2018	✓	**21-Dec-2018**	26-Dec-2018	✓
Soil Glass Jar - Unpreserved (EP071-SD)							
TRIP-1	**15-Dec-2018**	**20-Dec-2018**	29-Dec-2018	✓	**20-Dec-2018**	29-Jan-2019	✓
Soil Glass Jar - Unpreserved (EP080-SD)							
TRIP-1	**15-Dec-2018**	**21-Dec-2018**	29-Dec-2018	✓	**21-Dec-2018**	29-Dec-2018	✓
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons							
Soil Glass Jar - Unpreserved (EP080-SD)							
SPLIT-P1, TB2, TB3, C1-1, C2, C3-1, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**21-Dec-2018**	26-Dec-2018	✓	**21-Dec-2018**	26-Dec-2018	✓
Soil Glass Jar - Unpreserved (EP080-SD)							
TRIP-1	**15-Dec-2018**	**21-Dec-2018**	29-Dec-2018	✓	**21-Dec-2018**	29-Dec-2018	✓
EP080-SD: BTEXN							
Soil Glass Jar - Unpreserved (EP080-SD)							
SPLIT-P1, TB2, TB3, C1-1, C2, C3-1, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**21-Dec-2018**	26-Dec-2018	✓	**21-Dec-2018**	26-Dec-2018	✓
Soil Glass Jar - Unpreserved (EP080-SD)							
TRIP-1	**15-Dec-2018**	**21-Dec-2018**	29-Dec-2018	✓	**21-Dec-2018**	29-Dec-2018	✓

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
EP090: Organotin Compounds							
Soil Glass Jar - Unpreserved (EP090)							
SPLIT-P1, TB2, C3-1, C4, C6-1	**12-Dec-2018**	**21-Dec-2018**	26-Dec-2018	✓	**27-Dec-2018**	30-Jan-2019	✓
Soil Glass Jar - Unpreserved (EP090)							
TRIP-1	**15-Dec-2018**	**21-Dec-2018**	29-Dec-2018	✓	**27-Dec-2018**	30-Jan-2019	✓
EP132B: Polynuclear Aromatic Hydrocarbons							
Soil Glass Jar - Unpreserved (EP132B-SD)							
SPLIT-P1, TB2, TB3, C1-1, C2, C3-1, C4, C5, C6-1, OC2, OC3	**12-Dec-2018**	**20-Dec-2018**	26-Dec-2018	✓	**21-Dec-2018**	29-Jan-2019	✓
Soil Glass Jar - Unpreserved (EP132B-SD)							
TRIP-1	**15-Dec-2018**	**20-Dec-2018**	29-Dec-2018	✓	**21-Dec-2018**	29-Jan-2019	✓
EP202A: Phenoxyacetic Acid Herbicides by LCMS							
Soil Glass Jar - Unpreserved (EP202)							
SPLIT-P1, TB2, C3-1, C4, C6-1	**12-Dec-2018**	**21-Dec-2018**	26-Dec-2018	✓	**21-Dec-2018**	30-Jan-2019	✓
Soil Glass Jar - Unpreserved (EP202)							
TRIP-1	**15-Dec-2018**	**21-Dec-2018**	29-Dec-2018	✓	**21-Dec-2018**	30-Jan-2019	✓

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)							
ASS Field Screening Analysis	EA037	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Buchi Ammonia	EK055	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	4	31	**12.90**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosporus By Discrete Analyser	EK067G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatile Fraction	EP071-SD	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX in Sediments	EP080-SD	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Buchi Ammonia	EK055	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosporus By Discrete Analyser	EK067G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatile Fraction	EP071-SD	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX in Sediments	EP080-SD	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Buchi Ammonia	EK055	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **SOIL**

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

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosporus By Discrete Analyser	EK067G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatile Fraction	EP071-SD	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX in Sediments	EP080-SD	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Buchi Ammonia	EK055	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosporus By Discrete Analyser	EK067G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatile Fraction	EP071-SD	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX in Sediments	EP080-SD	1	12	**8.33**	**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
ASS Field Screening Analysis	EA037	SOIL	In house: Referenced to Acid Sulfate Soils Laboratory Methods Guidelines, version 2.1 June 2004. As received samples are tested for pH field and pH fox and assessed for a reaction rating.
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 (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Particle Size Analysis by Hydrometer	EA150H	SOIL	Particle Size Analysis by Hydrometer according to AS1289.3.6.3 - 2003
Soil Particle Density	* EA152	SOIL	Soil Particle Density by AS 1289.3.5.1-2006 : 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 (2013) 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 AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Buchi Ammonia	EK055	SOIL	In house: Referenced to APHA 4500-NH3 B&G, H Samples are steam distilled (Buchi) prior to analysis and quantified using titration, FIA or Discrete Analyser.
Nitrite as N - Soluble by Discrete Analyser	EK057G	SOIL	In house: Referenced to APHA 4500-NO3- B. Nitrite in a water extract is determined by direct colourimetry by Discrete Analyser.
Nitrate as N - Soluble by Discrete Analyser	EK058G	SOIL	In house: Referenced to APHA 4500-NO3- F. Nitrate in the 1:5 soil:water extract is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results.
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	SOIL	In house: Thermo Scientific Method D08727 and NEMI (National Environmental Method Index) Method ID: 9171. This method covers the determination of total oxidised nitrogen (NOx-N) and nitrate (NO3-N) by calculation, Combined oxidised Nitrogen (NO2+NO3) in a water extract is determined by direct colourimetry by Discrete Analyser.
TKN as N By Discrete Analyser	EK061G	SOIL	In house: Referenced to APHA 4500-Norg-D Soil samples are digested using Kjeldahl digestion followed by determination by Discrete Analyser.
Total Nitrogen as N (TKN + NOx) By Discrete Analyser	EK062G	SOIL	In house: Referenced to APHA 4500 Norg/NO3- Total Nitrogen is determined as the sum of TKN and Oxidised Nitrrogen, each determined seperately as N.
Total Phosporus By Discrete Analyser	EK067G	SOIL	In house: Referenced to APHA 4500 P-B&F This procedure involves sulfuric acid digestion and quantification using Discrete Analyser.

Analytical Methods	Method	Matrix	Method Descriptions
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	SOIL	In house: Referenced to APHA 4500 P-F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) 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 LECO furnace in the presence of strong oxidants / catalysts. The evolved (Organic) Carbon (as CO2) is automaticaly measured by infra-red detector.
TPH - Semivolatile Fraction	EP071-SD	SOIL	In house: Referenced to USEPA SW 846 - 8270D. 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 (2013) Schedule B(3) (Method 504)
TRH Volatiles/BTEX in Sediments	EP080-SD	SOIL	In house: Referenced to USEPA SW 846 - 8260B Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve.
Organotin Analysis	EP090	SOIL	In house: Referenced to USEPA SW 846 - 8270D 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 8270D GCMS Capillary column, SIM mode using large volume programmed temperature vaporisation injection.
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202	SOIL	In house: LCMS (Electrospray in negative mode). Residues of acid herbicides are extracted from soil samples under the alkaline condition. An aliquot of the alkaline aqueous phase is taken and acidified before a SPE cleanup. After eluting off from the SPE cartridge, residues of acid herbicides are dissolved in HPLC mobile phase prior to instrument analysis.

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	SOIL	In house: Referenced to APHA 4500 Norg- D; APHA 4500 P - H. Macro Kjeldahl digestion.
Drying only	EN020D	SOIL	In house
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (2013) Schedule B(3) (Method 202)
Extraction for Phenoxy Acid Herbicides in Soils.	EP202-PR	SOIL	In-House: Alkaline extract followed by SPE clean up of acidified portion of the sample extract.
Dry and Pulverise (up to 100g)	GEO30	SOIL	#
Methanolic Extraction of Soils for Purge and Trap	ORG16	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids 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.

Appendix D Particle Size Distribution Results

Certificate of Analysis

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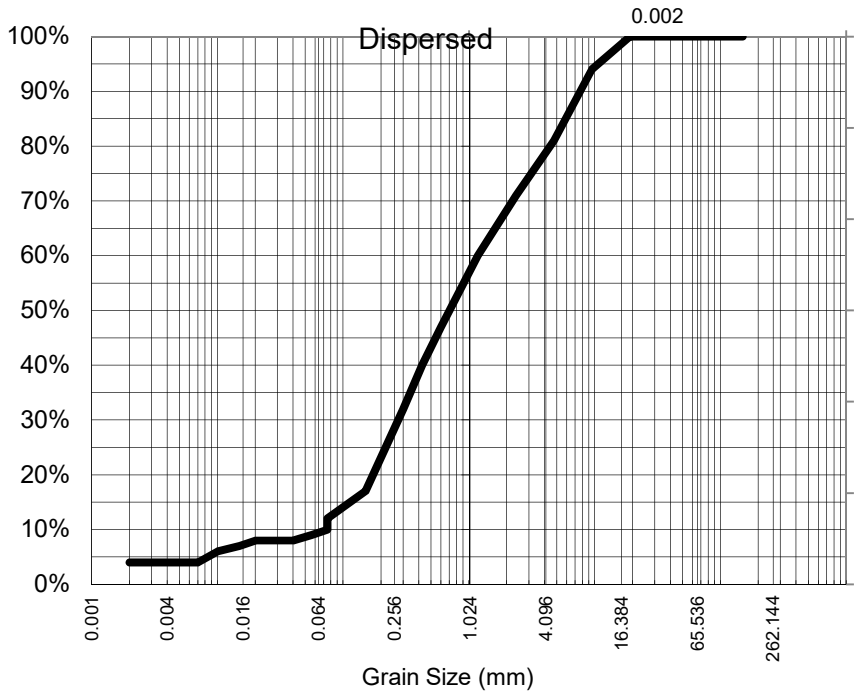
5/585 Maitland Road
Mayfield West, NSW 2304
pH 02 4014 2500
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Claudio Deldeo	**DATE REPORTED:**	3-Jan-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	19-Dec-2018
ADDRESS:	SUITE 5, 5/18 GRIFFON DRIVE PO BOX 1370 DUNSBOROUGH, PERTH	**REPORT NO:**	EP1814856-002 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	TRIP-1

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	94%
4.75	81%
2.36	71%
1.18	60%
0.600	47%
0.425	40%
0.300	32%
0.150	17%
0.075	12%
Particle Size (microns)	
56	9%
40	8%
28	8%
20	8%
15	7%
10	6%
7	4%
5	4%
2	4%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.734

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

Sample Comments:

Analysed: 28-Dec-18

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: FINES, SAND, SHELLS

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.61

NATA Accreditation: 825 Site: Newcastle
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NATA
WORLD RECOGNISED ACCREDITATION

Dianne Blane
Laboratory Coordinator
Authorised Signatory

Certificate of Analysis

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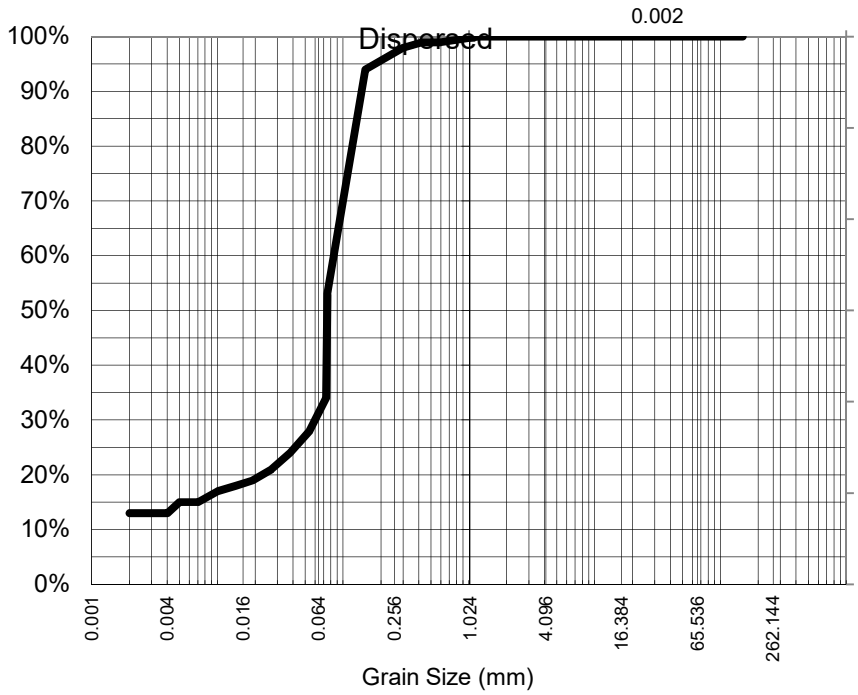
ALS Environmental

Newcastle, NSW

CLIENT:	Claudio Deldeo	**DATE REPORTED:**	3-Jan-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	19-Dec-2018
ADDRESS:	SUITE 5, 5/18 GRIFFON DRIVE PO BOX 1370 DUNSBOROUGH, PERTH	**REPORT NO:**	EP1814856-003 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	TB2

Particle Size Distribution



Particle Size (mm)	% Passing
1.18	100%
0.600	99%
0.425	99%
0.300	98%
0.150	94%
0.075	53%
Particle Size (microns)	
54	28%
38	24%
27	21%
19	19%
14	18%
10	17%
7	15%
5	15%
2	13%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.075

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

Sample Comments:

Analysed: 28-Dec-18

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: FINES, SAND, SHELLS

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.62

NATA Accreditation: 825 Site: Newcastle
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Certificate of Analysis

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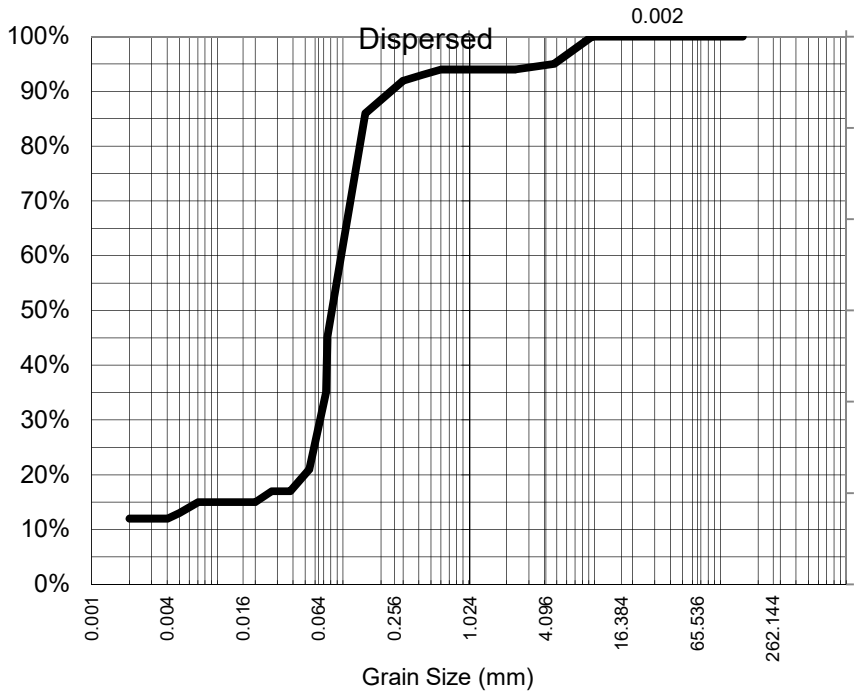
ALS Environmental

Newcastle, NSW

CLIENT:	Claudio Deldeo	**DATE REPORTED:**	3-Jan-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	19-Dec-2018
ADDRESS:	SUITE 5, 5/18 GRIFFON DRIVE PO BOX 1370 DUNSBOROUGH, PERTH	**REPORT NO:**	EP1814856-004 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	TB3

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	95%
2.36	94%
1.18	94%
0.600	94%
0.425	93%
0.300	92%
0.150	86%
0.075	45%
Particle Size (microns)	
54	21%
38	17%
27	17%
20	15%
15	15%
10	15%
7	15%
5	13%
2	12%

Median Particle Size (mm)*	0.084

Analysis Notes

Samples analysed as received.

