Port Hedland Spoilbank Marina

Sediment Sampling and Analysis Plan Implementation Report

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TEAL SOLUTIONS environmental advisory

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Executive Summary

A sediment quality assessment has been carried out at the site of the proposed Spoilbank Marina in Port Hedland. This technical investigation provides information on the physiochemical characteristics of the marine sediment (subtidal and intertidal) within the proposed dredge areas (Channel, Basin and Sand Trap) and the terrestrial sediments adjacent to the proposed Spoilbank Marina. The findings of this study will be used to inform a dredging impact assessment which will support a referral of the project to the Environmental Protection Authority (EPA).

Sampling was undertaken in accordance with the National Assessment Guidelines for Dredging (NAGD 2009). The dredged material will be disposed to onshore bunded areas located adjacent to the Spoilbank Marina. Forty (40) sites were sampled, thirty-five (35) to characterise the material to be dredged; and five (5) terrestrial sites across the Spoilbank to characterise the dredge disposal site. Sediments were collected using a vibrocore (11 sites) and diver push cores (22 sites) and a hand trowel (2 shoreline sites and the 5 terrestrial sites). All sites within the dredge footprint were analysed for particle size distribution, total organic carbon, metals, organotins and acid sulfate soils. Thirteen (13) of these sites were also selected for additional analysed of the following volatile chemical constituents: total recoverable hydrocarbon; benzene, toluene, ethylbenzene, xylenes and naphthalene; polycyclic aromatic hydrocarbons, organophosphate and organochlorine pesticides. The five terrestrial sites were tested for all of the above analytes (except for particle size distribution) and in addition were analysed for asbestos. A further four samples of deeper sediments in the Basin were obtained from the geotechnical survey (completed by CMW Geosciences and reported elsewhere) and these were analysed for acid sulfate soils.

At the majority (7 locations) of the vibrocore sites refusal on hard substrate was encountered at approximately 1 m depth. Four of the vibrocore sites achieved a penetration of deeper than 1 m and these cores samples were then split into two samples (0–1 m and 1–2 m horizon). Two of these deep cores showed an increase in the proportion of finer sediments in the deeper horizon, whilst the other two sites showed relatively consistent particle size with depth.

Sediment samples from the dredge areas were generally dominated by sand fraction particles (0.060–2 mm). The proportion of finer particle sizes generally increased with distance offshore along the Channel whilst samples in the Basin and Sand Trap were typically comprised of a higher proportion of coarser particles.

All of the analytes were below the available ANZG (2018) guideline values, NEPM (2013) Health Investigation Levels (HILS) and NAGD (2009) Screening Levels. Guideline values have not been set for aluminium or iron and these analytes were compared to the natural background. concentrations for Pilbara Coastal Sediments (DEC 2009); all but one site were below these background concentrations (the exception was site C01, located at the offshore end of the channel, where the aluminium concentration was equal to the estimated background concentration).

All samples were screened for acid sulfate soils and selected samples were subject to chromium suite acid sulfate analysis. The chromium reducible sulfur concentration of three samples (C02, B12-2 and S29-B2) was above the action criteria of 0.03% sulfur. However, consideration of the acid neutralising

capacity indicated a positive Net Acidity which indicated sufficient in situ buffering for any acid generated during handling.

Field QC testing exceeded the RPD of 35% at two of five locations (Site S26 - copper, iron and nickel and S30 - aluminium, arsenic, manganese). These results indicate there may be some variability in the results recorded for these analytes when analysed by different laboratories and these should be used with caution. Remaining QA/QC testing results provided confidence that remaining test results are reliable.

It is concluded that sediment is suitable for onshore disposal.

Acronyms and Abbreviations

Acronyms/Abbreviation	Description
ABA	Acid-Base Accounting
AASS	Actual Acid Sulfate Soils
ACM	Asbestos Containing Material
ADAS	Australian Diver Accreditation Scheme
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
ANC	Acid Neutralisation Capacity
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
Asb	Asbestos
BTEXN	Benzene, Toluene, Ethylbenzene, Xylenes and Naphthalene
COC	Chain of Custody
CoCP	Contaminant of Primary Concern
CoI	Contaminants of Investigation
CD	Chart Datum
DBT	Dibutyltin
DEC	Department of Environment and Conservation
DER	Department of Environmental Regulation
DoTEE	Department of the Environment and Energy
DoT	Department of Transport
DO	Dissolved Oxygen
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
EQC	Environmental Quality Criteria
ESD	Environmental Scoping Document
FF	Fine Fraction
GPS	Global Positioning System
HIL	Health Investigation Level
HT	Hand Trowel
ID	Identification
ISQG	Interim Sediment Quality Guideline
LCS	Laboratory Control Samples
LoR	Limit of Reporting
MB	Method Blank
MBT	Monobutyltin

Acronyms/Abbreviation	Description
NAGD	National Assessment Guidelines for Dredging
NATA	National Association of Testing Authorities
NEPM	National Environment Protection Measures
OCP	Organochlorine pesticide
OPP	Organophosphate pesticide
PAH	Polycyclic Aromatic Hydrocarbon
PASS	Potential Acid Sulfate Soils
PHPA	Port Hedland Port Authority
PPA	Pilbara Ports Authority
PQL	Practical Quantitation Limit
PSD	Particle size distribution
QAQC	Quality Assurance/Quality Control
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SAP	Sampling and Analysis Plan
SD	Standard Deviation
TOC	Total Organic Carbon
TBT	Tributyltin
TRH	Total Recoverable Hydrocarbon
WA	Western Australia

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1. Introduction

The Town of Port Hedland, together with LandCorp and the Pilbara Development Commission, are seeking to develop a marina in Port Hedland. It is proposed that the Spoilbank Marina (the Marina) be located on the western side of the Spoilbank, adjacent to the Port Hedland Yacht Club and will include a four-lane boat ramp, up to 80 boat pens and a ~1 km channel to provide access to the Port Hedland Outer Channel (Figure 1).

1.1. Proposal Description

The Port Hedland Spoilbank Marina development is located in Port Hedland in the Pilbara region of Western Australia. The Marina will be located on Lot 5751 and Lot 5550 on the Spoilbank, located approximately 1.5 km east of the Port Hedland town centre (Figure 1). The Marina will replace the existing Richardson Street boat ramp (which will be closed) and redirect boating activities away from the commercial operations of Port Hedland's inner harbour and navigation channel. The proposed Marina includes a four-lane boat ramp, 80 boat pens, trailer parking for 208 vehicles (~3.5 ha), 86 parking bays, dry dock area for commercial vessels, public and pen holder amenities, public open space (~3.5 ha). The proposal will include the following capital works (Figure 1 & Table 1):

- Capital dredging to create access Channel, Basin and Sand Trap
- Disposal of all dredge material to land adjacent to the Marina
- Construction of breakwaters and revetments

Ongoing management and maintenance of the Marina will also be required.

Table 1 Dredging areas

Element	Area (ha)	Design Depth (m CD)	Dredge Volume (m^3)
Key Elements			
Channel	2.75	-2.5	108,500
Sand Trap	6.83	-2.0	100,000
Basin	5.7	-2.0	332,000
Other			
Alternate Channel	1.27	-2.5	40,000
Breakwater	2.11	-2.0	107,000
Revetment	2.3	-2.0	110,000
Project Total Dredged	**18.5ha**		**757,500**

* Note dredging for the breakwater and revetment will be undertaken to enable foundation of the footings