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

Sample Comments:		**Analysed:**	28-Dec-18
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	FINES, SAND, SHELLS	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.6		

NATA Accreditation: 825 Site: Newcastle
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NATA
WORLD RECOGNISED ACCREDITATION

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Certificate of Analysis

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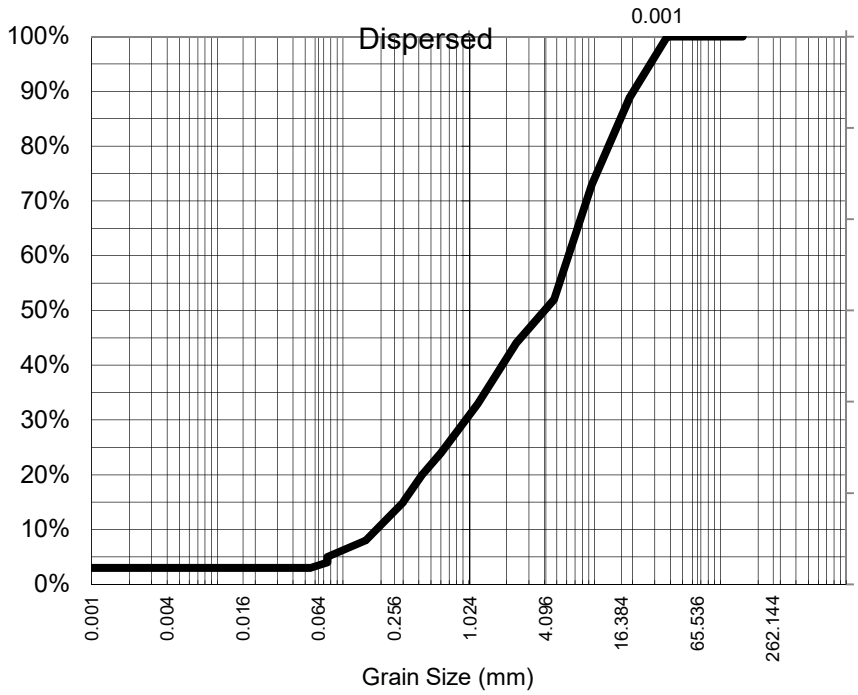
ALS Environmental

Newcastle, NSW

CLIENT:	Claudio Deldeo	**DATE REPORTED:**	3-Jan-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	19-Dec-2018
ADDRESS:	SUITE 5, 5/18 GRIFFON DRIVE PO BOX 1370 DUNSBOROUGH, PERTH	**REPORT NO:**	EP1814856-005 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	C1-1

Particle Size Distribution



Particle Size (mm)	% Passing
37.5	100%
19.0	89%
9.50	73%
4.75	52%
2.36	44%
1.18	33%
0.600	24%
0.425	20%
0.300	15%
0.150	8%
0.075	5%
Particle Size (microns)	
55	3%
39	3%
28	3%
20	3%
14	3%
10	3%
7	3%
5	3%
1	3%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	4.153

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:**	28-Dec-18
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	FINES, SAND, SHELLS	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.68		

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Dianne Blane
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Authorised Signatory

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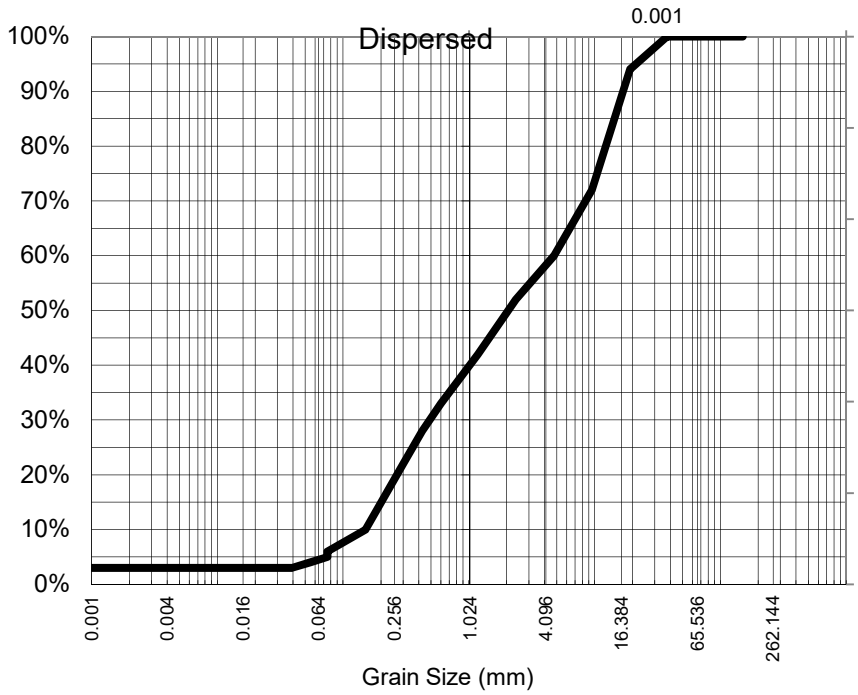
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Claudio Deldeo	**DATE REPORTED:**	3-Jan-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	19-Dec-2018
ADDRESS:	SUITE 5, 5/18 GRIFFON DRIVE PO BOX 1370 DUNSBOROUGH, PERTH	**REPORT NO:**	EP1814856-006 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	C2

Particle Size Distribution



Particle Size (mm)	% Passing
37.5	100%
19.0	94%
9.50	72%
4.75	60%
2.36	52%
1.18	42%
0.600	33%
0.425	28%
0.300	22%
0.150	10%
0.075	6%
Particle Size (microns)	
55	4%
39	3%
28	3%
20	3%
14	3%
10	3%
7	3%
5	3%
1	3%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	2.124

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:**	28-Dec-18
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	FINES, SAND, SHELLS	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.68		

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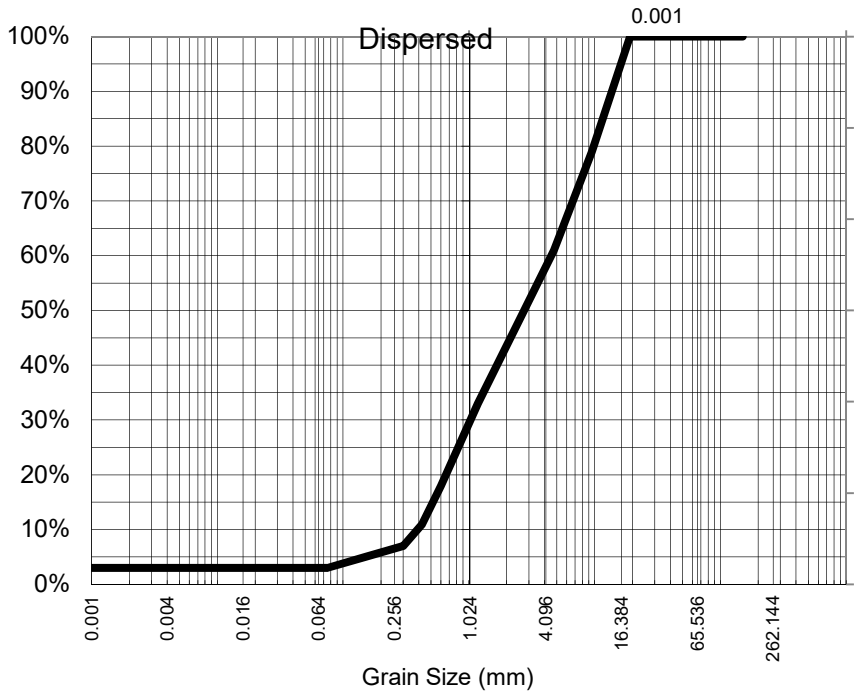
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	3-Jan-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	19-Dec-2018
ADDRESS:	SUITE 5, 5/18 GRIFFON DRIVE PO BOX 1370 DUNSBOROUGH, PERTH	**REPORT NO:**	EP1814856-007 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	C3-1

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	79%
4.75	61%
2.36	47%
1.18	33%
0.600	18%
0.425	11%
0.300	7%
0.150	5%
0.075	3%
Particle Size (microns)	
55	3%
39	3%
27	3%
19	3%
14	3%
10	3%
7	3%
5	3%
1	3%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	2.872

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:**	28-Dec-18
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	FINES, SAND, SHELLS	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.71		

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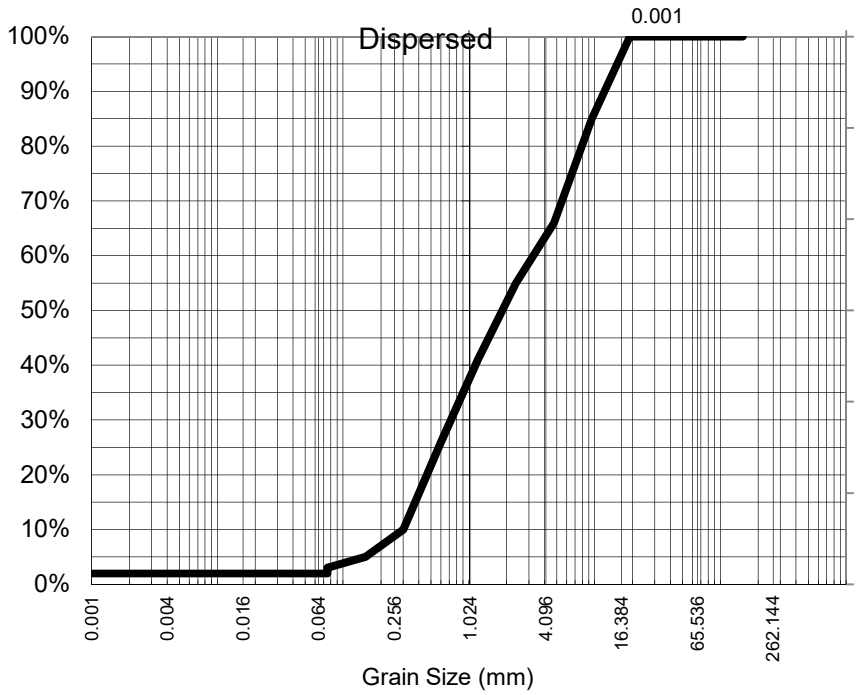
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	3-Jan-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	19-Dec-2018
ADDRESS:	SUITE 5, 5/18 GRIFFON DRIVE PO BOX 1370 DUNSBOROUGH, PERTH	**REPORT NO:**	EP1814856-008 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	C3-2

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	85%
4.75	66%
2.36	55%
1.18	41%
0.600	26%
0.425	18%
0.300	10%
0.150	5%
0.075	3%
Particle Size (microns)	
55	2%
39	2%
28	2%
20	2%
14	2%
10	2%
7	2%
5	2%
1	2%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	1.939

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:**	28-Dec-18
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	FINES, SAND, SHELLS	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.68		

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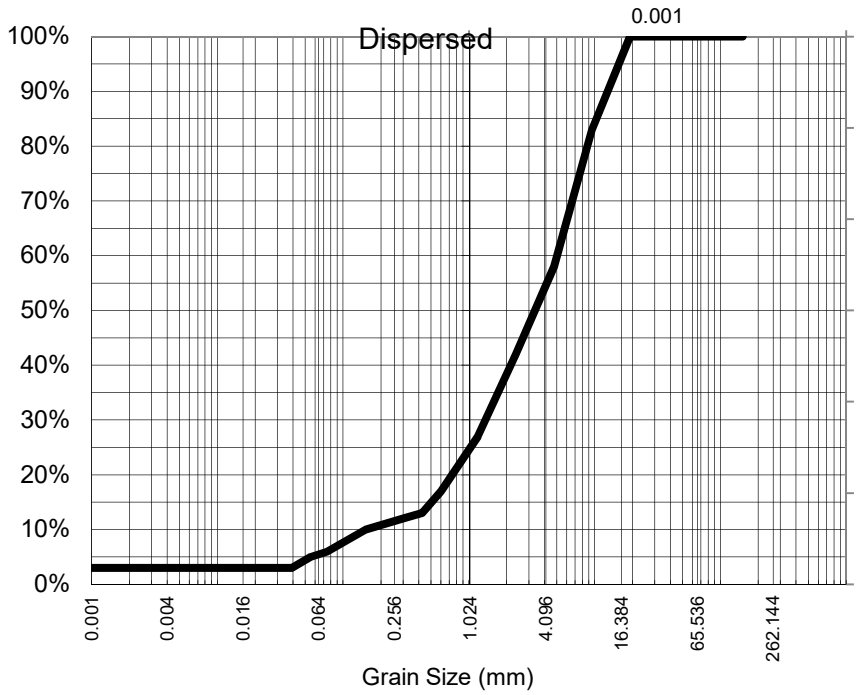
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	3-Jan-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	19-Dec-2018
ADDRESS:	SUITE 5, 5/18 GRIFFON DRIVE PO BOX 1370 DUNSBOROUGH, PERTH	**REPORT NO:**	EP1814856-009 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	C4

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	83%
4.75	58%
2.36	42%
1.18	27%
0.600	17%
0.425	13%
0.300	12%
0.150	10%
0.075	6%
Particle Size (microns)	
55	5%
39	3%
28	3%
20	3%
14	3%
10	3%
7	3%
5	3%
1	3%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	3.555

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:**	28-Dec-18
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	FINES, SAND, SHELLS	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.67		

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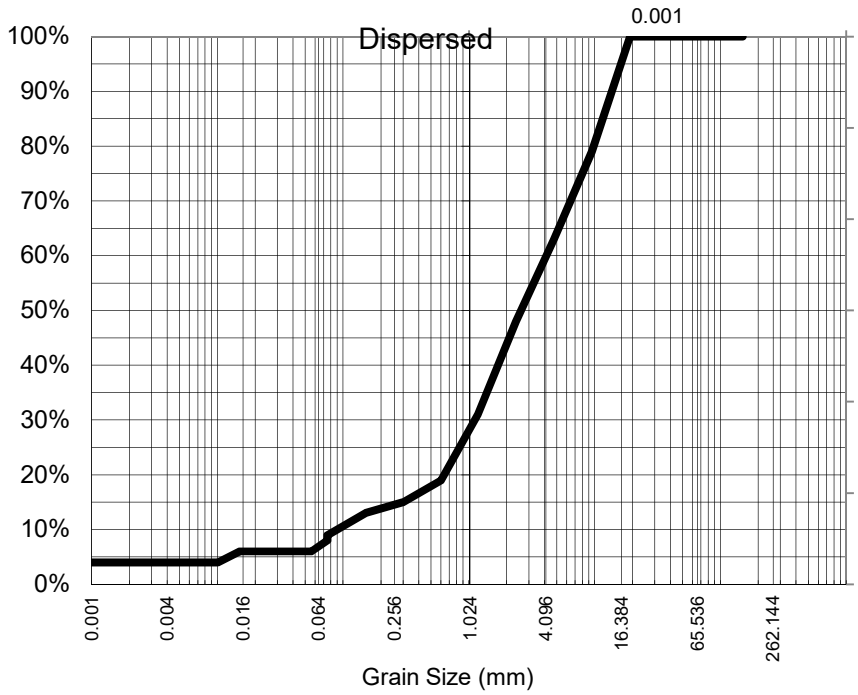
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	3-Jan-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	19-Dec-2018
ADDRESS:	SUITE 5, 5/18 GRIFFON DRIVE PO BOX 1370 DUNSBOROUGH, PERTH	**REPORT NO:**	EP1814856-010 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	C5

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	79%
4.75	63%
2.36	48%
1.18	31%
0.600	19%
0.425	17%
0.300	15%
0.150	13%
0.075	9%
Particle Size (microns)	
56	6%
40	6%
28	6%
20	6%
15	6%
10	4%
7	4%
5	4%
1	4%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	2.679

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:**	28-Dec-18
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	FINES, SAND, SHELLS	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.64		

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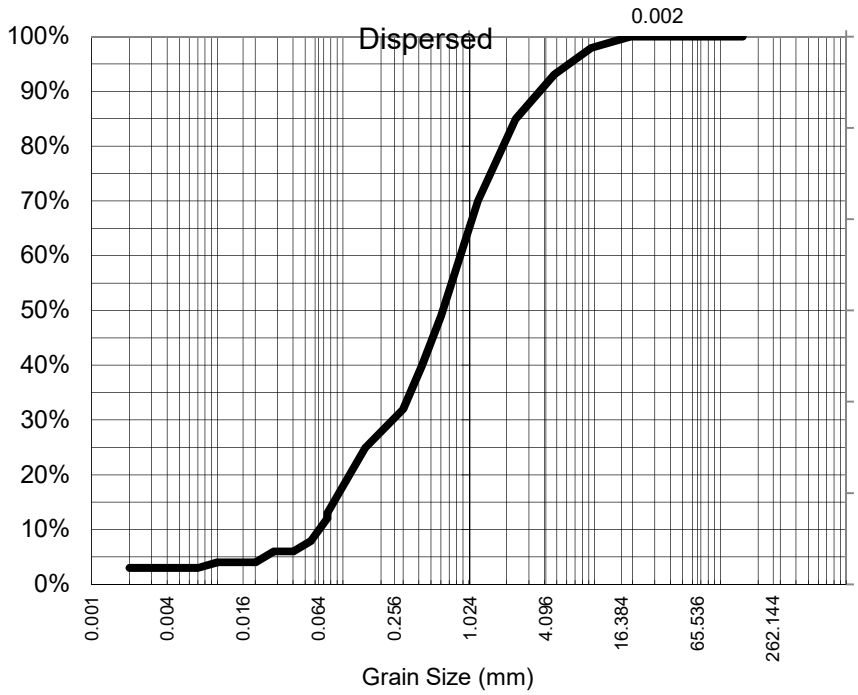
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	3-Jan-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	19-Dec-2018
ADDRESS:	SUITE 5, 5/18 GRIFFON DRIVE PO BOX 1370 DUNSBOROUGH, PERTH	**REPORT NO:**	EP1814856-011 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	C6-1

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	98%
4.75	93%
2.36	85%
1.18	70%
0.600	49%
0.425	40%
0.300	32%
0.150	25%
0.075	13%
Particle Size (microns)	
56	8%
40	6%
28	6%
20	4%
14	4%
10	4%
7	3%
5	3%
2	3%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.628

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

Sample Comments:

Analysed: 28-Dec-18

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: FINES, SAND, SHELLS

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.63

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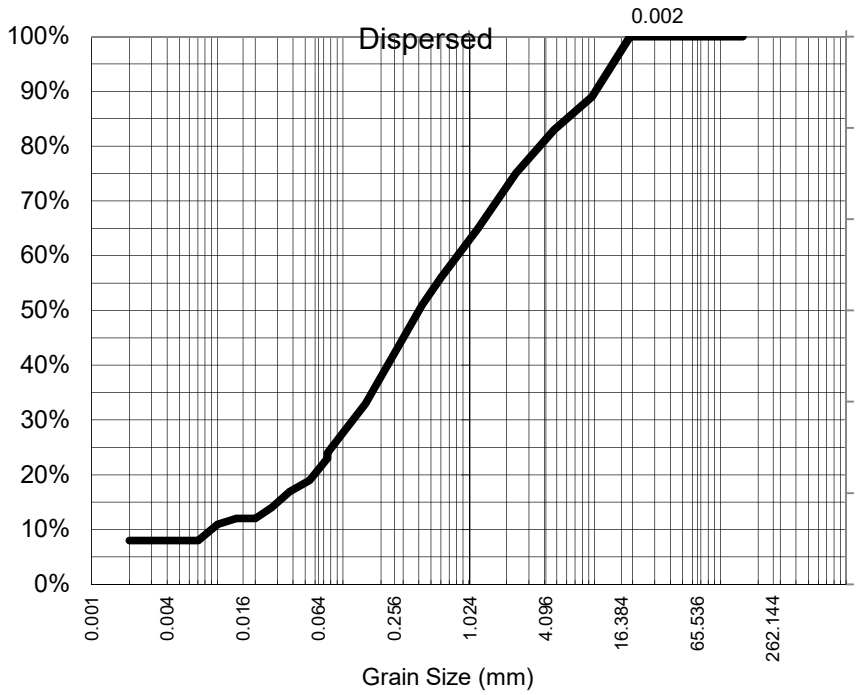
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	3-Jan-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	19-Dec-2018
ADDRESS:	SUITE 5, 5/18 GRIFFON DRIVE PO BOX 1370 DUNSBOROUGH, PERTH	**REPORT NO:**	EP1814856-012 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	OC2

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	89%
4.75	83%
2.36	75%
1.18	65%
0.600	56%
0.425	51%
0.300	45%
0.150	33%
0.075	24%
Particle Size (microns)	
54	19%
38	17%
27	14%
20	12%
14	12%
10	11%
7	8%
5	8%
2	8%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.404

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

Sample Comments:

Analysed: 28-Dec-18

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: FINES, SAND, SHELLS

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.6

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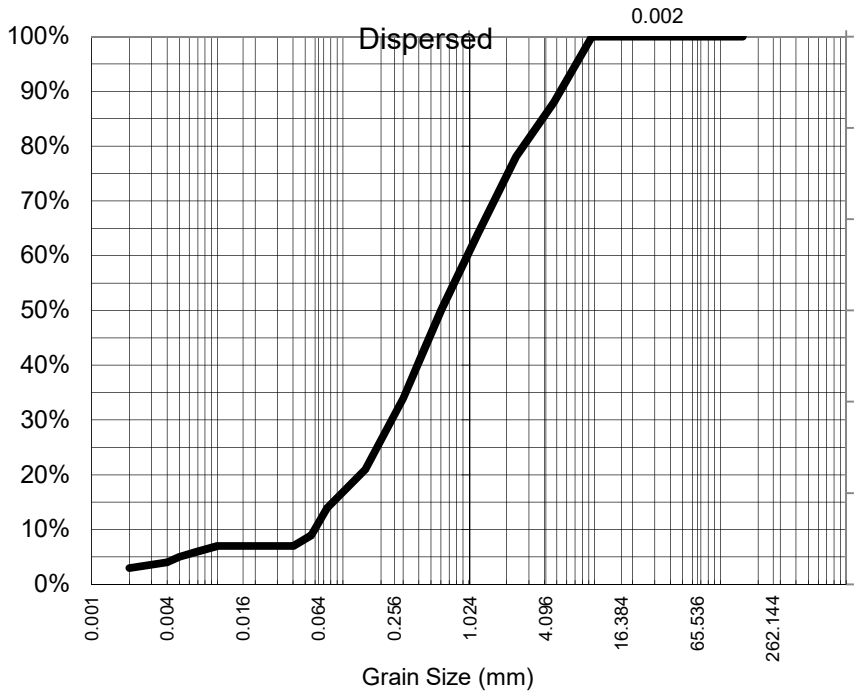
ALS Environmental

Newcastle, NSW

CLIENT:	Claudio Deldeo	**DATE REPORTED:**	3-Jan-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	19-Dec-2018
ADDRESS:	SUITE 5, 5/18 GRIFFON DRIVE PO BOX 1370 DUNSBOROUGH, PERTH	**REPORT NO:**	EP1814856-013 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	OC3

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	88%
2.36	78%
1.18	64%
0.600	50%
0.425	42%
0.300	34%
0.150	21%
0.075	14%
Particle Size (microns)	
56	9%
40	7%
28	7%
20	7%
14	7%
10	7%
7	6%
5	5%
2	3%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.600

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

Sample Comments:

Analysed: 28-Dec-18

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: FINES, SAND, SHELLS

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.64

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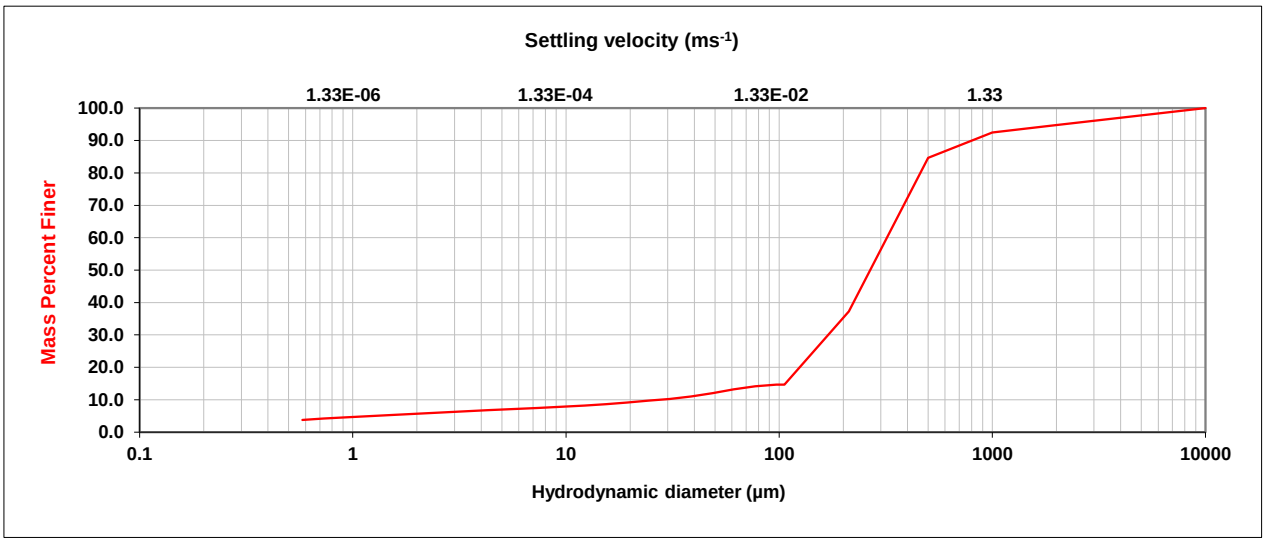
37 Kensington Street
East Perth
WA 6004

Client:	ALS
Client ID:	EP1900623_016 C7
Job No:	19_0098
Laboratory ID:	19_0098_11

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10 mL sodium hexametaphosphate	**Concentration:**	~5 % w/w

Sample density:	2.761 g/cm^3 (assumed)		
Liquid density:	0.994 g/cm^3	**Critical diameter:**	53.12 µm
Liquid viscosity:	0.722 cp		



Fraction name	Max size (µm)	Min size (µm)	In %	Settling velocity (ms^{-1})*
Gravel	10000	2000	5.3	4.50E+01
Sand	2000	60	81.5	1.33E+00
Silt	60	2	7.3	1.20E-03
Clay	2	1	1.0	2.81E-06
Sub-clay	1	0	4.9	3.12E-07
Total			100.0	

Analyst: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Reported by: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Authorised by: Dan Cukierski, B.Sc.(Geology), M.Sc.(Geoscience)

Note : Data from 106 µm to 10,000 µm by wet screening , from 0.3µm to 106 µm by Sedimentation.

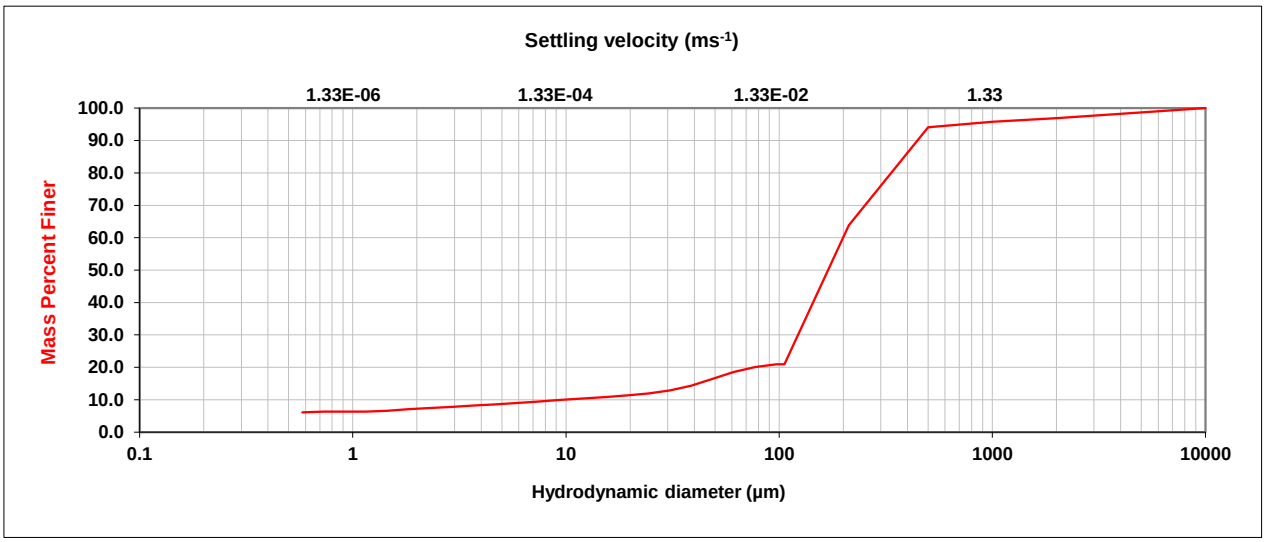
* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

37 Kensington Street
East Perth
WA 6004

Client:	ALS
Client ID:	EP1900623_017 C8-1
Job No:	19_0098
Laboratory ID:	19_0098_12

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10 mL sodium hexametaphosphate	**Concentration:**	~5 % w/w

Sample density:	2.756 g/cm^3 (assumed)		
Liquid density:	0.994 g/cm^3	**Critical diameter:**	53.21 µm
Liquid viscosity:	0.723 cp		



Fraction name	Max size (µm)	Min size (µm)	In %	Settling velocity (ms^{-1})*
Gravel	10000	2000	3.1	4.50E+01
Sand	2000	60	78.3	1.33E+00
Silt	60	2	11.1	1.20E-03
Clay	2	1	1.1	2.81E-06
Sub-clay	1	0	6.4	3.12E-07
Total			100.0	

Analyst:	Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)
Reported by:	Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)
Authorised by:	Dan Cukierski, B.Sc.(Geology), M.Sc.(Geoscience)

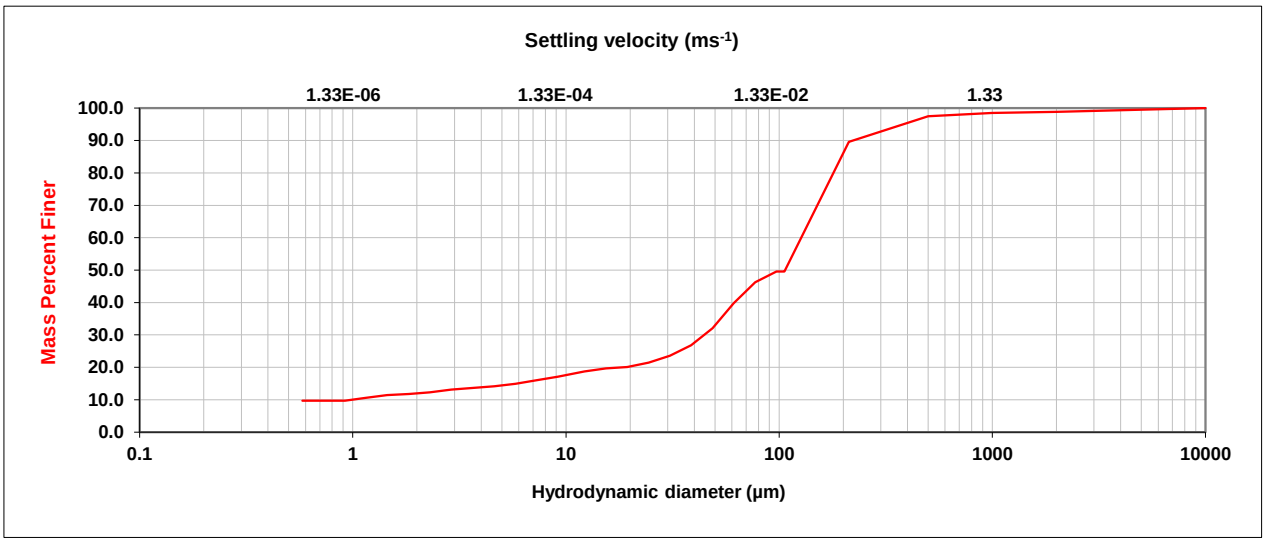
Note : Data from 106 µm to 10,000 µm by wet screening , from 0.3µm to 106 µm by Sedimentation.
* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

37 Kensington Street
East Perth
WA 6004

Client:	ALS
Client ID:	EP1900623-018 C9-1
Job No:	19_0098
Laboratory ID:	19_0098_13

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10 mL sodium hexametaphosphate	**Concentration:**	~5 % w/w

Sample density:	2.713 g/cm^3 (assumed)		
Liquid density:	0.994 g/cm^3	**Critical diameter:**	53.67 µm
Liquid viscosity:	0.724 cp		



Fraction name	Max size (µm)	Min size (µm)	In %	Settling velocity (ms^{-1})*
Gravel	10000	2000	1.2	4.50E+01
Sand	2000	60	59.0	1.33E+00
Silt	60	2	27.5	1.20E-03
Clay	2	1	1.7	2.81E-06
Sub-clay	1	0	10.6	3.12E-07
Total			100.0	

Analyst:	Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)
Reported by:	Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)
Authorised by:	Dan Cukierski, B.Sc.(Geology), M.Sc.(Geoscience)

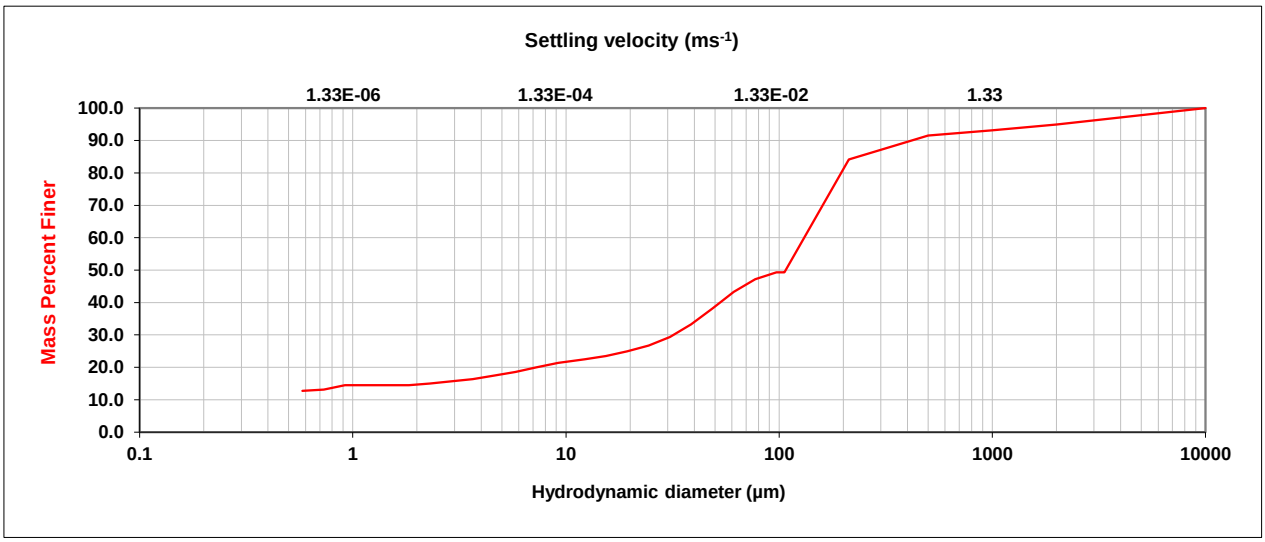
Note : Data from 106 µm to 10,000 µm by wet screening , from 0.3µm to 106 µm by Sedimentation.
* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

37 Kensington Street
East Perth
WA 6004

Client:	ALS
Client ID:	EP1900623_019 C9-2
Job No:	19_0098
Laboratory ID:	19_0098_14

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10 mL sodium hexametaphosphate	**Concentration:**	~5 % w/w

Sample density:	2.736 g/cm^3 (assumed)		
Liquid density:	0.994 g/cm^3	**Critical diameter:**	53.45 µm
Liquid viscosity:	0.725 cp		



Fraction name	Max size (µm)	Min size (µm)	In %	Settling velocity (ms^{-1})*
Gravel	10000	2000	5.1	4.50E+01
Sand	2000	60	51.6	1.33E+00
Silt	60	2	28.3	1.20E-03
Clay	2	1	0.5	2.81E-06
Sub-clay	1	0	14.5	3.12E-07
Total			100.0	

Analyst: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Reported by: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Authorised by: Dan Cukierski, B.Sc.(Geology), M.Sc.(Geoscience)

Note : Data from 106 µm to 10,000 µm by wet screening , from 0.3µm to 106 µm by Sedimentation.

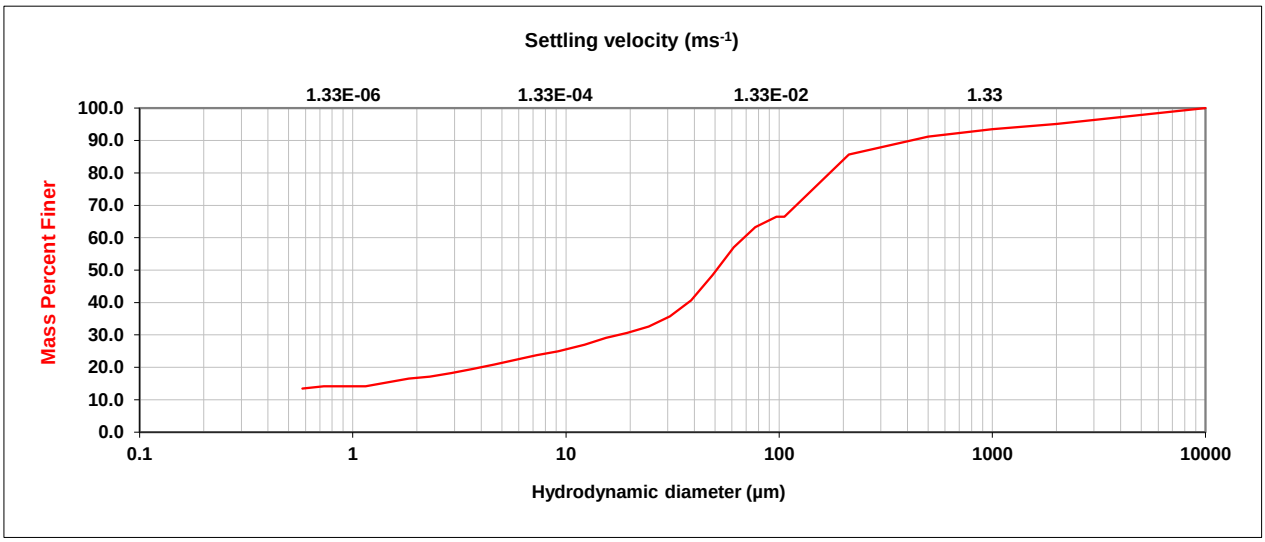
* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

37 Kensington Street
East Perth
WA 6004

Client:	ALS
Client ID:	EP1900623_020 C10-1
Job No:	19_0098
Laboratory ID:	19_0098_15

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10 mL sodium hexametaphosphate	**Concentration:**	~5 % w/w

Sample density:	2.711 g/cm^3 (assumed)		
Liquid density:	0.994 g/cm^3	**Critical diameter:**	53.70 µm
Liquid viscosity:	0.725 cp		



Fraction name	Max size (µm)	Min size (µm)	In %	Settling velocity (ms^{-1})*
Gravel	10000	2000	4.9	4.50E+01
Sand	2000	60	38.0	1.33E+00
Silt	60	2	39.9	1.20E-03
Clay	2	1	2.9	2.81E-06
Sub-clay	1	0	14.2	3.12E-07
Total			100.0	

Analyst: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Reported by: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Authorised by: Dan Cukierski, B.Sc.(Geology), M.Sc.(Geoscience)

Note : Data from 106 µm to 10,000 µm by wet screening , from 0.3µm to 106 µm by Sedimentation.