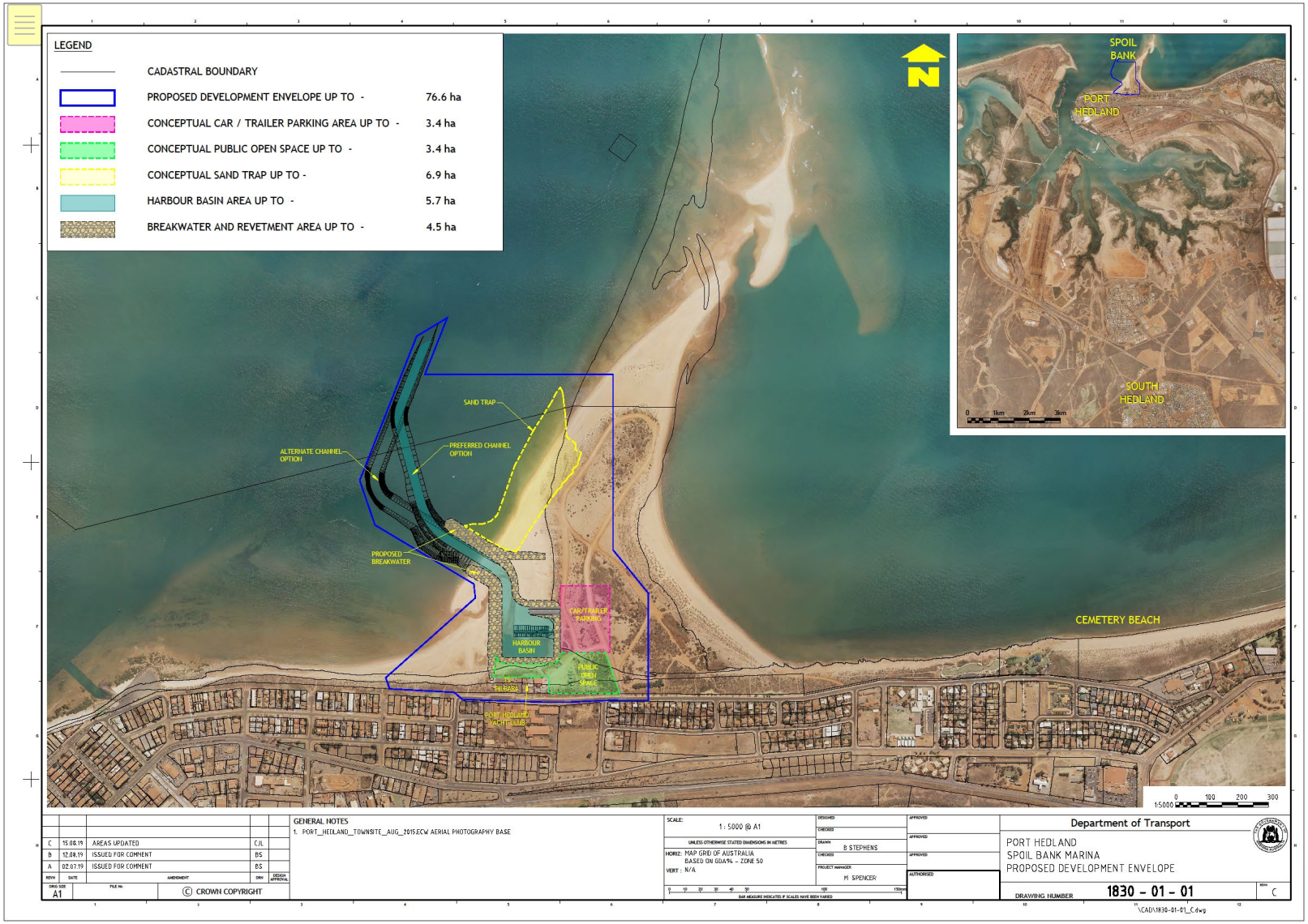

Figure 1-1 **Spoilbank Marina concept plan**

Figure 1-2 Dredging zones

1.2. Scope and Objectives

Sediment sampling was undertaken in accordance with the *Port Hedland Spoilbank Marina Sediment Sampling and Analysis Plan* (O2 Marine, 2019; see Appendix A). This report presents the results of this sampling program, and includes:

- Summary of field sampling and laboratory methods
- Comparison of sediment quality against relevant guideline values
- Consideration of any risks to marine environmental quality arising from the proposed dredging works
- Confirm the suitability for onshore disposal of the dredged material; and
- Describe sediment characteristics for use in dredge plume modelling.

2. Methods

The Sediment Sampling and Analysis Plan (SAP O2 Marine, 2019) details the proposed sampling design and methods for the survey. During the implementation of this survey some modifications to the proposed sampling design were required and these are outlined in the following sections.

2.1. Sampling

Sediment sampling was undertaken from 26 to 28 September 2019 and all coordinated were determined using a hand-held GPS with an accuracy of ±5 metres. Sampling was undertaken at 43 sites: using a vibrocore (11 sites), push cores (22 sites), hand trowel (7 sites) and rotary core (3 sites) (Table 2). Rotary core samples were obtained during a geotechnical survey[1] undertaken between 2 and 11 November 2019. 20 L of marine water was also obtained offshore 20^0 18' 13.4" S – 118^0 35' 10.2" E) for use in elutriate analysis if required. Due to field logistics it was necessary to relocate five sites from the sampling location proposed in the SAP and this is denoted by the suffix "-B" after the site location (Table 2). Where penetration beyond 1 m depth was achieved, sample horizons at each site are denoted using suffix numbering: '1' for 0–1 m horizon and '2' for the 1–2 m horizon (Table 3). The geotechnical survey sites were denoted as BH11, BH12 and BH13 and the four samples (two samples were obtained from site BH12) were denoted by depth below Chart Datum (Table 3). The geotechnical sampling logs, Chain of Custody forms and sampling location map are provided in Appendix B.

The process used in selection of sampling sites is detailed in the SAP (O2 Marine, 2019), and marine locations have been distinguished based on dredging areas (Channel, Sandtrap and Basin) and terrestrial construction areas (Terrestrial). These areas are identified in Figure 2-1.

[1] This survey has been documented CMG Geosciences in a separate report

Table 2 Sampling sites

Site ID	Latitude (WGS849	Longitude (WGS84)	Method	Date sampled	Time (WST)	Water depth (m)	Penetration Depth (m)	Core Recovery
			CHANNEL					
C01	20° 17' 54.4" S	118° 35' 13.3" E	Push core	27/9/19	16:15	5	0.3	
C02	20° 18' 16.1" S	118° 35' 23.5" E	Vibrocore	27/9/19	16:35	5	1	0.9
C03	20° 18' 0.7" S	118° 35' 10.8" E	Push core	28/9/19	17:25	5	0.3	
C04	20° 18' 2.3" S	118° 35' 11.0" E	Push core	28/9/19	9:20	4	0.3	
C05	20° 18' 4.3" S	118° 35' 11.1" E	Push core	27/9/19	9:00	6	0.3	
C06	20° 18' 6.1" S	118° 35' 12.1" E	Push core	28/9/19	14:45	3	0.3	
C07	20° 18' 6.1" S	118° 35' 12.1" E	Push core	26/9/19	9:40	6	0.3	
C08	20° 18' 14.2" S	118° 35' 9.2" E	Vibrocore	26/9/19	13:50	2.5	0.5	0.4
C09	20° 17' 55.5" S	118° 35' 13.5" E	Vibrocore	27/9/19	14:34	1	1	0.5
C10	20° 18' 15.5" S	118° 35' 15.7" E	Push core	27/9/19	15:40	3	0.3	
			BASIN					
B11	20° 18' 16.9" S	118° 35' 18.9" E	Push core	27/9/19	10:20	2	0.3	
B12	20° 18' 17.1" S	118° 35' 18.5" E	Vibrocore	27/9/19	14:16		2.2	1
B13	20° 18' 18.8" S	118° 35' 23.0" E	Push core	25/9/19	15:30	intertidal	0.3	0.5
B14	20° 18' 18.4" S	118° 35' 27.0" E	Push core	28/9/19	16:00	intertidal	0.3	0.6
B15	20° 18' 19.8" S	118° 35' 20.3" E	Push core	28/9/19	13:00	intertidal	0.7	0.5
B16	20° 18' 20.1" S	118° 35' 20.9" E	Vibrocore	28/9/19	13:30	intertidal	2	1
B17	20° 18' 22.8" S	118° 35' 23.8" E	Vibrocore	28/9/19	13:45	intertidal	0.7	0.6
B18	20° 18' 23.4" S	118° 35' 21.5" E	Push core	28/9/19	15:15	intertidal	0.3	
B19	20° 18' 24.2" S	118° 35' 20.5" E	Push core	28/9/19	15:30	intertidal	0.3	