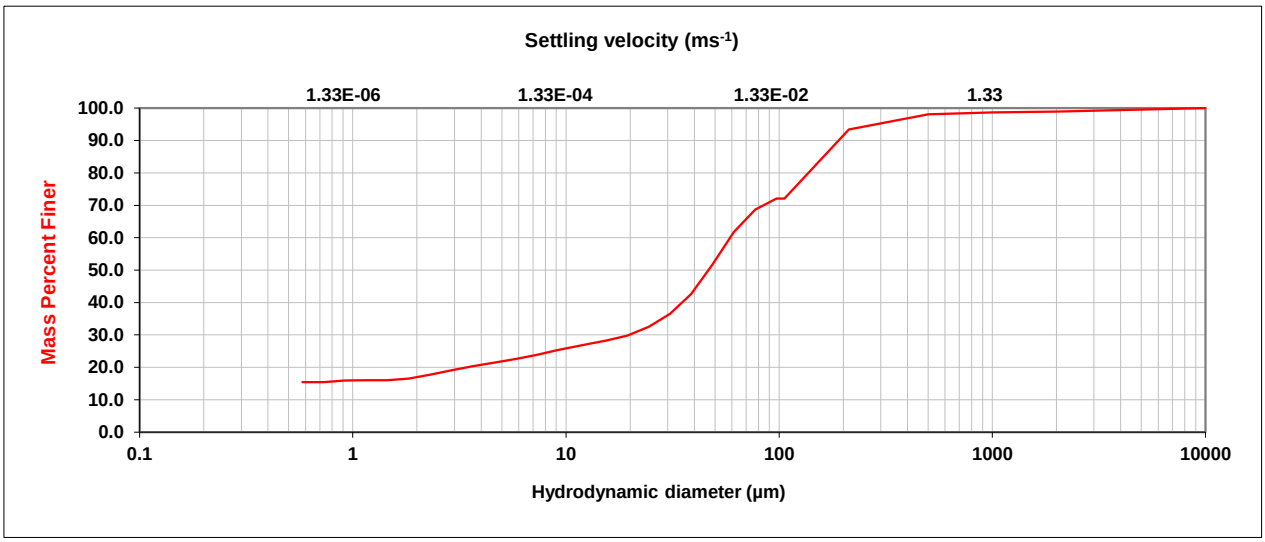
* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

37 Kensington Street
East Perth
WA 6004

Client:	ALS
Client ID:	EP1900623_021 C11
Job No:	19_0098
Laboratory ID:	19_0098_16

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10 mL sodium hexametaphosphate	**Concentration:**	~5 % w/w

Sample density:	2.711 g/cm^3 (assumed)		
Liquid density:	0.994 g/cm^3	**Critical diameter:**	53.68 µm
Liquid viscosity:	0.724 cp		



Fraction name	Max size (µm)	Min size (µm)	In %	Settling velocity (ms^{-1})*
Gravel	10000	2000	1.1	4.50E+01
Sand	2000	60	37.2	1.33E+00
Silt	60	2	44.0	1.20E-03
Clay	2	1	1.7	2.81E-06
Sub-clay	1	0	16.0	3.12E-07
Total			100.0	

Analyst: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Reported by: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Authorised by: Dan Cukierski, B.Sc.(Geology), M.Sc.(Geoscience)

Note : Data from 106 µm to 10,000 µm by wet screening , from 0.3µm to 106 µm by Sedimentation.

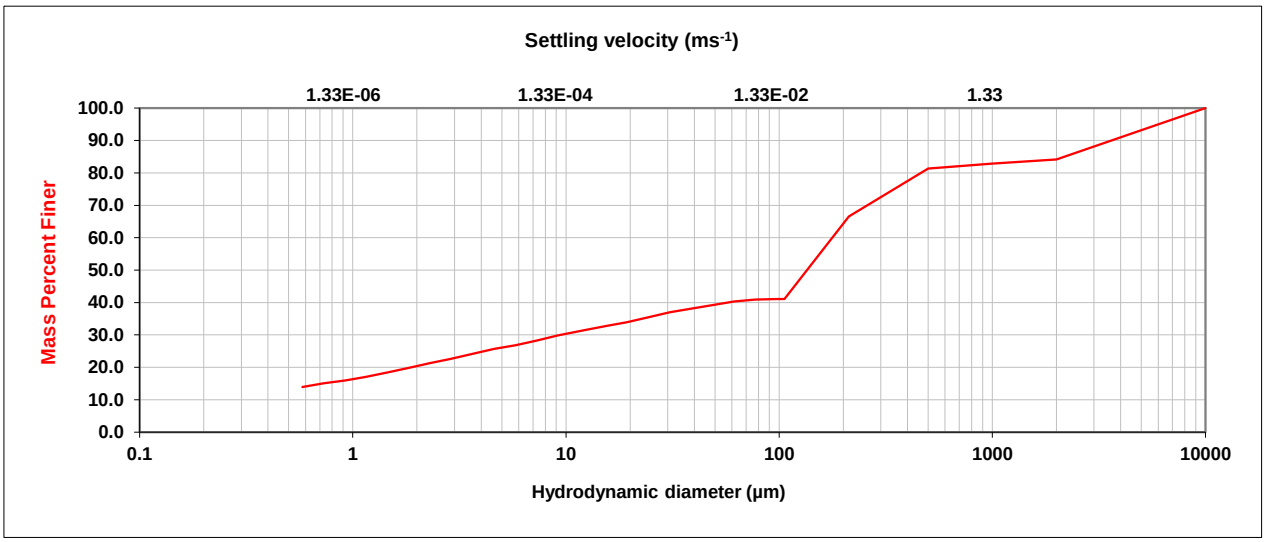
* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

37 Kensington Street
East Perth
WA 6004

Client:	ALS
Client ID:	EP1900623_023 O1
Job No:	19_0098
Laboratory ID:	19_0098_18

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10 mL sodium hexametaphosphate	**Concentration:**	~5 % w/w

Sample density:	2.723 g/cm^3 (assumed)		
Liquid density:	0.994 g/cm^3	**Critical diameter:**	53.54 µm
Liquid viscosity:	0.723 cp		



Fraction name	Max size (µm)	Min size (µm)	In %	Settling velocity (ms^{-1})*
Gravel	10000	2000	15.8	4.50E+01
Sand	2000	60	43.9	1.33E+00
Silt	60	2	19.0	1.20E-03
Clay	2	1	4.3	2.81E-06
Sub-clay	1	0	17.0	3.12E-07
Total			100.0	

Analyst: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Reported by: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Authorised by: Dan Cukierski, B.Sc.(Geology), M.Sc.(Geoscience)

Note : Data from 106 µm to 10,000 µm by wet screening , from 0.3µm to 106 µm by Sedimentation.

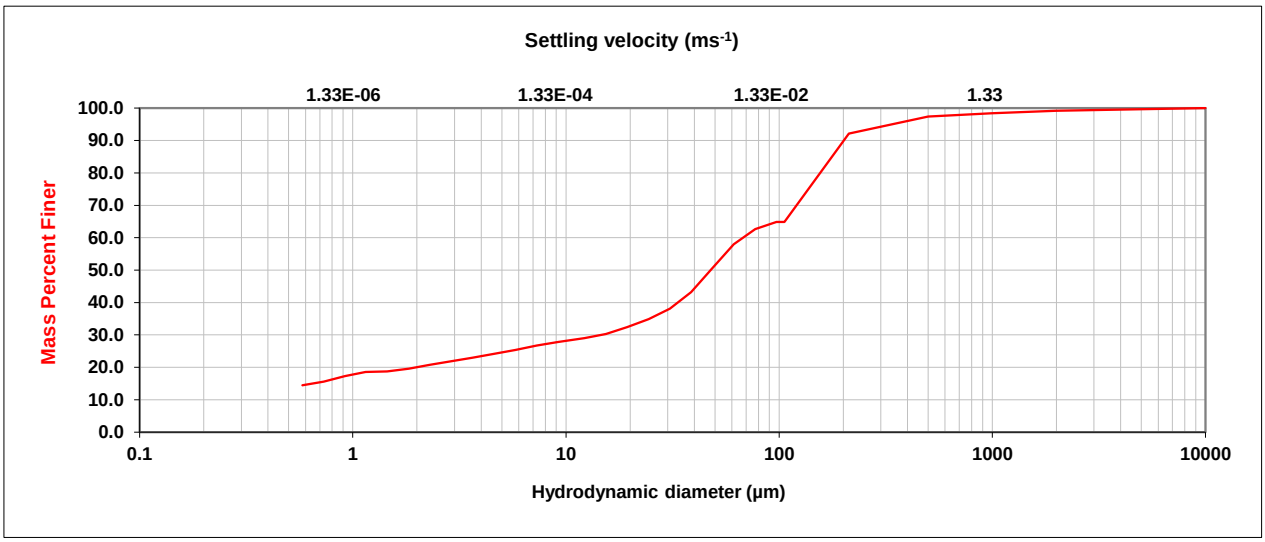
* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

37 Kensington Street
East Perth
WA 6004

Client:	ALS
Client ID:	EP1900623_024 O2
Job No:	19_0098
Laboratory ID:	19_0098_19

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10 mL sodium hexametaphosphate	**Concentration:**	~5 % w/w

Sample density:	2.691 g/cm^3 (assumed)		
Liquid density:	0.994 g/cm^3	**Critical diameter:**	53.87 µm
Liquid viscosity:	0.723 cp		



Fraction name	Max size (µm)	Min size (µm)	In %	Settling velocity (ms^{-1})*
Gravel	10000	2000	0.8	4.50E+01
Sand	2000	60	41.2	1.33E+00
Silt	60	2	37.2	1.20E-03
Clay	2	1	2.2	2.81E-06
Sub-clay	1	0	18.6	3.12E-07
Total			100.0	

Analyst: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Reported by: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Authorised by: Dan Cukierski, B.Sc.(Geology), M.Sc.(Geoscience)

Note : Data from 106 µm to 10,000 µm by wet screening , from 0.3µm to 106 µm by Sedimentation.

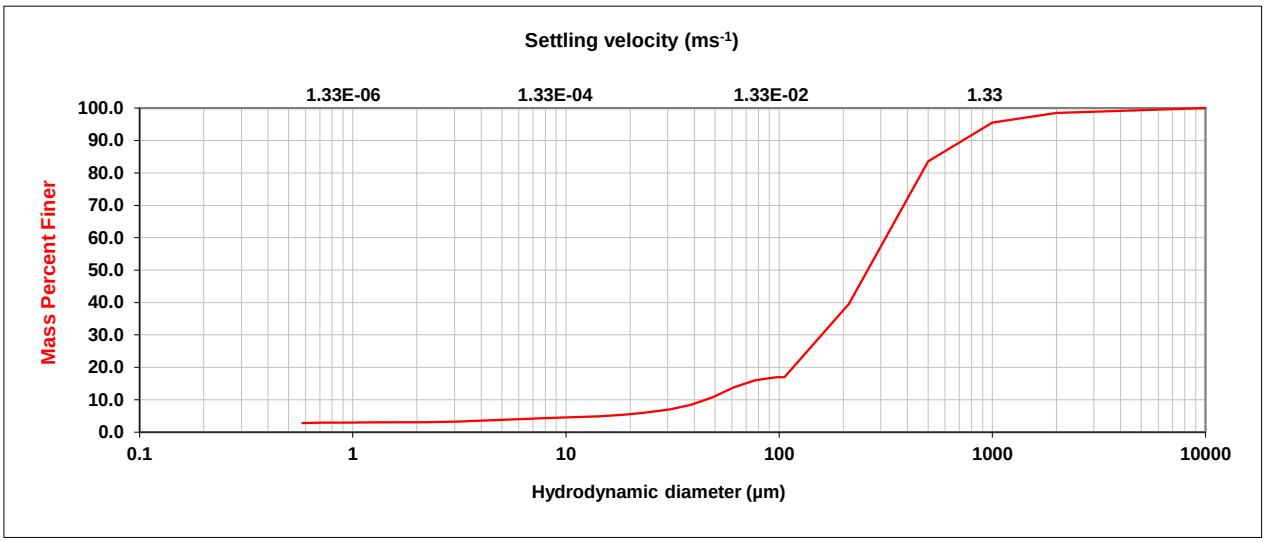
* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

37 Kensington Street
East Perth
WA 6004

Client:	ALS
Client ID:	EP1900623_025 O3
Job No:	19_0098
Laboratory ID:	19_0098_20

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10 mL sodium hexametaphosphate	**Concentration:**	~5 % w/w

Sample density:	2.719 g/cm^3 (assumed)		
Liquid density:	0.994 g/cm^3	**Critical diameter:**	53.60 µm
Liquid viscosity:	0.724 cp		



Fraction name	Max size (µm)	Min size (µm)	In %	Settling velocity (ms^{-1})*
Gravel	10000	2000	1.5	4.50E+01
Sand	2000	60	84.7	1.33E+00
Silt	60	2	10.6	1.20E-03
Clay	2	1	0.1	2.81E-06
Sub-clay	1	0	3.1	3.12E-07
Total			100.0	

Analyst:	Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)
Reported by:	Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)
Authorised by:	Dan Cukierski, B.Sc.(Geology), M.Sc.(Geoscience)

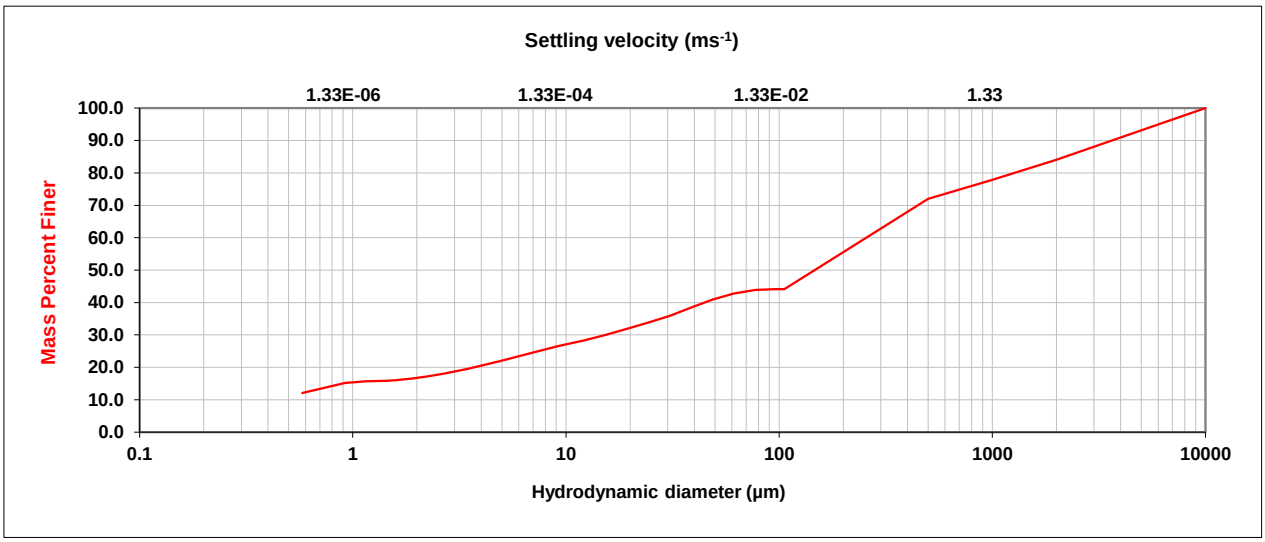
Note : Data from 106 µm to 10,000 µm by wet screening , from 0.3µm to 106 µm by Sedimentation.
* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

37 Kensington Street
East Perth
WA 6004

Client:	ALS
Client ID:	EP1900623_022 OC1-1
Job No:	19_0098
Laboratory ID:	19_0098_17

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10 mL sodium hexametaphosphate	**Concentration:**	~5 % w/w

Sample density:	2.727 g/cm^3 (assumed)		
Liquid density:	0.994 g/cm^3	**Critical diameter:**	53.53 µm
Liquid viscosity:	0.725 cp		



Fraction name	Max size (µm)	Min size (µm)	In %	Settling velocity (ms^{-1})*
Gravel	10000	2000	16.0	4.50E+01
Sand	2000	60	41.2	1.33E+00
Silt	60	2	25.5	1.20E-03
Clay	2	1	1.6	2.81E-06
Sub-clay	1	0	15.7	3.12E-07
Total			100.0	

Analyst: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Reported by: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Authorised by: Dan Cukierski, B.Sc.(Geology), M.Sc.(Geoscience)

Note : Data from 106 µm to 10,000 µm by wet screening , from 0.3µm to 106 µm by Sedimentation.