Site ID	Latitude (WGS849	Longitude (WGS84)	Method	Date sampled	Time (WST)	Water depth (m)	Penetration Depth (m)	Core Recovery
B20	20° 18' 26.4" S	118° 35' 19.5" E	Push core	28/9/19	15:35	intertidal	0.3	
B21	20° 18' 29.5" S	118° 35' 21.8" E	Push core	28/9/19	13:30	intertidal	0.3	
B22-B	20° 18' 30.8" S	118° 35' 23.4" E	Vibrocore	28/9/19	16:05	Land		0.5
B23	20° 18' 30.7" S	118° 35' 26.8" E	Push core	28/9/19	15:45	Land	0.3	
B24-B	20° 18' 27.5" S	118° 35' 27.4" E	Vibrocore	28/9/19	12:45	Land	2	1
B25	20° 18' 25.3" S	118° 35' 28.4" E	Push core	28/9/19	12:30	Land	0.3	
BH11 (10.50-10.55)	20° 18' 30.4" S	118° 35' 29.7" E	HQ3 coring	11/11/19	13:30	Land	1.7	
BH12 (745-755)	20° 18' 29.4" S	118° 35' 33.5" E	HQ3 coring	02/11/19	15:20	Land	0.67	
BH12 (830-835)	20° 18' 29.4" S	118° 35' 33.5" E	HQ3 coring	05/11/19	20:20	Land	1.52	
BH13 (5.40-5.50)	20° 18' 28.2" S	118° 35' 26.8" E	HQ3 coring	09/11/19	12:25	Land	1.45	
			SAND TRAP					
S26	20° 18' 12.2" S	118° 35' 20.3" E	Vibrocore	28/9/19	16:00		1.3	1
S27	20° 18' 16.1" S	118° 35' 23.5" E	Push core	28/9/19	15:00	Land	0.3	
S28	20° 18' 16.3" S	118° 35' 23.5" E	Vibrocore	26/9/19	14:05	Land	0.8	0.5
S29-B	20° 18' 9.8" S	118° 35' 24.0" E	Vibrocore	26/9/19	15:01	1	2.1	1
S30-B	20° 18' 10.1" S	118° 35' 26.3" E	Hand trowel	26/9/19	16:00	0	0.2	
S31-B	20° 18' 9.6" S	118° 35' 27.9" E	Hand trowel	28/9/19	16:05	0	0.2	
S32	20° 18' 7.6" S	118° 35' 29.6" E	Push core	28/9/19	14:00	Land	0.3	
S33	20° 18' 5.6" S	118° 35' 28.3" E	Push core	28/9/19	14:00	Land	0.3	
S34	20° 18' 5.2" S	118° 35' 26.7" E	Push core	28/9/19	8:30	3	0.3	
S35	20° 18' 5.7" S	118° 35' 26.2" E	Push core	28/9/19	8:10	0	0.3	
			TERRESTRIAL					

Site ID	Latitude (WGS849	Longitude (WGS84)	Method	Date sampled	Time (WST)	Water depth (m)	Penetration Depth (m)	Core Recovery
O36	20° 18' 5.7" S	118° 35' 36.5" E	Hand trowel	28/9/19	16:40	Land	0.2	
O37	20° 18' 13.30" S	118° 35' 31.8" E	Hand trowel	28/9/19	16:35	Land	0.2	
O38	20° 18' 22.4" S	118° 35' 34.1" E	Hand trowel	28/9/19	16:30	Land	0.2	
O39	20° 18' 30.7" S	118° 35' 33.3" E	Hand trowel	28/9/19	16:30	Land	0.2	
O40	20° 18' 22.6" S	118° 35' 30.2" E	Hand trowel	28/9/19	16:45	Land	0.2	

Field quality control samples included the following sampling design in accordance with NAGD (2009) and NEPM (2013, 2013a). The following QAQC analysis was undertaken (Table 3):

- Four (4) field triplicates (three separate samples taken at the same location) to determine sampling and small-scale variability of the physical and chemical characteristics of the sediment (identified as TRIP – collected at Sites C06, B18, S27 and S35);
- Four (4) field duplicate (one sample thoroughly mixed then split into two sub-samples) to test intra-laboratory variation (identified as DUP – collected at Sites C06, B18, S27 and S35;
- Five (5) field splits (samples thoroughly mixed then split into two sub-samples with one of the samples sent to a secondary laboratory) to assess inter laboratory variation (identified as SPLIT – collected at C10, B12, B17, S26 and S30);
- One (1) trip blank filled with inert chromographic sand;
- Two (2) field blanks filled with inert chromographic sand;
- Three (3) rinsate blanks filled with deionised water;

2.2. Analytes

The following analytes were determined for the samples (Table 3):

- Particle size distribution (PSD)
- Moisture content and total organic carbon (TOC)
- Metals (aluminium, antimony, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, zinc)
- Hydrocarbons, including total recoverable hydrocarbon (TRH), benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN) and polycyclic aromatic hydrocarbon (PAH)
- Organotins: tributyl tin (TBT), dibutyl tin (DBT) and monobutyl tin (MBT)
- Pesticides: Organophosphate (OPP) and organochlorine (OCP) pesticides
- Acid sulphate soils: including both the screening test and chromium suite analysis
- Asbestos

Only the five terrestrial sites were analysed for asbestos and these sites were not analysed for PSD as these areas are not proposed to be dredged. The field QA/QC samples (splits, duplicates and triplicates) were not analysed for PSD or ASS or PSD. Analysis for hydrocarbons (TRH, BTEXN, PAH) and pesticides (OCP and OPP) were only conducted at selected samples across the dredging footprint (Table 3 and Figure 2-1).

Table 3 Sediment analysis

Sample	Site	Sampled horizon (m BGL)	Particle Size Distribution	Moisture Content and Total Organic Carbon	Metals	Hydrocarbons	Organotins	**Pesticides**	Acid sulfate screening	Chromium Suite Sulfur	Asbestos
					CHANNEL						
C01	C01	0-1	✓	✓	✓	✓	✓	✓	✓		
C02	C02	0-1	✓	✓	✓	✓	✓	✓	✓	✓	
C03	C03	0-1	✓	✓	✓	✓	✓	✓	✓		
C04	C04	0-1	✓	✓	✓	✓	✓	✓	✓		
C05	C05	0-1	✓	✓	✓		✓		✓		
C06	C06	0-1	✓	✓	✓		✓		✓	✓	
TRIP 1-0	C06	0-1		✓	✓		✓				
TRIP 1-1	C06	0-1		✓	✓		✓				
DUP 1	C06	0-1		✓	✓		✓				
C07	C07	0-1	✓	✓	✓		✓		✓	✓	
C08	C08	0-1	✓	✓	✓		✓		✓	✓	
C09	C09	0-1	✓	✓	✓	✓	✓	✓	✓	✓	
C10	C10	0-1	✓	✓	✓		✓		✓	✓	

Sample	Site	Sampled horizon (m BGL)	Particle Size Distribution	Moisture Content and Total Organic Carbon	Metals	Hydrocarbons	Organotins	**Pesticides**	Acid sulfate screening	Chromium Suite Sulfur	Asbestos
SPLIT (C10)	C10	0-1		✓	✓		✓				
					BASIN						
B11	B11	0-1	✓	✓	✓		✓		✓	✓	
B12-1	B12	0-1	✓	✓	✓		✓		✓	✓	
SPLIT (B12-1)	B12	0-1	✓	✓	✓		✓				
B12-2	B12	1-2		✓	✓		✓		✓	✓	
B13	B13	0-1	✓	✓	✓		✓		✓	✓	
B14	B14	0-1	✓	✓	✓		✓		✓	✓	
B15	B15	0-1	✓	✓	✓		✓		✓	✓	
B16	B16	0-1	✓	✓	✓		✓		✓	✓	
B16	B16	1-2	✓	✓	✓		✓		✓	✓	
B17	B17	0-1	✓	✓	✓		✓		✓	✓	
SPLIT (B17)	B17	0-1	✓	✓	✓		✓				
B18	B18	0-1		✓	✓		✓		✓	✓	
TRIP 2-0	B18	0-1	✓	✓	✓		✓				

Sample	Site	Sampled horizon (m BGL)	Particle Size Distribution	Moisture Content and Total Organic Carbon	Metals	Hydrocarbons	Organotins	**Pesticides**	Acid sulfate screening	Chromium Suite Sulfur	Asbestos
TRIP 2-1	B18	0-1	✓	✓	✓		✓				
DUP 2	B18	0-1		✓	✓		✓				
B19	B19	0-1		✓	✓		✓		✓	✓	
B20	B20	0-1	✓	✓	✓		✓		✓	✓	
B21	B21	0-1	✓	✓	✓		✓		✓	✓	
B22-B	B22-B	0-1	✓	✓	✓	✓	✓	✓	✓	✓	
B23	B23	0-1	✓	✓	✓		✓			✓	
B24–B1	B24-B	0-1	✓	✓	✓	✓	✓	✓	✓	✓	
B24–B2	B24-B	1-2	✓	✓	✓		✓		✓	✓	
BH11 10.50-10.55	BH11	1.65-1.70 (below mCD)	✓						✓	✓	
BH12 7.45-7.55	BH12	0.62-0.67 (below mCD)							✓	✓	
BH12 8.30-8.35	BH12	1.47-1.52 (below mCD)							✓	✓	
BH13 5.40-5.50	BH13	1.35-1.45 (below mCD)							✓	✓	