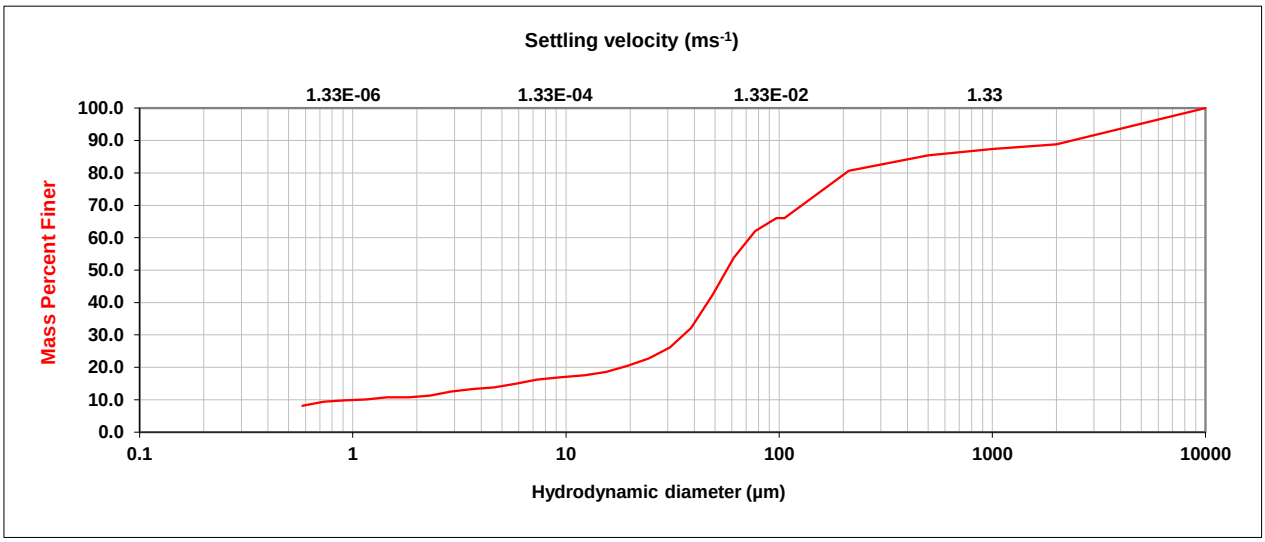
* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

37 Kensington Street
East Perth
WA 6004

Client:	ALS
Client ID:	EP1900623_009 TB1-1
Job No:	19_0098
Laboratory ID:	19_0098_04

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10 mL sodium hexametaphosphate	**Concentration:**	~5 % w/w

Sample density:	2.704 g/cm^3 (assumed)		
Liquid density:	0.994 g/cm^3	**Critical diameter:**	53.78 µm
Liquid viscosity:	0.725 cp		



Fraction name	Max size (µm)	Min size (µm)	In %	Settling velocity (ms^{-1})*
Gravel	10000	2000	11.2	4.50E+01
Sand	2000	60	35.0	1.33E+00
Silt	60	2	42.6	1.20E-03
Clay	2	1	1.2	2.81E-06
Sub-clay	1	0	10.1	3.12E-07
Total			100.0	

Analyst: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Reported by: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Authorised by: Dan Cukierski, B.Sc.(Geology), M.Sc.(Geoscience)

Note : Data from 106 µm to 10,000 µm by wet screening , from 0.3µm to 106 µm by Sedimentation.

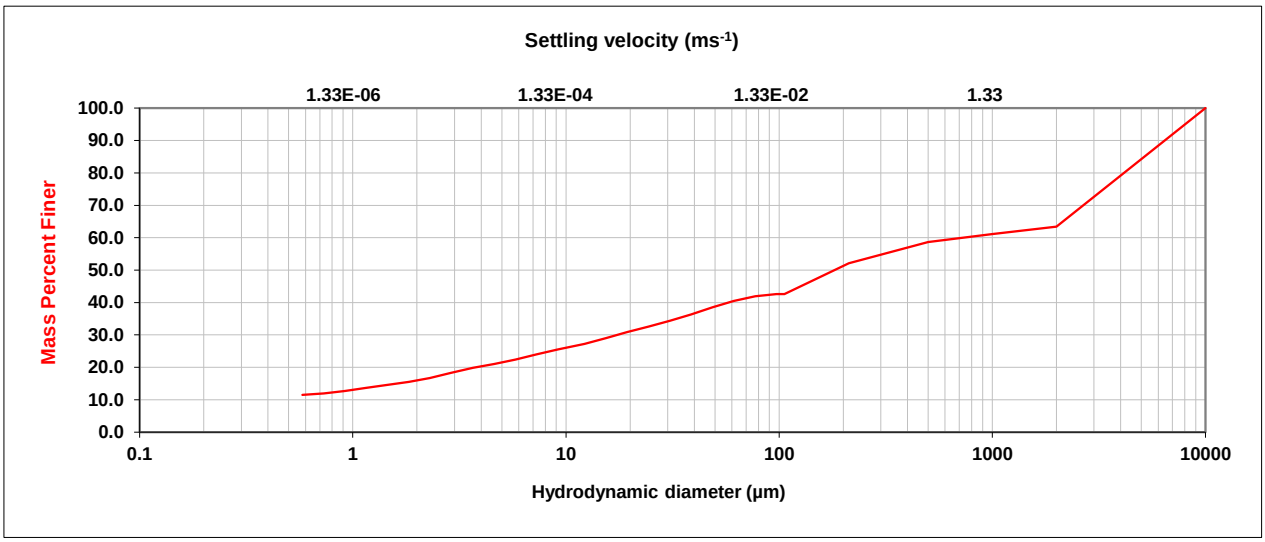
* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

37 Kensington Street
East Perth
WA 6004

Client:	ALS
Client ID:	EP1900623_010 TB4-1
Job No:	19_0098
Laboratory ID:	19_0098_05

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10 mL sodium hexametaphosphate	**Concentration:**	~5 % w/w

Sample density:	2.707 g/cm^3 (assumed)		
Liquid density:	0.994 g/cm^3	**Critical diameter:**	53.71 µm
Liquid viscosity:	0.723 cp		



Fraction name	Max size (µm)	Min size (µm)	In %	Settling velocity (ms^{-1})*
Gravel	10000	2000	36.5	4.50E+01
Sand	2000	60	22.9	1.33E+00
Silt	60	2	23.8	1.20E-03
Clay	2	1	3.1	2.81E-06
Sub-clay	1	0	13.6	3.12E-07
Total			100.0	

Analyst: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Reported by: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Authorised by: Dan Cukierski, B.Sc.(Geology), M.Sc.(Geoscience)

Note : Data from 106 µm to 10,000 µm by wet screening , from 0.3µm to 106 µm by Sedimentation.

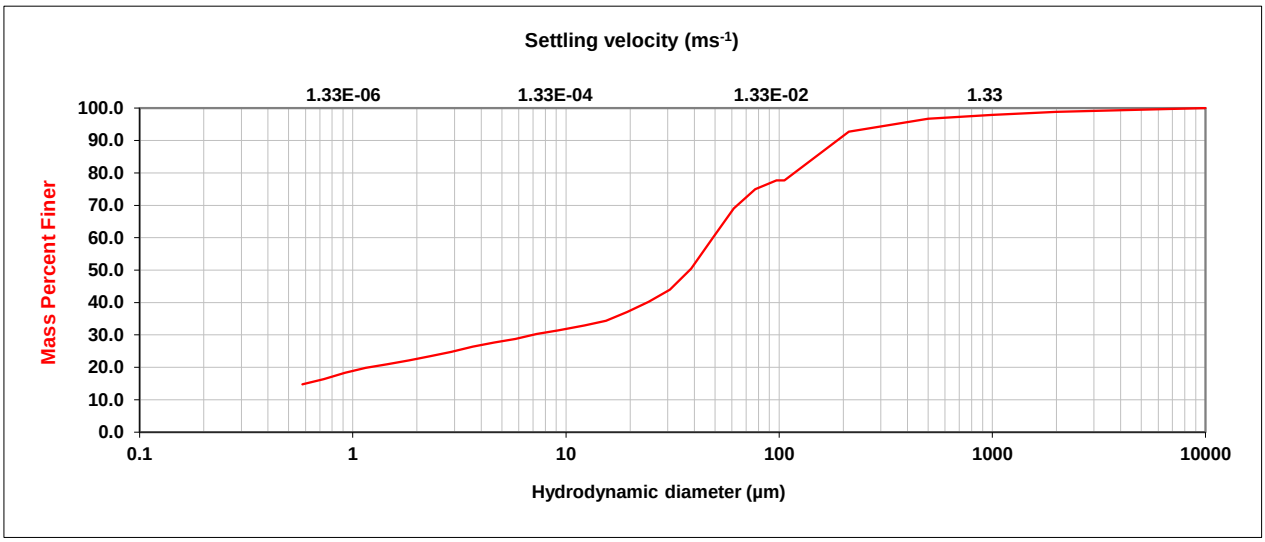
* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

37 Kensington Street
East Perth
WA 6004

Client:	ALS
Client ID:	EP1900623_011 TB5
Job No:	19_0098
Laboratory ID:	19_0098_06

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10 mL sodium hexametaphosphate	**Concentration:**	~5 % w/w

Sample density:	2.694 g/cm^3 (assumed)		
Liquid density:	0.994 g/cm^3	**Critical diameter:**	53.88 µm
Liquid viscosity:	0.725 cp		



Fraction name	Max size (µm)	Min size (µm)	In %	Settling velocity (ms^{-1})*
Gravel	10000	2000	1.2	4.50E+01
Sand	2000	60	29.8	1.33E+00
Silt	60	2	45.6	1.20E-03
Clay	2	1	3.5	2.81E-06
Sub-clay	1	0	19.9	3.12E-07
Total			100.0	

Analyst: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Reported by: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Authorised by: Dan Cukierski, B.Sc.(Geology), M.Sc.(Geoscience)

Note : Data from 106 µm to 10,000 µm by wet screening , from 0.3µm to 106 µm by Sedimentation.

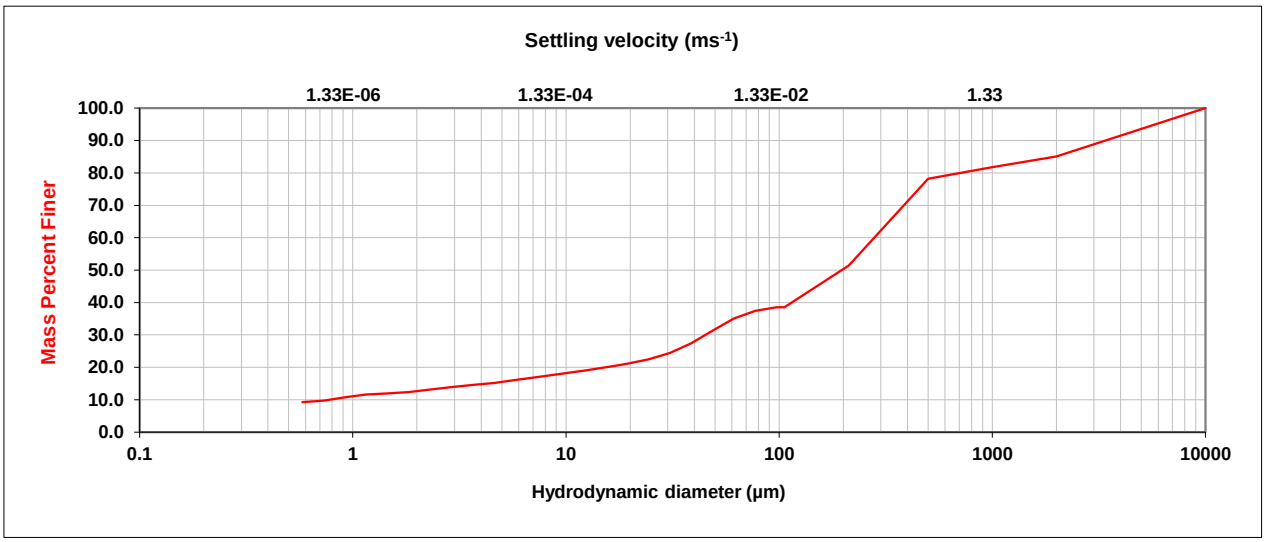
* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

37 Kensington Street
East Perth
WA 6004

Client:	ALS
Client ID:	EP1900623_012 TB6
Job No:	19_0098
Laboratory ID:	19_0098_07

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10 mL sodium hexametaphosphate	**Concentration:**	~5 % w/w

Sample density:	2.739 g/cm^3 (assumed)		
Liquid density:	0.994 g/cm^3	**Critical diameter:**	53.36 µm
Liquid viscosity:	0.723 cp		



Fraction name	Max size (µm)	Min size (µm)	In %	Settling velocity (ms^{-1})*
Gravel	10000	2000	15.0	4.50E+01
Sand	2000	60	50.0	1.33E+00
Silt	60	2	21.9	1.20E-03
Clay	2	1	1.5	2.81E-06
Sub-clay	1	0	11.6	3.12E-07
Total			100.0	

Analyst:	Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)
Reported by:	Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)
Authorised by:	Dan Cukierski, B.Sc.(Geology), M.Sc.(Geoscience)

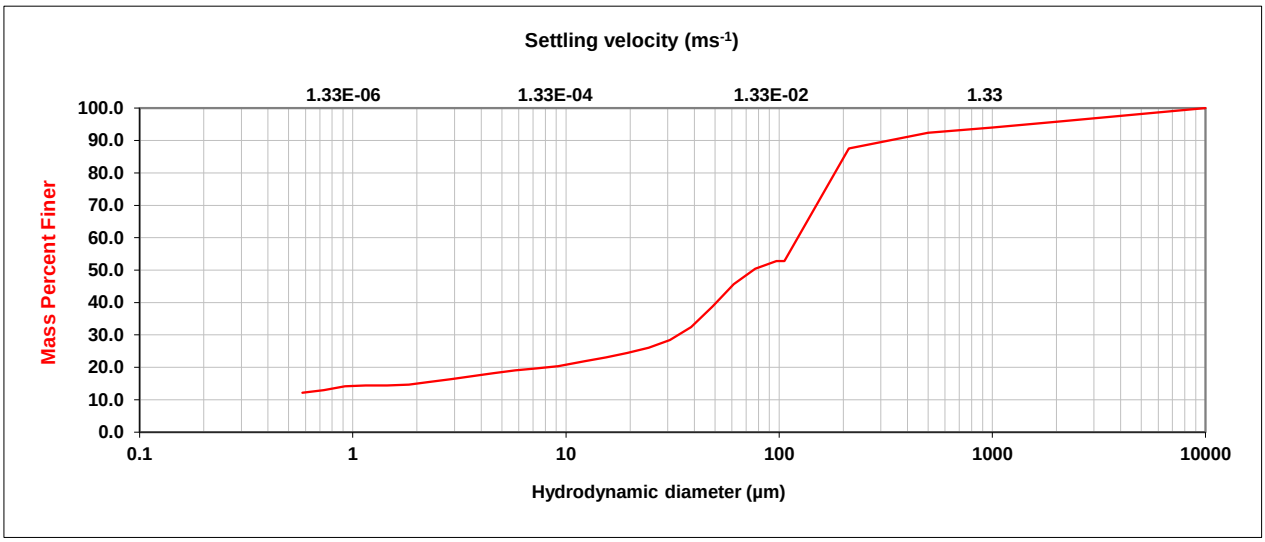
Note : Data from 106 µm to 10,000 µm by wet screening , from 0.3µm to 106 µm by Sedimentation.
* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

37 Kensington Street
East Perth
WA 6004

Client:	ALS
Client ID:	EP1900623_013 TB7
Job No:	19_0098
Laboratory ID:	19_0098_08

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10 mL sodium hexametaphosphate	**Concentration:**	~5 % w/w

Sample density:	2.719 g/cm^3 (assumed)		
Liquid density:	0.994 g/cm^3	**Critical diameter:**	53.58 µm
Liquid viscosity:	0.723 cp		



Fraction name	Max size (µm)	Min size (µm)	In %	Settling velocity (ms^{-1})*
Gravel	10000	2000	4.2	4.50E+01
Sand	2000	60	50.1	1.33E+00
Silt	60	2	30.2	1.20E-03
Clay	2	1	1.1	2.81E-06
Sub-clay	1	0	14.4	3.12E-07
Total			100.0	

Analyst: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Reported by: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Authorised by: Dan Cukierski, B.Sc.(Geology), M.Sc.(Geoscience)

Note : Data from 106 µm to 10,000 µm by wet screening , from 0.3µm to 106 µm by Sedimentation.

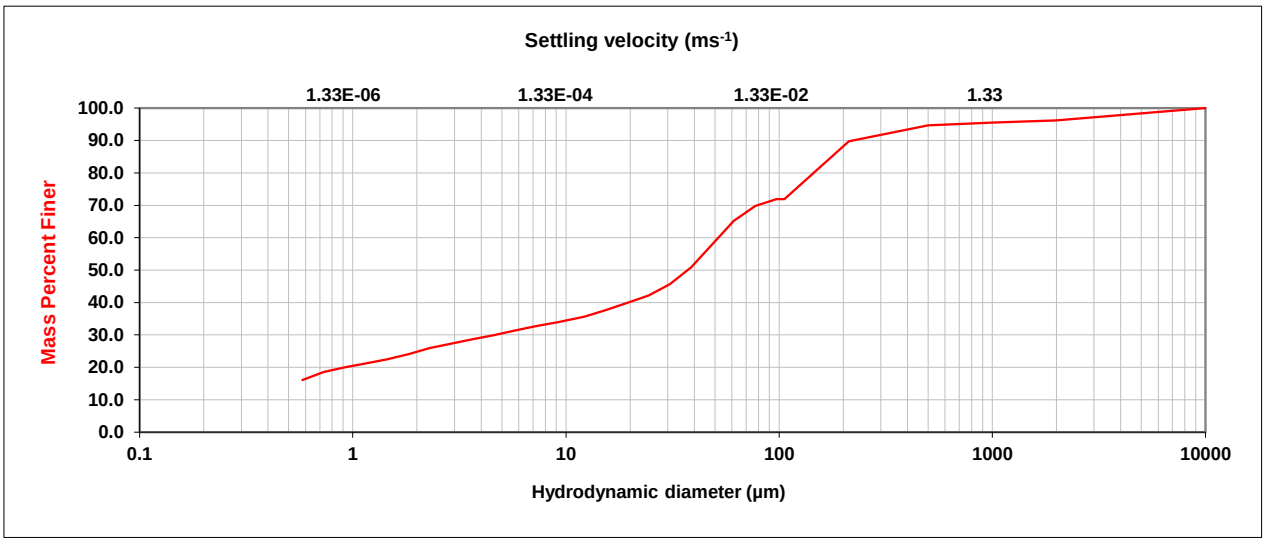
* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

37 Kensington Street
East Perth
WA 6004

Client:	ALS
Client ID:	EP1900623_014 TB8
Job No:	19_0098
Laboratory ID:	19_0098_09

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10 mL sodium hexametaphosphate	**Concentration:**	~5 % w/w

Sample density:	2.723 g/cm^3 (assumed)		
Liquid density:	0.994 g/cm^3	**Critical diameter:**	53.58 µm
Liquid viscosity:	0.725 cp		



Fraction name	Max size (µm)	Min size (µm)	In %	Settling velocity (ms^{-1})*
Gravel	10000	2000	3.8	4.50E+01
Sand	2000	60	31.0	1.33E+00
Silt	60	2	39.3	1.20E-03
Clay	2	1	4.8	2.81E-06
Sub-clay	1	0	21.2	3.12E-07
Total			100.0	

Analyst: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Reported by: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Authorised by: Dan Cukierski, B.Sc.(Geology), M.Sc.(Geoscience)

Note : Data from 106 µm to 10,000 µm by wet screening , from 0.3µm to 106 µm by Sedimentation.