Sample	Site	Sampled horizon (m BGL)	Particle Size Distribution	Moisture Content and Total Organic Carbon	Metals	Hydrocarbons	Organotins	**Pesticides**	Acid sulfate screening	Chromium Suite Sulfur	Asbestos
B25	B25	0-1			✓					✓	
					SAND TRAP						
S26	S26	0-1	✓	✓	✓		✓		✓	✓	
SPLIT (S26)	S26	0-1	✓	✓	✓		✓				
S27	S27	0-1	✓	✓	✓		✓		✓	✓	
TRIP 3-0	S27	0-1		✓	✓		✓				
TRIP 3-1	S27	0-1		✓	✓		✓				
DUP 3	S27	0-1	✓	✓	✓		✓				
S28	S28	0-1		✓	✓		✓		✓	✓	
S29–B1	S29-B	0-1		✓	✓		✓		✓	✓	
S29–B2	S29-B	1-2	✓	✓	✓		✓		✓	✓	
S30–B	S30-B	0-1	✓	✓	✓		✓		✓	✓	
SPLIT (S30-B)	S30-B	0-1	✓	✓	✓		✓				
S31- B	S31-B	0-1	✓	✓	✓		✓		✓	✓	
S32	S32	0-1		✓	✓		✓		✓	✓	

Sample	Site	Sampled horizon (m BGL)	Particle Size Distribution	Moisture Content and Total Organic Carbon	Metals	Hydrocarbons	Organotins	**Pesticides**	Acid sulfate screening	Chromium Suite Sulfur	Asbestos
S33	S33	0-1	✓	✓	✓		✓		✓	✓	
S34	S34	0-1	✓	✓	✓	✓	✓	✓	✓	✓	
S35	S35	0-1	✓	✓	✓		✓		✓	✓	
TRIP 4-0	S35	0-1	✓	✓	✓		✓				
TRIP 4-1	S35	0-1	✓	✓	✓		✓				
DUP 4	S35	0-1	✓	✓	✓		✓				
					TERRESTRIAL						
O36	O36	0-1		✓	✓	✓	✓	✓	✓		✓
O37	O37	0-1		✓	✓	✓	✓	✓	✓		✓
O38	O38	0-1		✓	✓	✓	✓	✓	✓		✓
O39	O39	0-1		✓	✓	✓	✓	✓	✓		✓
O40	O40	0-1		✓	✓	✓	✓	✓	✓		✓

Figure 2-1 Sampling Locations

3. Results

Excluding QAQC samples, a total of 48 samples were collected during the field survey (10 from the Channel, 22 from the Basin (including 4 obtained during the geotechnical survey), 11 from the Sand Trap and 5 Terrestrial) (Table 4). Sample photographs are presented in Appendix C and the laboratory reports are included in Appendix D and Appendix E. The sample logs for the four samples obtained during the geotechnical survey are presented in Appendix B.

Table 4 Sample descriptions

Site	Sediment type	Colour	Foreign material	Shell/Biota	Odour	Comments
			CHANNEL			
C01	Fine sand	Brown	nil	Worm	Slight	High liquid content
C02	Silt	Brown. Bottom 30 cm grey	nil	nil	Slight marine	Refusal <1 m
C03	Sand-silt	Dark brown/grey	nil	Low %	nil	
C04		Dark brown	nil	Yes	Marine	
C05	Sand-silt	Dark brown Grey	nil	nil	Marine organic	
C06	Silt	Dark brown	nil	Yes	nil	Trip 1
C07	Sand	Brown	nil	Moderate %	Marine	
C08	Sand-silt	Brown	nil	nil	Marine	Refusal @ 0.5 m
C09	sand	Brown	nil	nil	nil	Attempt vibrocore 1 m penetration
C10	Silt	Brown	nil	Low %	Marine	Split
			BASIN			
B11	Sand	Red	nil			
B12-1	Sand	>30 cm top black <30 cm grey brown/black	nil	nil	Unpleasant	Split
B12-2	Silt Clay (2 m)	Black -light brown		nil	Unpleasant	
B13	Sand	Red brown	nil	Low %	nil	Low gravel content
B14	Sand	Red brown	nil	nil	nil	Low gravel content
B15	Sand	Light red	nil	Yes	nil	
B16-1	Sand	Light red	nil	Low %	nil	

Site	Sediment type	Colour	Foreign material	Shell/Biota	Odour	Comments
B16-2	Sand	red	nil	nil	nil	
B17	Sand/rubble	Orange-brown	nil	nil	nil	
B18	Sand	Red	nil	Low %	nil	
B19	Sand	Red-orange	nil	nil	nil	
B20	Sand	Red-orange	nil	nil	nil	
B21	Sand	Brown	nil	nil	nil	
B22	Sand	Brown	nil	Low %	nil	
B23	Sand/gravel	Red	Sticks	Low %	nil	
B24-B1	Sand/gravel	Red	nil	Shell grit	nil	YC
B24-B2	Red sand	Red	nil	Shell grit	nil	
B25	Sand	Red	nil	Low %	nil	Push core
BH11	Samples collected as part of Separate Geotechnical Investigation and field observations presented in Appendix B.					
BH12						
BH12						
BH13						
	SAND TRAP					
S26	Silt/sand	Grey/Brown-red	nil	nil	nil	Refusal 1.3m
S27	Sand	Brown	nil	nil	nil	Trip 3
S28	Sand/gravel	Red	nil	Low %	nil	
S29-B1	Sand	Brown/grey	nil	nil	nil	
S29-B2	Silt	Grey	nil	nil	nil	
S30-B	Sand/gravel	Red	nil	Yes	nil	
S31-B	Sand/gravel	Red	nil	Yes	nil	

Site	Sediment type	Colour	Foreign material	Shell/Biota	Odour	Comments
S32	Sand	Red	nil	nil	nil	
S33	Sand	Red	nil	nil	nil	
S34	Sand	Red	nil	Yes	Marine	
S35	Sand	Red	nil	Low %	Unpleasant	
			TERRESTRIAL			
O36	Sand	Red	nil	nil	nil	
O37	Sand	Red	nil	nil	nil	
O38	Sand	Red	nil	nil	nil	
O39	Sand/Gravel	Red	nil	nil	nil	
O40	Fine sand	Red	nil	nil	nil	

3.1. Particle size distribution

Sand and gravel size fractions dominate all sediment samples (Table 5 and Figure 3). The sand size fraction was dominant at all sites except for two sites in the Basin (B11 and B24-B1) (Table 5). The proportion of gravel reduced with distance offshore with an average of 28% in the Basin, 14% in the Sand Trap and only 4% in the Channel (Table 5**)**. The majority of sites comprised of <10% of fine (<60 µm) sediments with the greatest proportion of fines in the Channel.

Table 5 Mean percent and standard deviation of particle size fractions in samples from the Channel, Basin and Sand Trap

Size Fraction	Channel	Basin	Sand trap
Number of Samples	10	18*	11
Gravel (>2 mm)	4% (±3)	28% (±17)	14% (±16)
Sand (0.06-2.00 mm)	76% (±11)	64% (±15)	79% (±16)
Silt (2-60 µm)	9% (±9)	2% (±5)	3% (±4)
Clay (<2 µm)	11% (±4)	6% (±4)	4% (±5)

* note: the four geotechnical samples were not analysed for particle size distribution

Four of the vibrocore sites penetrated below 1 m and at two of these sites (B12 and S29-B, both located just west of the Spoilbank) a notably higher proportion of fine sediment (clay and silt) was observed in the deeper (1-2 m) sample. It may be that these deeper sediments are similar to the offshore sediments observed in the Channel.