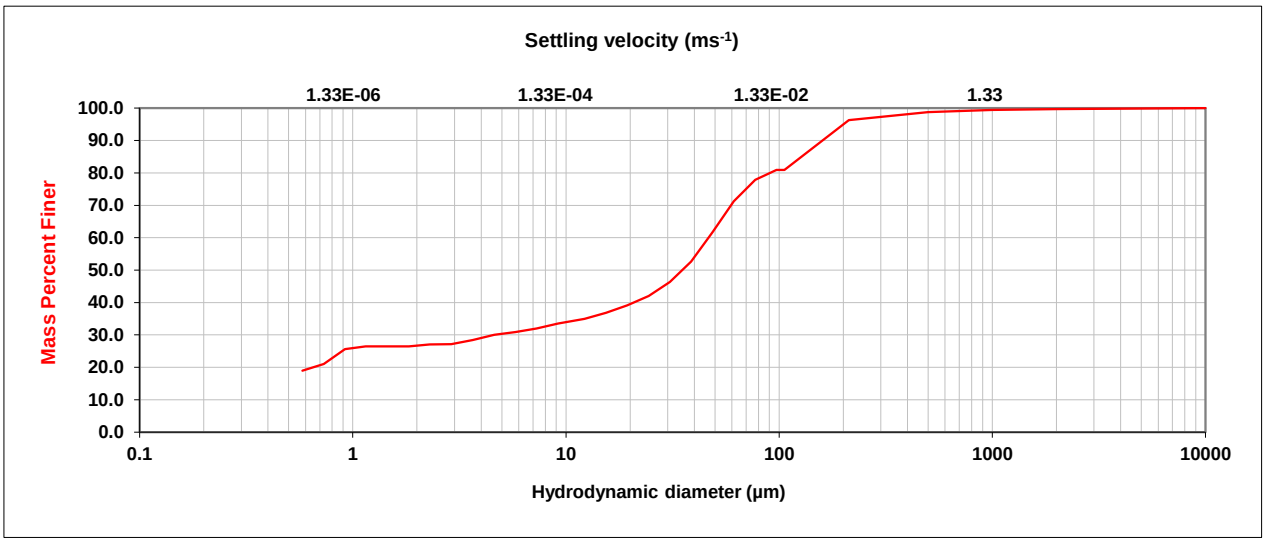
* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

37 Kensington Street
East Perth
WA 6004

Client:	ALS
Client ID:	EP1900623_015 TB10
Job No:	19_0098
Laboratory ID:	19_0098_10

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10 mL sodium hexametaphosphate	**Concentration:**	~5 % w/w

Sample density:	2.699 g/cm^3 (assumed)		
Liquid density:	0.994 g/cm^3	**Critical diameter:**	53.82 µm
Liquid viscosity:	0.724 cp		



Fraction name	Max size (µm)	Min size (µm)	In %	Settling velocity (ms^{-1})*
Gravel	10000	2000	0.3	4.50E+01
Sand	2000	60	28.4	1.33E+00
Silt	60	2	44.2	1.20E-03
Clay	2	1	0.6	2.81E-06
Sub-clay	1	0	26.4	3.12E-07
Total			100.0	

Analyst: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Reported by: Sumudu Ariyawansa, B.Sc.(Agriculture)(Hons), Dip.(Laboratory Technology)

Authorised by: Dan Cukierski, B.Sc.(Geology), M.Sc.(Geoscience)

Note : Data from 106 µm to 10,000 µm by wet screening , from 0.3µm to 106 µm by Sedimentation.

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

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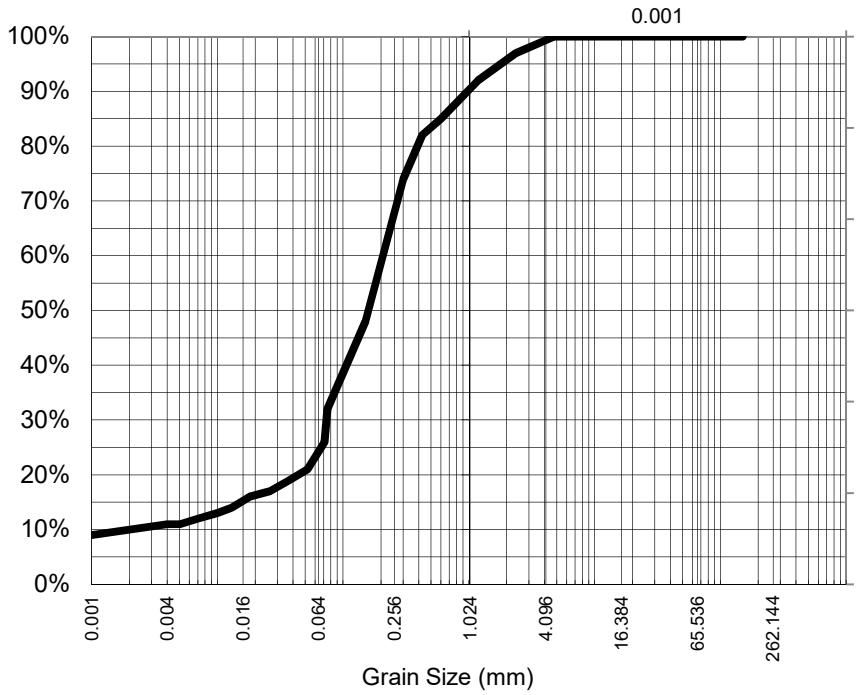
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	6-Mar-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA	**REPORT NO:**	EP1902034-001 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	RF1

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	97%
1.18	92%
0.600	85%
0.425	82%
0.300	74%
0.150	48%
0.075	32%
Particle Size (microns)	
52	21%
37	19%
26	17%
18	16%
13	14%
10	13%
7	12%
5	11%
1	9%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.162

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

Sample Comments:		**Analysed:**	11-Mar-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.75		

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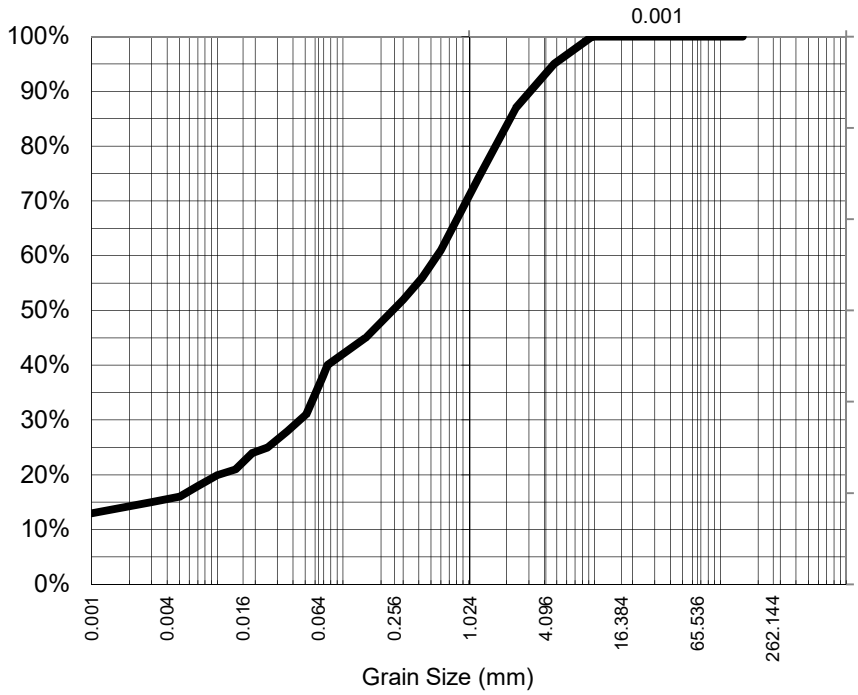
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA	**REPORT NO:**	EP1902034-002 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	RF2

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	95%
2.36	87%
1.18	74%
0.600	61%
0.425	56%
0.300	52%
0.150	45%
0.075	40%
Particle Size (microns)	
51	31%
36	28%
25	25%
19	24%
14	21%
10	20%
7	18%
5	16%
1	13%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.257

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

Sample Comments:

Analysed: 11-Mar-19

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, FINES, STONE

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.72

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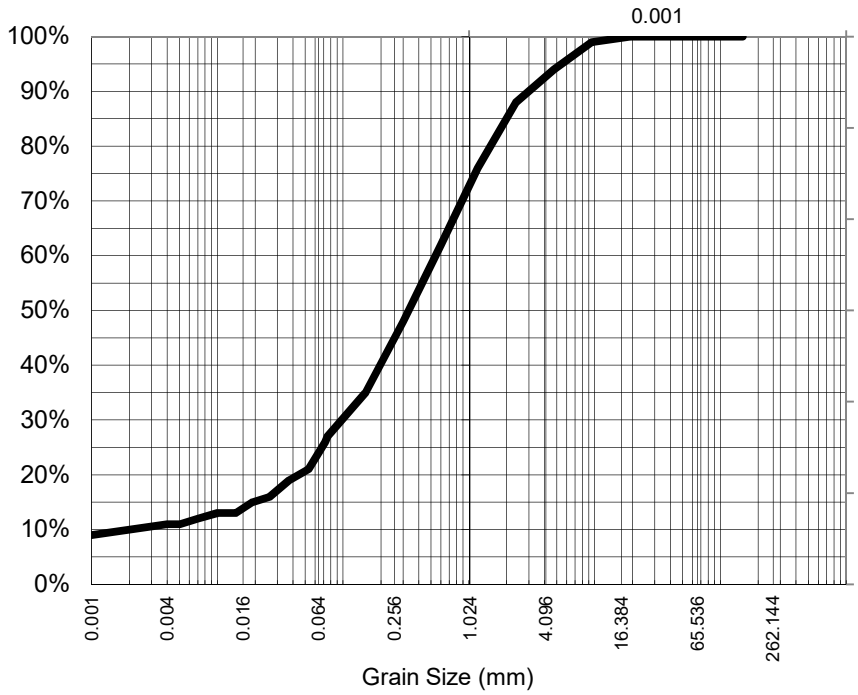
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	RF3

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	99%
4.75	94%
2.36	88%
1.18	76%
0.600	62%
0.425	55%
0.300	48%
0.150	35%
0.075	27%
Particle Size (microns)	
53	21%
37	19%
26	16%
19	15%
14	13%
10	13%
7	12%
5	11%
1	9%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.336

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

Sample Comments:

Analysed: 11-Mar-19

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, FINES, STONE

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.7

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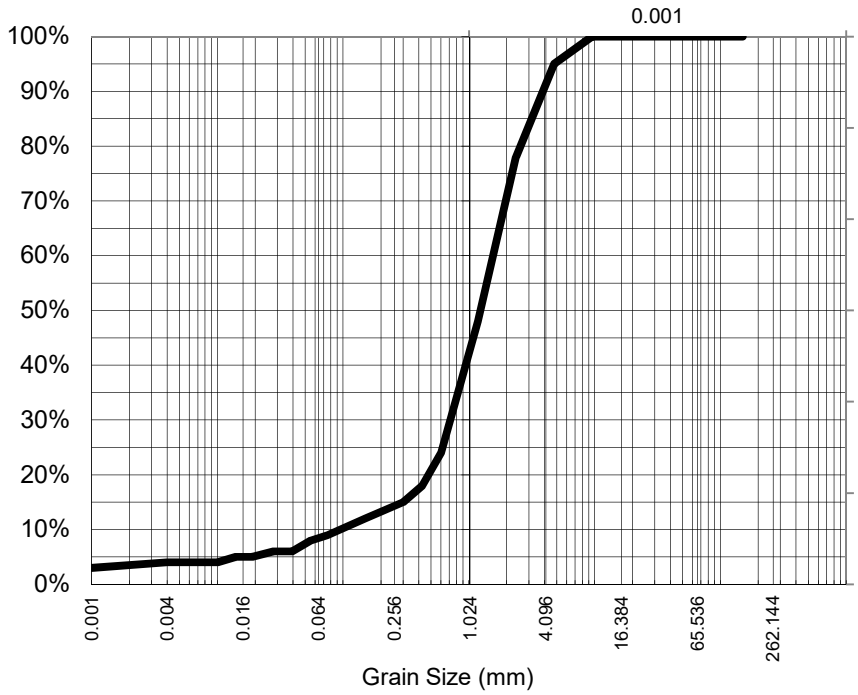
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA	**REPORT NO:**	EP1902034-004 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	RF4

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	95%
2.36	78%
1.18	48%
0.600	24%
0.425	18%
0.300	15%
0.150	12%
0.075	9%
Particle Size (microns)	
55	8%
39	6%
28	6%
19	5%
14	5%
10	4%
7	4%
5	4%
1	3%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	1.259

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:**	11-Mar-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, STONE, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.73		

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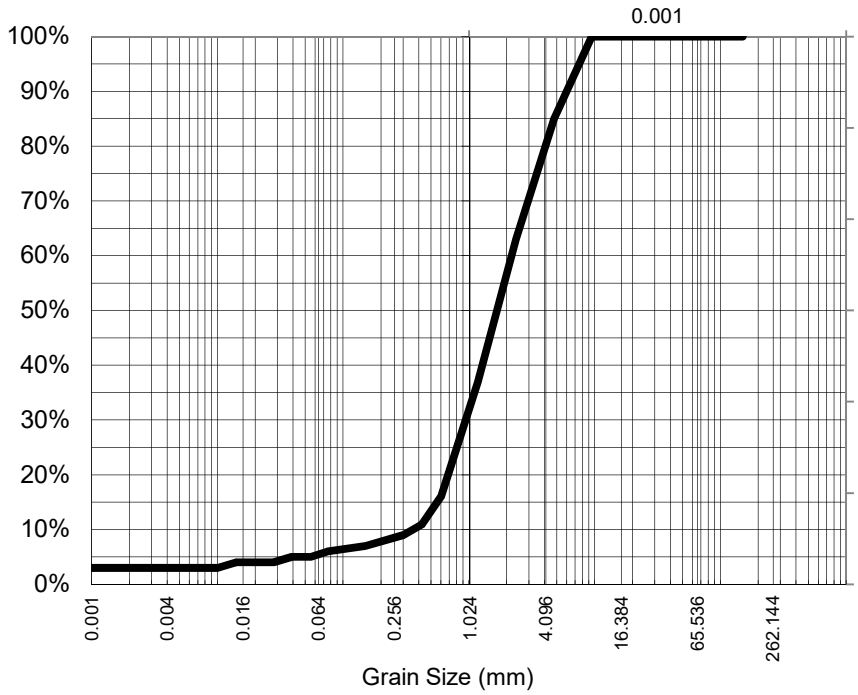
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA	**REPORT NO:**	EP1902034-005 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	RF5

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	85%
2.36	63%
1.18	37%
0.600	16%
0.425	11%
0.300	9%
0.150	7%
0.075	6%
Particle Size (microns)	
55	5%
39	5%
28	4%
19	4%
14	4%
10	3%
7	3%
5	3%
1	3%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	1.770

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:**	11-Mar-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, STONE, FINES	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.72		

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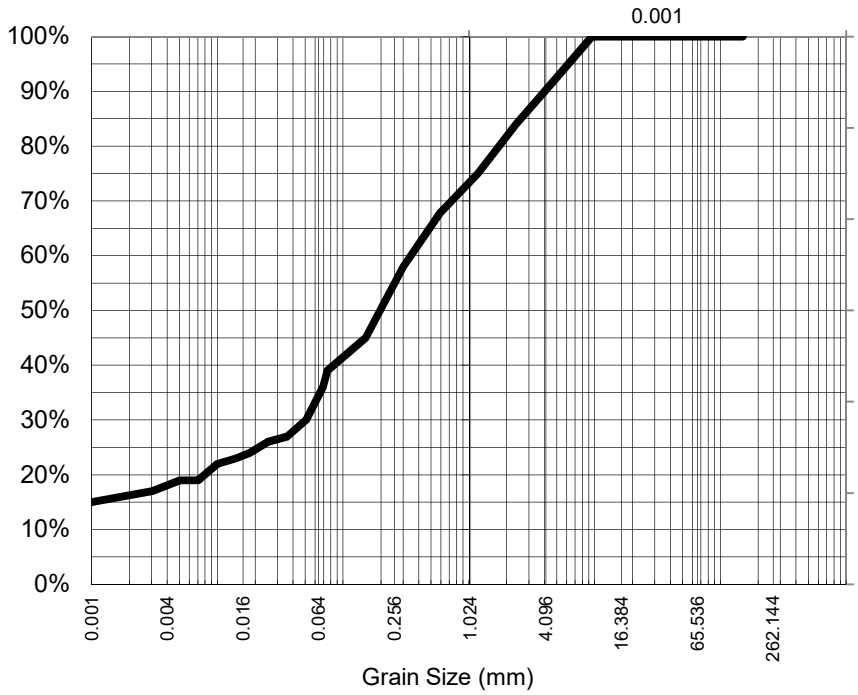
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA	**REPORT NO:**	EP1902034-006 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	RF6

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	92%
2.36	84%
1.18	75%
0.600	68%
0.425	63%
0.300	58%
0.150	45%
0.075	39%
Particle Size (microns)	
51	30%
36	27%
25	26%
18	24%
14	23%
10	22%
7	19%
5	19%
1	15%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.208

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

Sample Comments:

Analysed: 11-Mar-19

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, FINES, STONE

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.73

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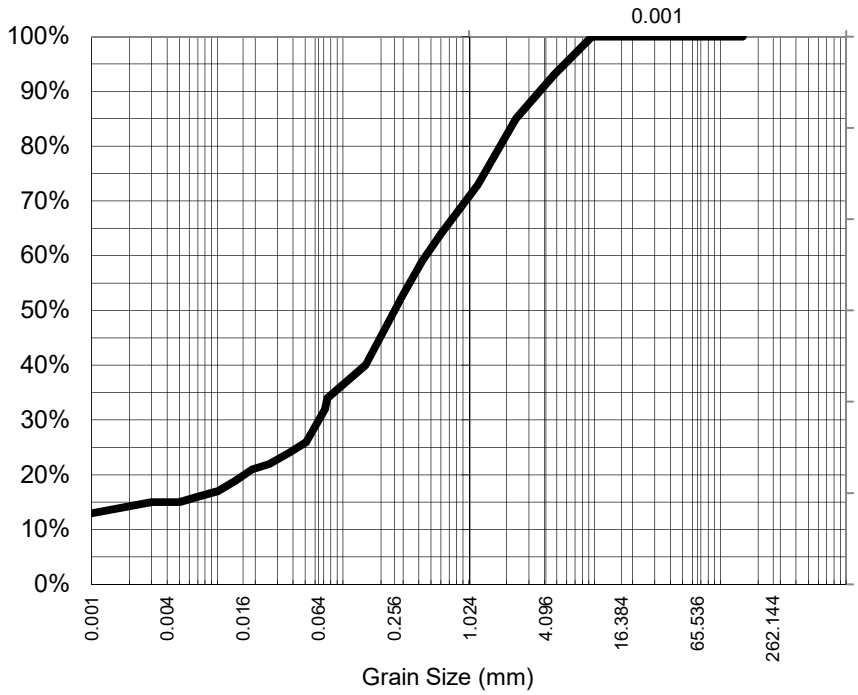
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	6-Mar-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA	**REPORT NO:**	EP1902034-007 / PSD
PROJECT:	18WAU-0002 Mardie Project: Sediment Sampling	**SAMPLE ID:**	RFB

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	93%
2.36	85%
1.18	73%
0.600	64%
0.425	59%
0.300	53%
0.150	40%
0.075	34%
Particle Size (microns)	
51	26%
37	24%
26	22%
19	21%
14	19%
10	17%
7	16%
5	15%
1	13%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.265

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

Sample Comments:		**Analysed:**	11-Mar-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, STONE	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.72		

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Appendix E Benthic Infauna Sampling

Appendix E: Mardie Benthic Infauna Sampling Results

METHODOLOGY

Macroinvertebrate sorting and taxonomy

Benthic samples were poured through a 500 µm mesh sieve to separate fauna and sediment. Sieved samples were then transferred to labelled jars and preserved with 70 % isopropyl. Samples were kept at 4ºC immediately after collection in the field and during transport to Carijoa in Perth, Western Australia. Samples were unpacked and checked for integrity upon delivery.

Picking of specimens from petri dishes was conducted under a dissecting microscope with all benthic fauna being separated from the sediment and counted. Picking quality assurance was done on 2 samples (10 % of the total samples) with a 5 % permissible error. Previous samples are checked if the error was greater than 5 % and repeated until a rate of less than 5 % was achieved.

Identification of benthic fauna was to the lowest taxonomic level possible dependent on the quality of the preservation of individual animals. A reference collection has been preserved and will be stored at Carijoa.

Analyses

Diversity indices

P.A.S.T v3.22 (Hammer et al. 2001) was used to calculate diversity indices in order to provide greater insight into community composition and included:

- Margalef's richness index (d): a richness index that calculates richness based on the total number of individuals in a sample
- Shannon's index (H): a diversity index that accounts for abundance and evenness
- Shannon's Evenness index (EH): an evenness index that calculates how evenly individuals are spread among species. Evenness is scaled on a value between 0 and 1 (1 = complete evenness).
- Dominance (D, 1-Simpson Index): assesses taxon dominance within a sample and ranges between 0 (all taxa are equally present) to 1 (one taxon dominates the community completely)

Multivariate analyses

Raw abundance data was standardised to remove sampling bias due to variation of sample size within and between samples (sites). Standardised data was subsequently square root transformed to even out the contribution of common vs rarer taxa where higher abundance

of some taxa could overshadow the contribution of less common taxa. Community similarity analyses were carried out with Primer v6 software (Clarke & Gorley, 2006).

Cluster and Principle Coordinates analysis (PCO) was run on Bray Curtis similarity matrix and was performed to obtain an ordination of sites based on relative similarity in composition and abundance of the shared taxa. Canonical Analysis of Principle Coordinates (CAP) was then used to provide a constrained ordination of sites and to correlate the variables (taxa) with patterns on the CAP plot (Anderson and Willis, 2003, Anderson, 2003). This was done using vector overlays that show the strength and direction of the Spearman correlation of taxa relative to the axis of the plotted ordination and the pattern of the sites plotted according to their similarity to each other. This provides a strong indication of which taxa are contributing most to the plotted distribution and grouping of the sites.

At a coarser level, a one-way Analysis of Similarity (ANOSIM) was used to determine if there was a difference in community composition between the area allocated for the Turning Basin (TB2, TB6, TB8, TB10) and the area surrounding the outfall (O1, O2, O3). ANOSIM produces an R-value with a range from 0 (no difference in composition) – 1 (compositions are completely different). A Similarity Percentage (SIMPER) routine was used to determine which taxa are contributing to the similarity/dissimilarity between the two locations.

Feeding guilds

Classifying taxa according to feeding guilds can be useful for assessing impacts at the ecosystem level. The feeding guilds used to characterise the taxa from each sample are defined by MacDonald et al. (2010) and included:

- Food source
    - Epibenthic = above sediment or from water column
    - Surface = surface of sediment
    - Subsurface = below sediment surface
- Diet
    - Carnivorous = animal matter
    - Herbivorous = plant matter
    - Omnivorous = animal and plant matter
- Feeding mode
    - Deposit feeder = ingests sediment
    - Detritus feeder = ingests particular matter only, without sediment
    - Suspension/filter feeder = strains particles from the water
    - Predator = eats live animals only
    - Scavenger = carrion only
    - Grazer = feeds by scraping, either on algae or sessile animals
    - Browsing = feeds by tearing or gathering particular items

Feeding guilds were overlaid on nMDS plots to assess whether guilds could be contributing to any differences between sites.

Foraminifera

Foraminifera are single-celled organisms in the phylum Protista. The majority of species are benthic and feed on dissolved organic molecules, bacteria, diatoms and phytoplankton. Larger species may feed on small invertebrates such as copepods. Previous studies have demonstrated that benthic foraminifera could provide sensitive and inexpensive bioindicators of coastal environmental viability. In particular, benthic foraminifera have been used as proxies for measuring the impact of pollutants such as hydrocarbons, heavy metals and anoxic conditions (see Capotondi et al, 2015 and references therein).
The most common foraminifera found in the benthic samples were counted to provide a qualitative representation only of their commonality and relative abundance.

RESULTS

In total, 128 individuals from 27 morphological species were identified (Table 1). The three most common taxa across all sites were Nematoda (n = 30), Sipuncula sp. (n = 25) and Polychaeta sp. 3 (n = 14). Polychaeta was the most diverse class in terms of the number of morphological species identified (14). TB8 had the highest number of morphological species identified (12) and TB2 had the lowest (3) (Table 1).

Table 1: Presence/absence of morphological species at each site

Morphological species	O1	O2	O3	TB2	TB6	TB8	TB10
Bivalvia sp. 1					■		
Bivalvia sp. 2						■	
Nassariidae sp. 1							
Harpacticoida sp. 1		■					
Annelida sp. 1	■						
Nematoda spp.	■		■	■		■	■
Cossuridae sp. 1				■			
Cossuridae sp. 2		■					
Nereididae sp. 1						■	
Polychaeta sp .1							■
Polychaeta sp. 2	■	■					■
Polychaeta sp. 3		■	■				■
Polychaeta sp. 4							■
Polychaeta sp. 5		■					
Polychaeta sp. 6					■		
Polychaeta sp. 8						■	
Polychaeta sp. 9						■	
Polychaeta sp. 10			■				
Capitellidae spp	■	■			■		■
Tanaidacea spp.		■					
Amphipoda sp. 1		■				■	
Copepoda sp. 1							■
Sipuncula sp. 1	■	■	■	■	■	■	■
Sipuncula sp. 2		■			■	■	
Sipuncula sp. 3						■	
Ostracoda sp. 1						■	■
Scaphopoda sp.1						■	

Diversity indices

Margalef's species richness index varied across sites, with TB8 having the highest index and O3 the lowest (Fig. 1). ANOVA revealed no significant difference in species richness between sites within the Turning Basin and sites surrounding the outfall ($F = 0.149$, $p = 0.715$).

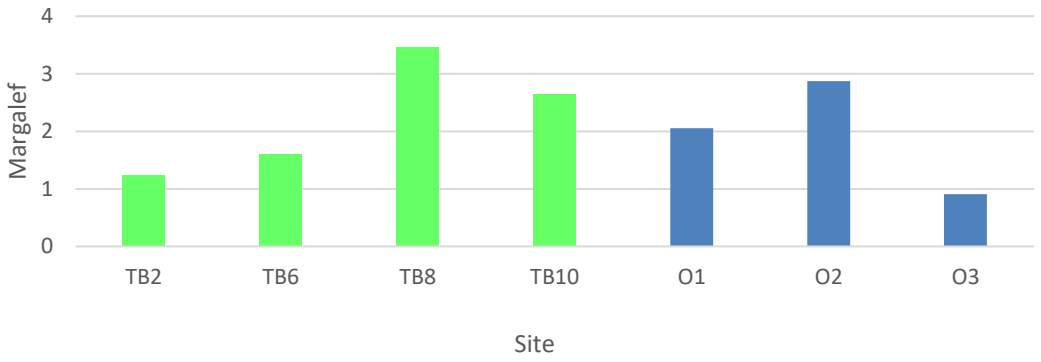

Figure 1: Margalef's species richness index (d) across sites. Green = sites within the Turning Basin and blue = sites surrounding the outfall.

Shannon's H diversity measure varied across sites, with TB8 having the greatest diversity and O3 the lowest (Fig. 2). ANOVA revealed no significant difference in diversity between sites within the Turning Basin and sites surrounding the outfall ($F = 0.227$, $p = 0.653$).

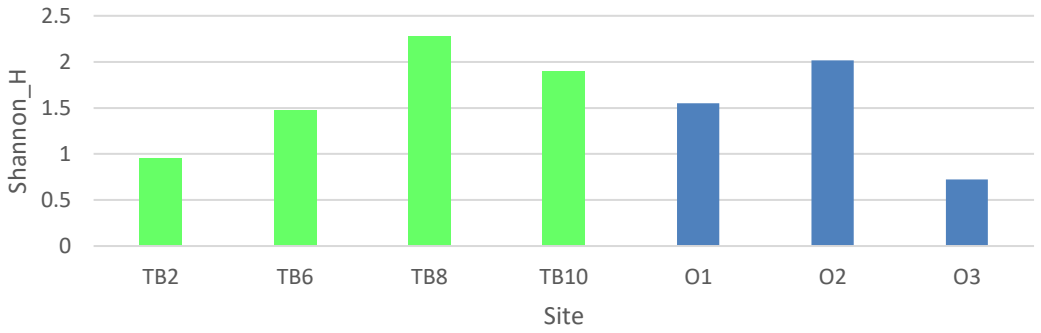

Figure 2: Shannon's diversity index (H) across sites. Green = sites within the Turning Basin and blue = sites surrounding the outfall.

Shannon's Evenness was high across most sites indicating that individuals are distributed evenly among the different morphological species (Fig. 3). Site O3 was calculated to be 0.5 indicating some unevenness. ANOVA revealed no significant difference in evenness between sites within the Turning Basin and sites surrounding the outfall ($F = 0.336$, $p = 0.587$).

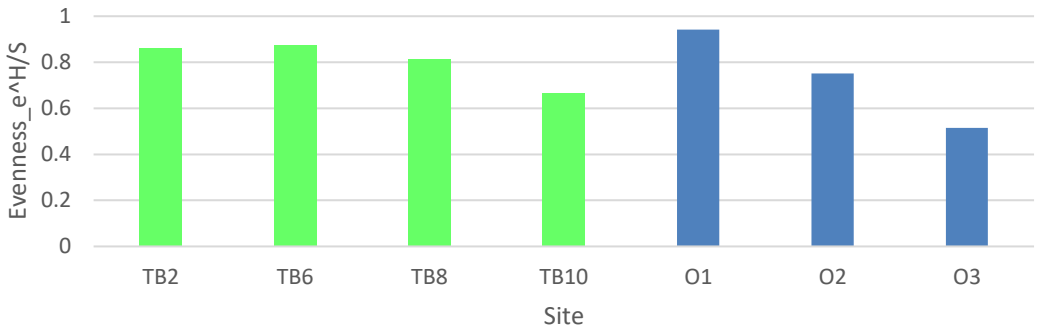

Figure 3: Shannon's evenness index (EH) across sites. Green = sites within the Turning Basin and blue = sites surrounding the outfall.

Dominance varied across sites but was generally low (< 0.4) for most sites indicating that no morphological species were dominating over others (Fig. 4). Some indication of dominance was observed for O3 which is attributed to the relative high number of Nematoda specimens found in the sample. ANOVA revealed no significant difference in dominance between sites within the Turning Basin and sites surrounding the outfall ($F = 0.327$, $p = 0.592$).

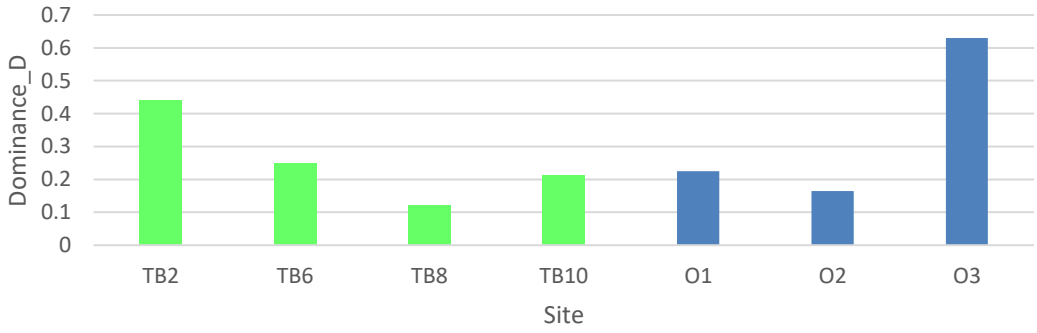

Figure 4: Dominance (D, 1-Simpson Index) across sites. Green = sites within the Turning Basin and blue = sites surrounding the outfall.

Community composition

Principle Coordinates analysis (PCO) showed that the first two principle components accounted for 62% of the variation of the dataset (Fig. 5). The PCO depicted a separation of the sites where TB10, O1 and O2 have 40% similarity and O3 and TB2 also have 40% similarity.

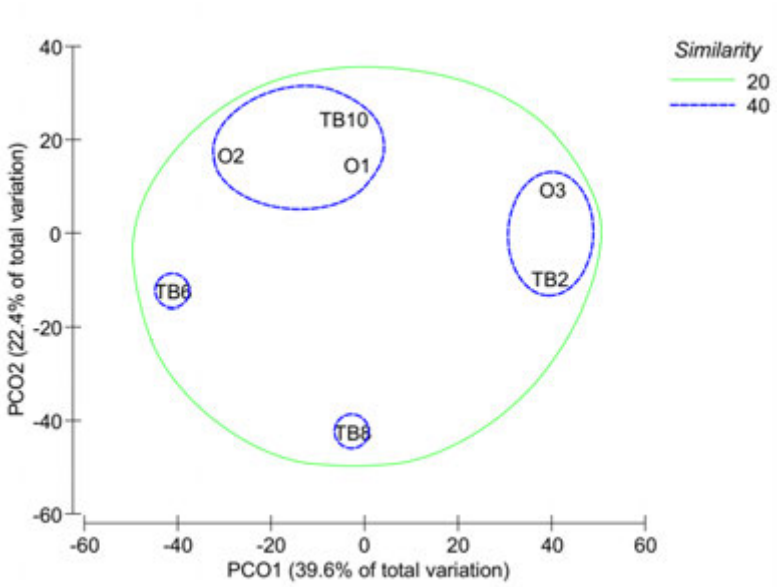

Figure 5. Principle Coordinates analysis (PCO) plot of component communities on Bray-Curtis similarity matrix of standardised, square root transformed abundance data. The first two principle components (x and y axis) accounted for 62 % of the variation of the dataset. Cluster analysis of 20 % and 40 % similarity revealed two groups of sites and two sites separated.

Canonical Analysis of Principle Coordinates (CAP) with vector overlay revealed the correlations (Spearman's rho >0.2) of taxa that characterise the differences between sites based on multivariate analysis (Table 2). The first CAP axis (CAP1) is highly correlated with Nematoda (Spearman's rho = 0.92) and Polychaeta sp.10 (Spearman's rho = 0.6) (Fig. 6), and negatively correlated with Sipuncula sp.2 (Spearman's rho = -0.89) and Capitellidae spp. (Spearman's rho = -0.65). The grouping of sites O1, O2 and TB10 is characterised by the presence of Polychaeta sp. 3, Polychaeta sp. 2 and Tanaidaceae spp. which are positively correlated to the second CAP axis (CAP2). Sites O3 and TB2 are characterised by Nematoda spp. and Polychaeta sp. 10 where the former was found in higher abundance at O3 and TB2 and Polychaeta sp. 10 was found only at site O3.The separation of site TB6 is characterised by Polychaeta sp. 6, Bivalvia sp. 1 and Capitellidae spp. Taxa that were negatively correlated with CAP2 included Bivalvia sp. 2, Nassariidae sp. 1, Nereididae sp. 1, Polychaeta sp. 8, Polychaeta sp. 9, Sipuncula sp. 3 and Scaphopoda sp. 1 and were found only in samples from TB8 (Table 2).

Table 2. Individual taxa showing Spearman's rho (>0.2) correlations with both canonical axes that separated the seven sites (see Fig. 6) along with their standardised, square root transformed abundance data.