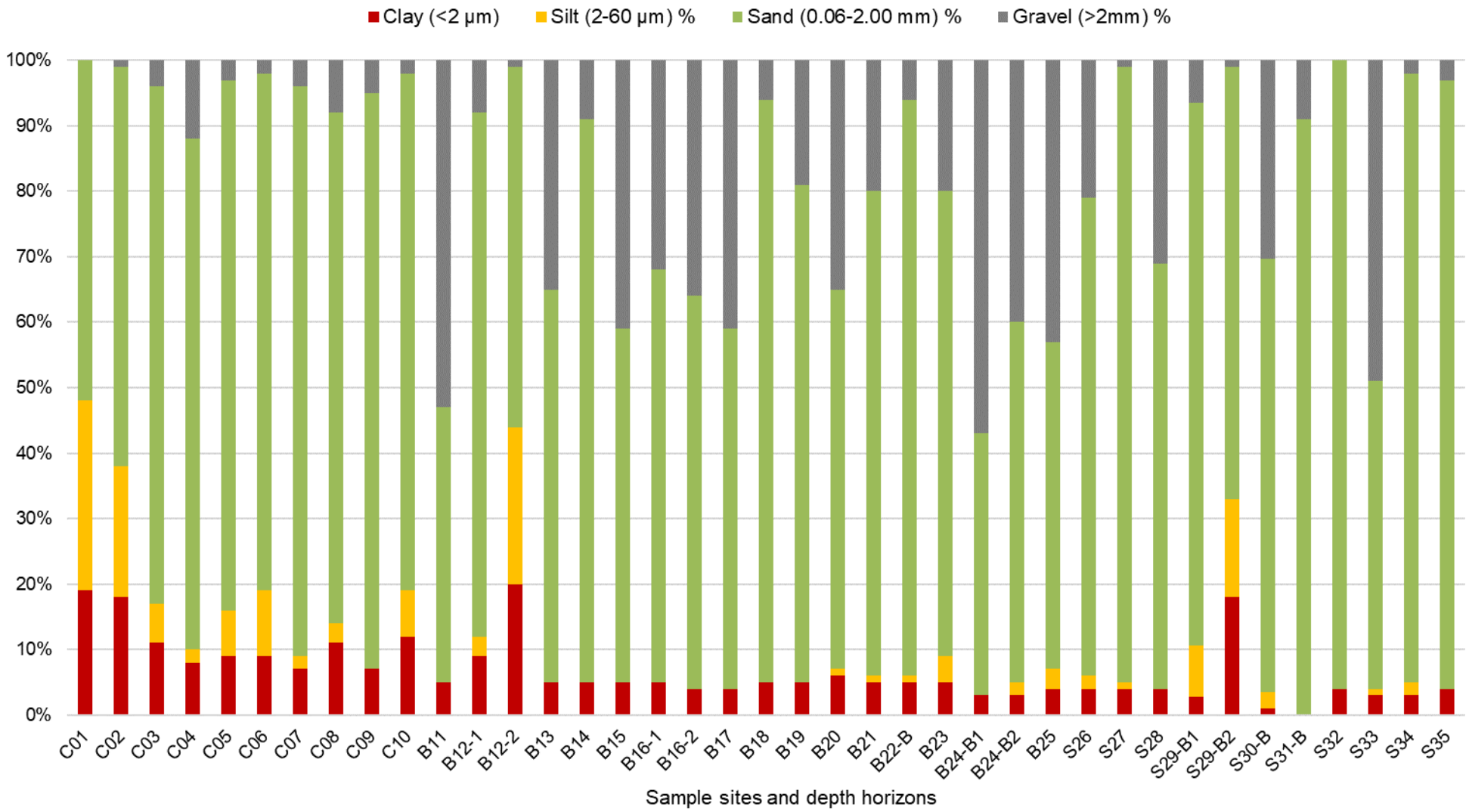

Figure 3-1 Particle size fractions

3.2. Moisture Content and Total Organic Carbon

The moisture content of the samples ranged from 0.1% (O38) up to 46.8% (C01) (Table 6). The Total Organic Carbon ranged from <0.1% which was observed at several sites up to 0.9% (C01). Higher levels of total organic carbon were typically found in the Channel sites.

Table 6 Moisture and total organic carbon content

Sample	Moisture Content (%)	Total Organic Carbon (%)
	CHANNEL	
C01	46.8	0.9
C02	32.6	0.7
C03	21.4	0.4
C04	26.1	0.3
C05	31.8	0.4
C06	29.4	0.4
C07	25.5	0.3
C08	30.6	0.5
C09	19.1	0.4
C10	30.8	0.2
	BASIN	
B11	22	0.2
B12-1	21.9	0.3
B12-2	25.7	0.5
B13	3.5	<0.1
B14	1.5	0.2
B15	14.5	<0.1
B16-1	20.6	<0.1
B16-2	13.8	0.1
B17	0.6	0.1
B18	17	0.1
B19	19.5	0.2
B20	10.1	0.3
B21	20.7	0.2
B22-B	16.2	0.1
B23	0.6	0.2
B24-B1	3.7	0.1
B24-B2	13	0.1
B25	0.2	0.2
	SANDTRAP	
S26	15.8	0.2
S27	21.4	0.1
S28	3.9	<0.1
S29-B1	15	<0.1
S29-B2	25.7	0.3
S30-B	10.2	0.1
S31-B	22.1	0.1
S32	6.6	0.1

Sample	Moisture Content (%)	Total Organic Carbon (%)
S33	4.1	0.1
S34	21.6	0.2
S35	18.3	0.1
	TERRESTRIAL	
O40	0.2	0.1
O37	4.3	<0.1
O38	0.1	0.1
O36	8.6	0.1
O39	23.2	0.2

3.3. Metals

All metal concentrations were below Screening Levels (ANZG 2018) and NEPM (2013) Health Investigation levels (Table 7). Relatively high values of aluminium (site C01, C02, B12-2 and S29-2) and iron (sites C01, C02, O38 and O39) were observed; however, these levels were consistent with previous assessments in the area (PPA 2009, PPA 2012, PPA 2018 and PPA 2019) and are considered to be representative of ambient natural conditions. The aluminium and iron concentrations were also highly correlated (R^2=0.95) and both were found to be strongly correlated (Al = R^2=0.92 and Fe = R^2=0.86) with the increased fine fraction (<60 µm). It should be also be noted that both aluminium and iron are very unlikely to cause a toxic effect in the marine environment.

Table 7 **Total sediment metal concentrations**

Analyte	*Aluminium*	*Antimony*	*Arsenic*	*Cadmium*	*Chromium*	*Copper*	*Iron*	*Lead*	*Manganese*	*Mercury*	*Nickel*	*Silver*	*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
PQL	1	0.1	0.1	0.1	0.5	0.5	1	0.5	1	0.01	0.5	0.1	0.5
ANZG (2018)	11,000[1]	2	20	1.5	80	65	30,400[1]	50	460[2]	0.15	21	1.0	200
HILs	-	-	*300*	*100*	*(VI) 240*	*20,000*	*340*	*600*	*9,000*	*400*	*800*	-	*30,000*
EILs (ACLs)			*100*		*320*	*270*		*1,100*			*30-560*		*230-1,300*
						CHANNEL							
C01	11,000	0.6	13	<0.1	49	21	29,000	8	260	<0.01	19	<0.1	30
C02	10,000	0.3	13	<0.1	45	11	19,000	9	220	<0.01	18	<0.1	23
C03	4,800	0.3	14	<0.1	25	8.1	14,000	3.9	180	<0.01	10	<0.1	15
C04	3,400	0.3	14	<0.1	20	5	9,100	2.9	200	<0.01	7.6	<0.1	11
C05	3,900	0.2	13	<0.1	24	6.9	11,000	3.6	210	<0.01	9	<0.1	13
C06	3,600	0.2	11	<0.1	22	5.4	9,000	3	170	<0.01	8.7	<0.1	12
C07	2,200	0.2	11	<0.1	17	3.2	6,200	2.2	130	<0.01	5.3	<0.1	8.4
C08	3,600	0.2	10	<0.1	20	5.3	8,200	2.6	150	<0.01	7.1	<0.1	12
C09	1,300	0.2	4.1	<0.1	15	1.9	3,700	1.5	48	<0.01	4.2	<0.1	3.3
C10	4,200	0.2	10	<0.1	24	6	10,000	3.5	150	<0.01	10	<0.1	13
Mean	4,800	0.3	11.3	<0.1	26.1	7.4	11,920	4.0	171.8	<0.01	9.9	<0.1	14.1
95% UCL	7,135	0.3	13.0	<0.1	32.8	11.2	16,159	5.7	205.5	<0.01	12.7	<0.1	18.4
						BASIN							
B11	630	0.2	3.5	<0.1	14	1	3,100	1.2	28	<0.01	2.5	<0.1	1.6
B12-1	2,400	0.5	5.1	<0.1	18	3.2	5,800	2.3	71	<0.01	7	<0.1	4.8
B12-2	6,500	0.4	9.5	<0.1	33	7.5	14,000	5.2	140	<0.01	16	<0.1	16
B13	890	0.2	3.2	<0.1	14	1.3	3,300	1.7	49	<0.01	3.1	<0.1	2.3
B14	900	0.2	4.3	<0.1	15	1.2	3,300	1.9	41	<0.01	3.4	<0.1	2.5
B15	700	0.2	3.3	<0.1	13	1	3,200	1.2	33	<0.01	2.6	<0.1	1.6
B16-1	650	0.2	3	<0.1	16	1	3,500	1.7	29	<0.01	3	<0.1	2.3