Taxa	Correlation	TB2	TB10	O3	O1	O2	TB6	TB8
Nematoda spp.	0.92	7.75	2.58	8.82	3.78	0.00	0.00	3.54
Polychaeta sp. 10	0.60	0.00	0.00	1.92	0.00	0.00	0.00	0.00
Cossuridae sp. 1	0.47	4.47	0.00	0.00	0.00	0.00	0.00	0.00
Harpacticoida sp. 1	-0.29	0.00	0.00	0.00	0.00	2.09	0.00	0.00
Cossuridae sp. 2	-0.29	0.00	0.00	0.00	0.00	2.09	0.00	0.00
Polychaeta sp. 5	-0.29	0.00	0.00	0.00	0.00	2.09	0.00	0.00
Bivalvia sp. 2	-0.29	0.00	0.00	0.00	0.00	0.00	0.00	2.04
Nassariidae sp. 1	-0.29	0.00	0.00	0.00	0.00	0.00	0.00	2.04
Nereididae sp. 1	-0.29	0.00	0.00	0.00	0.00	0.00	0.00	2.04
Polychaeta sp. 8	-0.29	0.00	0.00	0.00	0.00	0.00	0.00	2.04
Polychaeta sp. 9	-0.29	0.00	0.00	0.00	0.00	0.00	0.00	2.04
Sipuncula sp. 3	-0.29	0.00	0.00	0.00	0.00	0.00	0.00	2.89
Scaphopoda sp. 1	-0.29	0.00	0.00	0.00	0.00	0.00	0.00	3.54
Amphipoda sp. 1	-0.45	0.00	0.00	0.00	0.00	2.09	0.00	2.04
Bivalvia sp. 1	-0.63	0.00	0.00	0.00	0.00	0.00	2.89	0.00
Polychaeta sp. 6	-0.63	0.00	0.00	0.00	0.00	0.00	5.77	0.00
Capitellidae spp.	-0.65	0.00	3.65	0.00	3.78	4.66	5.00	0.00
Sipuncula sp. 2	-0.89	0.00	0.00	0.00	0.00	2.95	5.00	4.08

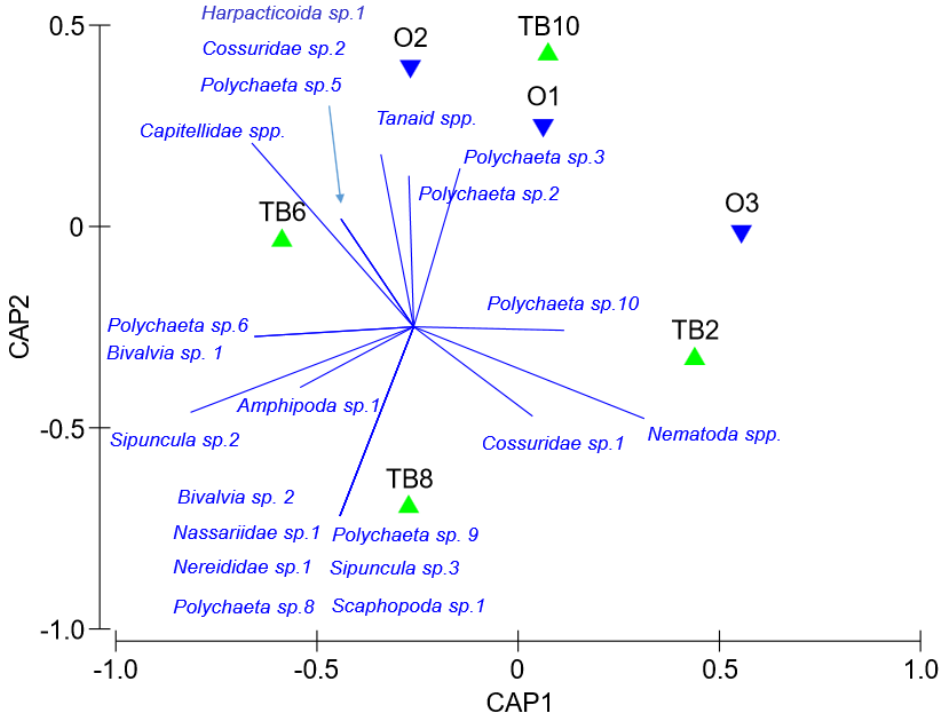

Figure 6. Canonical Analysis of Principle Coordinates (CAP) plot of component communities run on Bray Curtis similarity matrix of standardised, square root transformed abundance data. Taxa with correlations of Spearman's rho >0.2 with canonical axes are overlayed with vectors in order to characterise the dissimilarities in composition and abundance of taxa between sites (see Table 2).

Overall, there was no significant difference in community composition between sites in the Turning Basin and sites surrounding the outfall (ANOSIM R statistic = -0.278; p = 0.914) (Table 3). Community composition for sites within the Turning Basin were 27% similar, and 31% similar for sites surrounding the outfall. SIMPER revealed Sipuncula sp. 1, Nematoda spp. and Capitellidae spp. to characterise both locations and, in addition, Sipuncula sp. 2 and Polychaeta sp. 3 further characterised the Turning Basin and surrounding outfall area, respectively.

Table 3: One-way ANOSIM and SIMPER of benthic infauna communities. The species typical for each location are shown. Ave. diss. = average dissimilarity, Ave. simm. = average similarity. No significant difference in composition was found between the two locations.

	Turning Basin (TB)	**Surrounding outfall (O)**
Turning Basin (TB)	*Ave. simm. = 26.7%* Sipuncula sp.1 Nematoda spp. Sipuncula sp. 2 Capitellidae spp.	
Surrounding outfall (O)	*R = -0.278* *p = 0.914* *Ave diss. = 65.7%*	*Ave. simm. = 30.8%* Sipuncula sp. 1 Nematoda spp. Polychaeta spp. 3 Capitellidae spp.

Feeding guilds

Food source

Surface feeding was the most common source of food for all sites combined (61%), followed by subsurface feeding (36%) and epibenthic feeding (3%). Counts of each food source guild are overlaid as bubble plots on nMDS plots in Fig. 7. Surface and subsurface feeding was present at all sites and epibenthic feeding was only present at TB6, TB8, TB10 and O2.

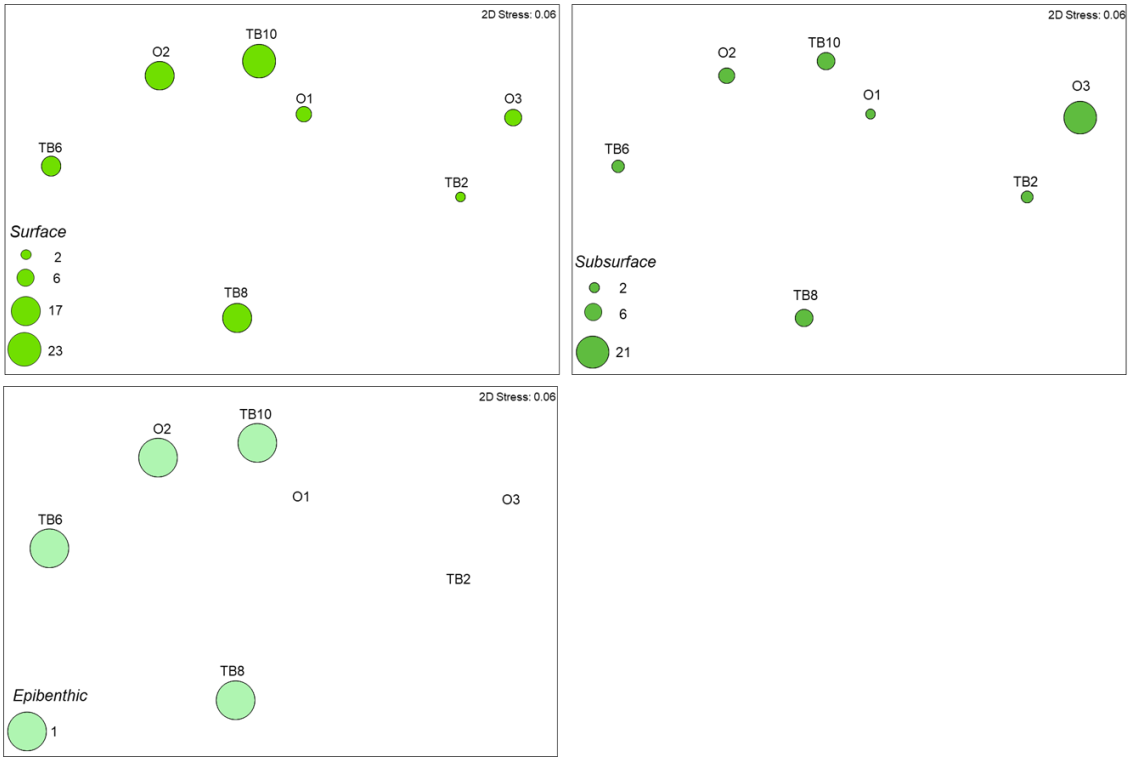

Figure 7: nMDS plots of community composition overlaid with food source guilds as bubble plots to indicate presence and dominance of guilds.

Diet

Omnivores dominated the diet feeding guilds (70%), followed by herbivores (28%) and carnivores (2%). Counts of each diet source guild are overlaid as bubble plots on nMDS plots in Fig. 8. Omnivores and herbivores were present at all sites, whereas carnivores were only present at TB8.

Figure 8: nMDS plots of community composition overlaid with diet guilds as bubble plots to indicate presence and dominance of guilds.

Feeding mode

The most common feeding mode was detritus feeding (44%) followed closely by browsers (35%). Grazers comprised 16%, while all other forms of feeding comprised less than 2%. Counts of each feeding mode guild are overlaid as bubble plots on nMDS plots in Fig. 9. Browsers and detritus feeders were present at all sites, and grazers at all sites except TB2. Suspension/filter feeders were present at TB6, TB8, TB10 and O2 and deposit feeders at only TB2 and O2. Predators and scavengers were only present at TB8.

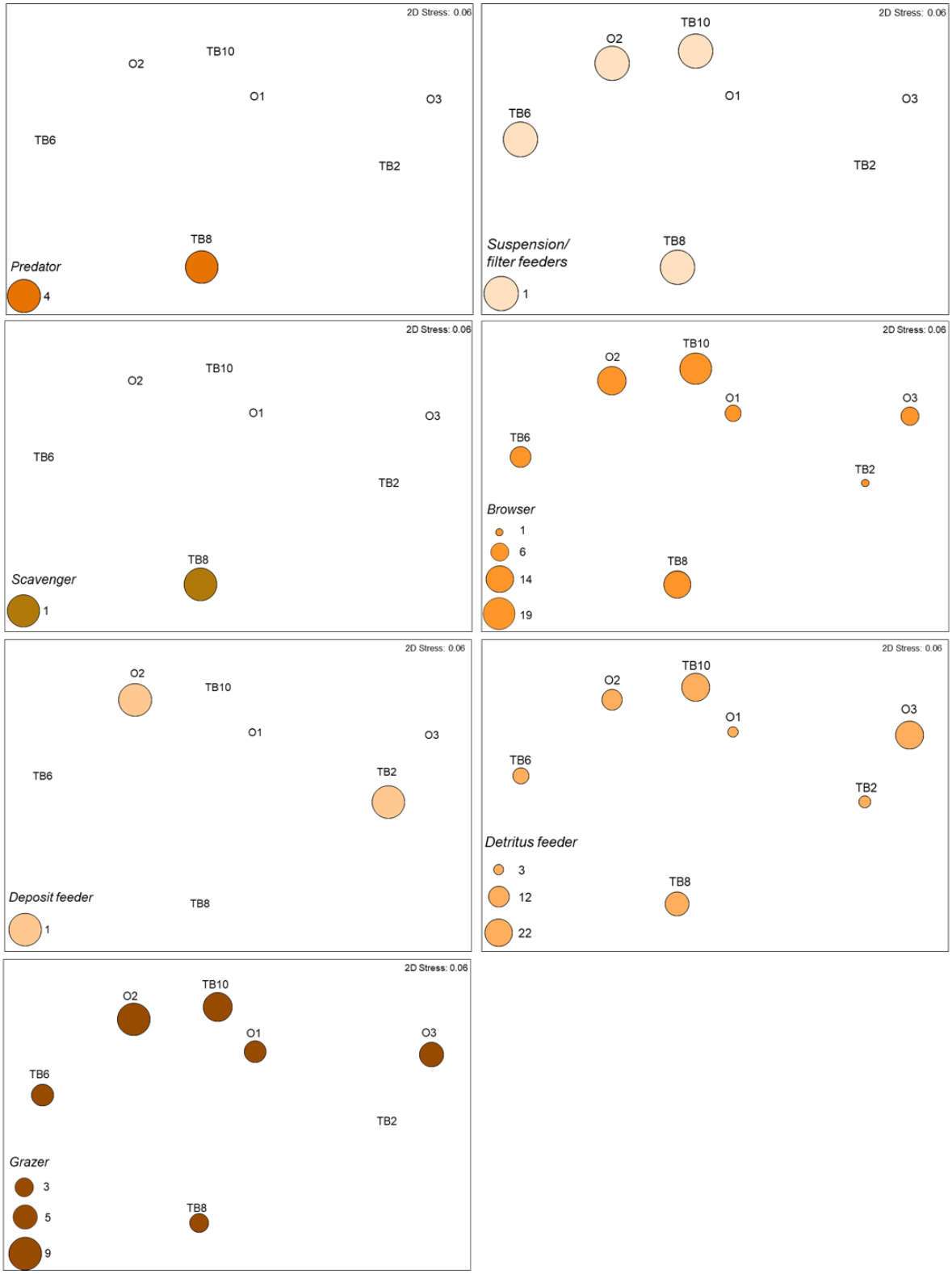

Figure 9: nMDS plots of community composition overlaid with feeding mode guilds as bubble plots to indicate presence and dominance of guilds.

Foraminifera

In total, 7718 individuals were counted from seven families, which included identification to genus for Spiroloculina spp. and Quinqueloculina spp. The family Peneroplidae spp. was the most abundant (n = 3913) and was found at all seven sites. Quinqueloculina spp. (n = 1643), Elphidiidae spp. (n = 1195) and Spiroloculina spp. (n = 758) were also present at all seven sites. Sorititdae spp. was present at all sites except TB6, Rotallidae spp. was present at all sites except O1 and Nodosariidaes pp. was present at all except TB2. It is likely that TB2 also contained living specimens from Nodosariidae spp., as fragments from what appeared to be Nodosariidae were found in the sample. Qualitative total percentage composition of the five families and two genera is shown in Fig. 10.

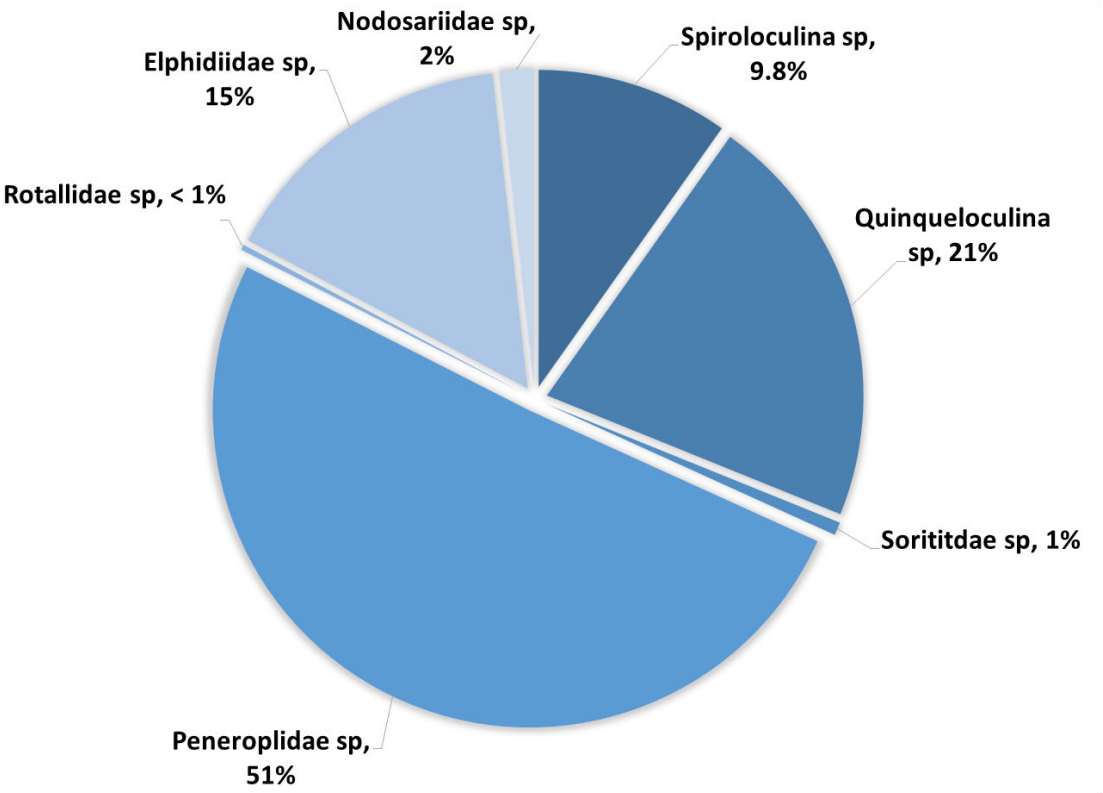

Figure 10. Qualitative total percent composition of *Foraminifera* families present in benthic samples.

DISCUSSION POINTS

- Species richness and diversity was highest at site TB8 and O2 with the lowest richness and diversity found at site O3. There was no significant difference in species richness or diversity indices across all the sites.
- There was no significant difference in evenness between sites within the Turning Basin and sites surrounding the outfall and all sites had high evenness suggesting that the abundances are distributed evenly among the different morphological species present.
- Composition of taxa varied at each site, most notably between TB8 and O3. However there was no significant difference in community composition between sites in the Turning Basin and sites surrounding the outfall.

- Surface feeding was the most common source of food for all sites and omnivores dominated across all sites.
- Previous studies suggest that the presence of Quinqueloculina spp. in relatively high abundance may be an indication of low environmental stress and that this particular genus of foraminifera could be considered a good bioindicator.

CONCLUSION

The distribution and abundance of taxa across the survey area is heterogeneous.

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