Analyte	Aluminium	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
B16-2	690	0.2	3.2	<0.1	12	1	3,200	1.5	37	<0.01	2.6	<0.1	1.8
B17	630	0.1	2.9	<0.1	12	0.9	2,500	1	30	<0.01	2.6	<0.1	2.2
B18	870	0	5	<0.1	12	1	2,800	1	38	<0.01	3	<0.1	2
B19	700	0.2	4.5	<0.1	12	1.3	2,800	1.5	33	<0.01	3.6	<0.1	2.2
B20	1,100	0.1	4.5	<0.1	13	1.6	3,800	1.4	59	<0.01	3.4	<0.1	2.9
B21	1,000	0.2	6	<0.1	11	1.5	3,800	1.4	58	<0.01	3.4	<0.1	3.2
B22-B	1,500	0.1	4.7	<0.1	15	2.2	4,100	1.7	51	<0.01	4.6	<0.1	4.1
B23	1,600	0.1	7.6	<0.1	16	2.8	4,800	2.7	83	<0.01	4.5	<0.1	10
B24-B1	890	0.1	4.9	<0.1	14	1.1	2,900	1.2	43	<0.01	4.4	<0.1	2.5
B24-B2	880	0	6	<0.1	12	1	3,300	1	40	<0.01	3	<0.1	2
B25	1,600	0.3	4.8	<0.1	15	4	7,400	2.4	89	<0.01	4.6	<0.1	5.3
Mean	1,341	0.2	4.8	<0.1	14.8	1.9	4,311	1.8	52.9	<0.01	4.3	<0.1	3.9
95% UCL	2,747	0.3	5.5	<0.1	16.8	3.6	5,418	2.2	64.6	<0.01	5.6	<0.1	7.6
SAND TRAP													
S26	1,300	0.2	4.1	<0.1	15	1.7	4,000	1.9	48	<0.01	4.4	<0.1	3.3
S27	1,600	0.2	5.1	<0.1	15	1.9	4,500	2	64	<0.01	5.2	<0.1	3.9
S28	1,000	0.2	3.8	<0.1	14	1.3	3,400	1.8	50	<0.01	3.9	<0.1	2.2
S29-B1	2,000	0.2	5.2	<0.1	17	2.6	5,200	2.2	84	<0.01	6	<0.1	4.6
S29-B2	**7,100**	0.4	11	<0.1	35	8	15,000	5.8	150	<0.01	18	<0.1	17
S30-B	1,400	0.3	8.7	<0.1	16	1.9	6,000	1.7	72	<0.01	3.8	<0.1	2.9
S31-B	680	0.1	3.1	<0.1	11	0.8	2,200	1	31	<0.01	2.2	<0.1	1.7
S32	760	0.1	3.5	<0.1	12	1	2,600	1.1	31	<0.01	2.7	<0.1	1.9
S33	1,300	0.2	7.9	<0.1	13	2.9	4,500	2.1	150	<0.01	5.4	<0.1	2.1
S34	1,300	0.2	8	<0.1	16	2	4,300	2.3	55	<0.01	5.3	<0.1	3.6
S35	1,500	0.2	8.8	<0.1	15	2.8	4,700	2.6	68	<0.01	7.5	<0.1	3.9
Mean	1,813	0.2	6.3	<0.1	16.3	2.5	5,127	2.2	73.0	<0.01	5.9	<0.1	4.3
95% UCL	4,169	0.3	7.8	<0.1	19.8	3.6	7,042	3.0	100.0	<0.01	8.3	<0.1	10.0
TERRESTRIAL													
O40	1,900	0.2	5.7	<0.1	17	4.7	8,900	3.6	89	<0.01	7.2	<0.1	5.9
O37	1,300	0.2	5.3	<0.1	14	3.2	5,500	2.5	65	<0.01	5.6	<0.1	3.3
O38	2,500	0.3	6.5	<0.1	21	4.5	18,000	17	390	<0.01	8.6	<0.1	8.3

Analyte	Aluminium	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
O36	890	0.1	5.8	<0.1	12	1.6	3,200	1.9	39	<0.01	3.6	<0.1	2.4
O39	2,900	0.2	3.5	<0.1	25	9	17,000	5.5	140	<0.01	7.9	<0.1	11
Mean	*1,898*	*0.2*	*5.4*	*<0.1*	*17.8*	*4.6*	*10,520*	*6.1*	*144.6*	*<0.01*	*6.6*	*<0.1*	*6.2*
95% UCL	*2,687*	*0.3*	*6.4*	*<0.1*	*22.8*	*7.2*	*16,904*	*18.0*	*280.1*	*<0.01*	*8.5*	*<0.1*	*9.6*

[1] Estimated background concentrations in Pilbara sediments from DEC (2006)

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

3.4. Hydrocarbons

Hydrocarbons were analysed for 13 sites and all concentrations were below the Practical Quantitation Limits (Table 9 and Table 10, Appendix D).

Table 8 **Total recoverable hydrocarbon and BTEXN concentrations**

Analyte	TRH C_{6-9}	TRH C_{6-10}	TRH C_{6-10} minus BTEX (F1)	TRH C_{10-14}	TRH C_{15-28}	TRH C_{29-36}	TRH $C_{>10-16}$	TRH $C_{>10-16}$	TRH $C_{>16-34}$	TRH $C_{>34-40}$	Benzene	Toluene	Ethylbenzene	*m/p*-Xylenes	o-Xylenes	Naphthalene
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
PQL	0.2	2	2	0.2	0.4	0.4	20	20	25	25	0.1	0.1	0.1	0.2	0.1	0.5
ANZG (2018)	550	550	550	550	550	550	550	550	550	550	-	-	-	-	-	-
CHANNEL																
C01	<0.2	<2	<2	<0.2	<0.4	<0.4	<20	<20	<25	<25	<0.1	<0.1	<0.1	<0.2	<0.1	<0.5
C02	<0.2	<2	<2	<0.2	<0.4	<0.4	<20	<20	<25	<25	<0.1	<0.1	<0.1	<0.2	<0.1	<0.5
C03	<0.2	<2	<2	<0.2	<0.4	<0.4	<20	<20	<25	<25	<0.1	<0.1	<0.1	<0.2	<0.1	<0.5
C04	<0.2	<2	<2	<0.2	<0.4	<0.4	<20	<20	<25	<25	<0.1	<0.1	<0.1	<0.2	<0.1	<0.5
C09	<0.2	<2	<2	<0.2	<0.4	<0.4	<20	<20	<25	<25	<0.1	<0.1	<0.1	<0.2	<0.1	<0.5
BASIN																
B22-B	<0.2	<2	<2	<0.2	<0.4	<0.4	<20	<20	<25	<25	<0.1	<0.1	<0.1	<0.2	<0.1	<0.5
B24-B1	<0.2	<2	<2	<0.2	<0.4	<0.4	<20	<20	<25	<25	<0.1	<0.1	<0.1	<0.2	<0.1	<0.5
SAND TRAP																
S34	<0.2	<2	<2	<0.2	<0.4	<0.4	<20	<20	<25	<25	<0.1	<0.1	<0.1	<0.2	<0.1	<0.5
TERRESTRIAL																
O40	<0.2	<2	<2	<0.2	<0.4	<0.4	<20	<20	<25	<25	<0.1	<0.1	<0.1	<0.2	<0.1	<0.5
O37	<0.2	<2	<2	<0.2	<0.4	<0.4	<20	<20	<25	<25	<0.1	<0.1	<0.1	<0.2	<0.1	<0.5
O38	<0.2	<2	<2	<0.2	<0.4	<0.4	<20	<20	<25	<25	<0.1	<0.1	<0.1	<0.2	<0.1	<0.5
O36	<0.2	<2	<2	<0.2	<0.4	<0.4	<20	<20	<25	<25	<0.1	<0.1	<0.1	<0.2	<0.1	<0.5
O39	<0.2	<2	<2	<0.2	<0.4	<0.4	<20	<20	<25	<25	<0.1	<0.1	<0.1	<0.2	<0.1	<0.5
Mean	***0.1***	***1***	***1***	***0.1***	***0.2***	***0.2***	***10***	***10***	***12.5***	***12.5***	***0.05***	***0.05***	***0.05***	***0.1***	***0.05***	***0.25***
UCL 95	***0.1***	***1***	***1***	***0.1***	***0.2***	***0.2***	***10***	***10***	***12.5***	***12.5***	***0.05***	***0.05***	***0.05***	***0.1***	***0.05***	***0.25***

Table 9 **Polycyclic aromatic hydrocarbon concentrations**

Analyte	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b,j+k)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Chrysene	Coronene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Perylene	Phenanthrene	Pyrene
Units	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PQL	5	5	5	5	5	5	10	5	5	5	5	5	5	5	5	5	5	5
HILs	**400**	**400**	**400**	**400**	**400**	**4**	**400**	**400**	**400**	**400**	**400**	**400**	**400**	**400**	**400**	**400**	**400**	**400**
								CHANNEL										
C01	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
C02	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
C03	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
C04	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
C09	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
								BASIN										
B22-B	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
B24-B1	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
								SAND TRAP										
S34	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
								TERRESTRIAL										
O40	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
O37	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
O38	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
O36	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
O39	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Mean	***2.5***	***2.5***	***2.5***	***2.5***	***2.5***	***2.5***	***5***	***2.5***	***2.5***	***2.5***	***2.5***	***2.5***	***2.5***	***2.5***	***2.5***	***2.5***	***2.5***	***2.5***
UCL 95	***2.50***	***2.50***	***2.50***	***2.50***	***2.50***	***2.50***	***5.00***	***2.50***	***2.50***	***2.50***	***2.50***	***2.50***	***2.50***	***2.50***	***2.50***	***2.50***	***2.50***	***2.50***

3.5. Organotins

Three tributyltin concentrations in the outer Channel were above the PQL and two of these also had dibutyltin concentrations above the PQL; however, no values were above the guideline value (ANZG 2018) (Table 10). No monobutyl tin was observed above the PQL.

Table 10 Organotin concentrations

Analyte	Tributyl tin as Sn	Dibutyltin	Monobutyltin
Units	µgSn/kg	µgSn/kg	µgSn/kg
PQL	0.5	0.5	0.5[1]
ANZG (2018)	9	-	-
		CHANNEL	
C01	2.2 (2.4)	0.9 (1.0)	<0.5
C02	0.5 (0.7)	0.7 (1.0)	<0.5
C03	0.7 (1.8)	<0.5	<0.5
C04	<0.5	<0.5	<0.5
C05	<0.5	<0.5	<0.5
C06	<0.5	<0.5	<0.5
C07	<0.5	<0.5	<0.5
C08	<0.5	<0.5	<0.5
C09	<0.5	<0.5	<0.5
C10	<0.5	<0.5	<0.5
Mean	**0.5 (0.7)**	**<0.5 (<0.5)**	**<0.5**
95%UCL	**1.4 (1.8)**	**0.5 (0.8)**	**<0.5**
		BASIN	
B11	<0.5	<0.5	<0.5
B12-1	<0.5	<0.5	<0.5
B12-2	<0.5	<0.5	<0.5
B13	<0.5	<0.5	<0.5
B14	<0.5	<0.5	<0.5
B15	<0.5	<0.5	<0.5
B16-1	<0.5	<0.5	<0.5
B16-2	<0.5	<0.5	<0.5
B17	<0.5	<0.5	<0.5
B18	<0.5	<0.5	<0.5
B19	<0.5	<0.5	<0.5
B20	<0.5	<0.5	<0.5
B21	<0.5	<0.5	<1
B22-B	<0.5	<0.5	<0.5
B23	<0.5	<0.5	<0.5

Analyte	Tributyl tin as Sn	Dibutyltin	Monobutyltin
B24-B1	<0.5	<0.5	<0.5
B24-B2	<0.5	<0.5	<0.5
B25	<0.5	<0.5	<0.5
		SAND TRAP	
S26	<0.5	<0.5	<0.5
S27	<0.5	<0.5	<0.5
S28	<0.5	<0.5	<0.5
S29-B1	<0.5	<0.5	<0.5
S29-B2	<0.5	0.6	<1
S30-B	<0.5	<0.5	<0.5
S31-B	<0.5	<0.5	<0.5
S32	<0.5	<0.5	<0.5
S33	<0.5	<0.5	<0.5
S34	<0.5	<0.5	<0.5
S35	<0.5	<0.5	<0.5
		TERRESTRIAL	
O40	<0.5	<0.5	<0.5
O37	<0.5	<0.5	<0.5
O38	<0.5	<0.5	<0.5
O36	<0.5	<0.5	<0.5
O39	<0.5	<0.5	<0.5
Mean	***0.31***	***0.28***	***0.25***
UCL 95	***0.39***	***0.31***	***0.25***

*All values normalised to 1% TOC.

[1]Monobutyltin PQL was raised by laboratory to 1 µgSn/kg at sites B21 and S29-B2 due to low extracted internal standard recovery

3.6. Pesticides

All organophospate and organochloride and pesticide concentrations were below the PQLs (Table 11)

Table 11 Pesticide concentrations

	Organochlorine Pesticides (OCP)																		Organophosphate Pesticides (OPP)											
Sample	Aldrin	a-BHC	b-BHC	d-BHC	a-chlordane	g-Chlordane	p,p'-DDD	p,p'-DDE	p,p'-DDT	Dieldrin	a-endosulphan	b-endosulphan	Endosulfan Sulphate	Heptachlor	Heptachlor Epoxide	Hexachlorobenzene (HCB)	Lindane (g-BHC)	Endrin	Bromophos Ethyl	Diazinon	Dimethoate	Ethion	Fenitrothion	Fenthion	Chlorpyrifos	Chlorpyrifos-methyl	Malathion	Parathion-ethyl	Parathion-methyl	Ronnel
PQL	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	50	50	50	50	50	50	50	50	50	50	50	50
C01	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
C02	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
C03	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
C04	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
C09	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
B22-B	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
B24-B1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
S34	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
O36	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
O37	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
O38	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
O39	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
O40	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50

3.7. Acid Sulfate Soils

The screening acidity (pH_F) of the samples ranged from 7.5 to 9.9, which are typical of marine sediments and did not indicate the presence of any Actual Acid Sulfate Soils (AASS). The oxidised screening test (pH_{FOX}) ranged from 6.3 to 7.2 (Table 12). The maximum change between pH_F and pH_{FOX} was 3.3 at the Basin site (B14). Three samples (samples CO1, CO3, B12-2) showed a 'Vigorous' reaction and two samples (CO4, CO8) exhibited a 'Very Vigorous' reaction to oxidation with 30% peroxide (Table 12). The rate of reaction is often more vigorous due to the presence of organics, some metalloid compounds and other oxides which may be unrelated to presence of PASS. On its own the screening test cannot definitively indicate PASS (DER, 2014). Indeed, none of the five samples with high reaction rates exhibited the other screening conditions indicative of potential acid sulfate soil (PASS) presence, including $pH_{FOX} < 6$ and change in pH between pH_F and $pH_{FOX} >2$).

Table 12 Acid sulfate soils screening results

Site	pH_F	pH_{FOX}	ΔpH	Rate of Reaction	PASS
			CHANNEL		
C01	7.8	6.4	1.4	Vigorous	No
C02	8	7.1	0.9	Moderate	No
C03	7.8	6.5	1.3	Vigorous	No
C04	7.7	7.1	0.6	Very Vigorous	No
C05	7.5	6.7	0.8	Moderate	No
C06	8.3	6.3	2	Moderate	No
C07	7.8	6.5	1.3	Moderate	No
C08	7.6	7.2	0.4	Very Vigorous	No
C09	8.2	6.6	1.6	Moderate	No
C10	8	6.6	1.4	Moderate	No
			BASIN		
B11	8.2	6.8	1.4	Moderate	No
B12-1	8.3	6.7	1.6	Moderate	No
B12-2	8.1	6.4	1.7	Vigorous	No
B13	9.7	6.5	3.2	Moderate	No
B14	9.9	6.6	3.3	Moderate	No
B15	9.1	6.8	2.3	Moderate	No
B16-1	9.5	6.5	3	Moderate	No
B16-2	8.7	6.7	2	Moderate	No
B17	8.9	7	1.9	Moderate	No
B18	9	7	2.5	Moderate	No
B19	9.3	6.4	2.9	Moderate	No
B20	9.2	6.7	2.5	Moderate	No
B21	8.4	6.9	1.5	Moderate	No
B22-B	8.2	6.6	1.6	Moderate	No
B23	8.7	6.6	2.1	Moderate	No

Site	pH_F	pH_{FOX}	ΔpH	Rate of Reaction	PASS
B24-B1	9	7	2	Moderate	No
B24-B2	9	7	2.2	Moderate	No
B25	9.4	7.1	2.3	Moderate	No
SAND TRAP					
S26	8.5	6.6	1.9	Moderate	No
S27	7.8	6.7	1.1	Moderate	No
S28	9.2	6.5	2.7	Moderate	No
S29-B1	8.4	6.6	1.8	Moderate	No
S29-B2	8.3	6.6	1.7	Moderate	No
S30-B	8.2	6.9	1.3	Moderate	No
S31-B	9.2	6.5	2.7	Moderate	No
S32	8.9	6.5	2.4	Moderate	No
S33	8.3	6.9	1.4	Moderate	No
S34	7.9	6.9	1	Moderate	No
S35	8.1	6.7	1.4	Moderate	No
TERRESTRIAL					
O40	9.1	6.7	2.4	Moderate	No
O37	9.1	7.2	1.9	Moderate	No
O38	8.7	7	1.7	Moderate	No
O36	9	6.4	2.6	Moderate	No
O39	8.9	6.7	2.2	Moderate	No

The screening acid sulfate test did not detect the presence of PASS, nonetheless Chromium Suite analysis was undertaken on nine samples considered to have a higher risk of PASS, based on depth horizons and sample colour and odours (Table 13). Three sites (C02, B12-2, S29-B2) exceed the action criteria (0.03%S) for coarse texture sands to loamy sands and peats (DER 2015). However, the acid neutralising ability of these sediments (calculated conservatively using a fineness factor of 3) was found to be sufficient to buffer any acidity generated (Table 13).

Table 13 Chromium reducible sulfur suite results

Sample	pHKCl (23A)	Chromium Reducible Sulfur (%S)	Chromium Reducible Sulfur (mole H+/t)	Acid Neutralising Capacity (% $CaCO_3$)	Acid Neutralising Capacity (mole H+/t)	ANC Fineness Factor	Net Acidity (mole H+/t)
Action Criteria	*<6.5*	*0.03*	*18*			*3*	*18*
			CHANNEL				
C02	9.3	**0.26**	**160**	29	5800	3	-1773.3
			BASIN				
B12-2	9.5	**0.14**	**87**	25	5000	3	-1579.7
B16-2	9.8	0.005	4	7.8	1600	3	-529.3
B24-B2	9.7	0.005	4	9.3	1900	3	-629.3
BH11 10.50-0.55	9.3	0.005	4	1.3	260	3	-82.7
BH12_7.45-7.55	9.6	0.005	4	22	4400	3	-1462.7
BH12 8.30-8.35	9.4	0.005	4	6.6	1300	3	-429.3
BH13_5.40-5.50	9.3	0.005	4	1.2	240	3	-76.0
			SAND TRAP				
S29-B2	9.5	**0.15**	**94**	27	5400	3	-1706.0

3.8. Asbestos

No asbestos or asbestos containing material was detected at any of the samples (Table 14).

Table 14 Asbestos analysis

Analyte	unit	PQL	O36	O37	O38	O39	O40
Asbestos Detected	g/kg	0.1	No	No	No	No	No
Asbestos (Trace)	Fibres	5	No	No	No	No	No
Asbestos Type	-	0.1	-	-	-	-	-
Synthetic Mineral Fibre	g/kg	0.1	No	No	No	No	No
Organic Fibre	g/kg	0.01	No	No	No	No	No
Sample weight (dry)	g	0.01	478	248	247	292	204
Asbestos Containing Material (ACM) (as 15% Asbestos in ACM >7mm)	% (w/w)	0.0004	<0.01	<0.01	<0.01	<0.01	<0.01
Asbestos (Fines and Fibrous <7mm)	g	0.001	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
Asbestos (Fines and Fibrous FA+AF)	% (w/w)	0.0001	<0.001	<0.001	<0.001	<0.001	<0.001
Fibrous Asbestos >7mm	g	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
Asbestos Containing Material	g	0.1	<0.1	<0.1	<0.1	<0.1	<0.1

4. Quality Assurance/Quality Control

The field sampling methods and small-scale sediment variability were found to be reliable with all RSD values below 50% as recommended in NAGD (2009) (Table 15 and Appendix F).

Intra-laboratory quality assurance was undertaken using duplicate samples and all samples were found to agree within an RPD of 35% except for one analyte (antimony) at S35 which had an RPD of 40% (Table 16). The PQL for antimony was 0.1 mg/kg and the values for S35 and DUP 4 were 0.2 mg/kg and 0.3 mg/kg, respectively. The calculation of the RPD with such concentrations is not unexpected and the values were considerably lower than the guideline value of 2 mg/kg.

The variation between laboratories was found to meet the recommended RPD of 35% at the majority of sites for most analytes (Table 17 and Appendix F). However, several sites and analytes did exceed the recommended 35% RPD threshold. Most of these exceedances were due to the use of different Practical Quantitation Limit between the primary and secondary laboratories (analytes found to be below the PQL are halved prior to the calculation of RPD, in-line with NAGD (2009) recommendations). However, two sites (S26 and S30B) reported an RPD values above the recommend threshold (Table 17). NAGD (2009) recommends that the values for these analytes at these sites are recommended to be used as estimates only. However, all concentrations of analytes for these sites are well below the ANZG (2018) guideline values, indicating that is highly unlikely that exceedances have been misreported as non-exceedances.

A Chain of Custody form was included with samples during transport which included sample ID, date collected, parameters for analysis, laboratory details and receival times (refer Appendix G).

Table 15 Relative Standard Deviation (RSD) values for the total metal concentrations in the field quality control samples

	Metals													Organotin		
Sample	Aluminium	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc	Monobutyltin as Sn	Dibutyltin as Sn	Tributyltin as Sn
Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/kg	µg/kg	µg/kg
PQL	1	0.1	0.1	0.1	0.5	0.5	1	0.5	1	0.01	0.5	0.1	0.5	0.5	0.5	0.5
C06	3,600	0.2	11	0.05	22	5.4	9,000	3	170	0.005	8.7	0.05	12	0.25	0.25	0.25
TRIP 1-0	3,900	0.2	13	0.05	23	5.5	9,400	3.2	170	0.005	9.2	0.05	12	0.25	0.25	0.25
TRIP 1-1	4,600	0.2	13	0.05	25	5.5	10,000	3.5	180	0.005	9.4	0.05	13	0.25	0.25	0.25
RSD (%)	**10.4**	**0.0**	**7.6**	**0.0**	**5.3**	**0.9**	**4.3**	**6.4**	**2.7**	**0.0**	**3.2**	**0.0**	**3.8**	**0.0**	**0.0**	**0.0**
B18	870	0.1	5.1	0.05	12	1.2	2,800	1.3	38	0.005	2.9	0.05	1.9	0.25	0.25	0.25
TRIP 2-0	950	0.1	4.2	0.05	13	1.3	3,200	1.3	42	0.005	3.4	0.05	3.5	0.25	0.25	0.25

	Metals													Organotin		
TRIP 2-1	860	0.1	4.1	0.05	12	1.1	2,800	1.1	37	0.005	2.8	0.05	2.1	0.25	0.25	0.25
RSD (%)	**4.5**	**0.0**	**10.1**	**0.0**	**3.8**	**6.8**	**6.4**	**7.6**	**5.5**	**0.0**	**8.7**	**0.0**	**28.5**	**0.0**	**0.0**	**0.0**
S27	1,600	0.2	5.1	0.05	15	1.9	4,500	2	64	0.005	5.2	0.05	3.9	0.25	0.25	0.25
TRIP 3-0	1,600	0.2	6.8	0.05	16	2.5	4,700	2.8	62	0.005	6.7	0.05	4.1	0.25	0.25	0.25
TRIP 3-1	1,600	0.3	7	0.05	15	2.8	4,500	2.7	56	0.005	7.9	0.05	3.8	0.25	0.25	0.25
RSD (%)	**0.0**	**20.2**	**13.5**	**0.0**	**3.1**	**15.6**	**2.1**	**14.2**	**5.6**	**0.0**	**16.7**	**0.0**	**3.2**	**0.0**	**0.0**	**0.0**
S35	1,500	0.2	8.8	0.05	15	2.8	4,700	2.6	68	0.005	7.5	0.05	3.9	0.25	0.25	0.25
TRIP 4-0	1,500	0.3	6.5	0.05	14	2.1	4,200	2.2	57	0.005	5.7	0.05	3.8	0.25	0.25	0.25
TRIP 4-1	1,200	0.2	6.4	0.05	14	1.9	3,700	2.1	45	0.005	5.1	0.05	3.2	0.25	0.25	0.25
RSD (%)	**10.1**	**20.2**	**15.3**	**0.0**	**3.3**	**17.0**	**9.7**	**9.4**	**16.6**	**0.0**	**16.7**	**0.0**	**8.5**	**0.0**	**0.0**	**0.0**

Table 16 **Relative percent difference (RPD) values for the total metal concentrations in the field quality control 'duplicate' samples**

Sample	*Metals* Aluminium	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc	*Organotins* Monobutyltin as Sn	Dibutyltin as Sn	Tributyltin as Sn
Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/kg	µg/kg	µg/kg
PQL	1	0.1	0.1	0.1	0.5	0.5	1	0.5	1	0.01	0.5	0.1	0.5	0.5	0.5	0.5
C06	3,600	0.2	11	0.05	22	5.4	9,000	3	170	0.005	8.7	0.05	12	0.25	0.25	0.25
DUP 1	3,900	0.2	13	0.05	23	5.5	9,400	3.2	170	0.005	9.2	0.05	12	0.25	0.25	0.25
RPD (%)	**8.0**	**0.0**	**16.7**	**0.0**	**4.4**	**1.8**	**4.3**	**6.5**	**0.0**	**0.0**	**5.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
B18	870	0.1	5.1	0.05	12	1.2	2,800	1.3	38	0.005	2.9	0.05	1.9	0.25	0.25	0.25
DUP 2	860	0.1	4.1	0.05	12	1.1	2,800	1.1	37	0.005	2.8	0.05	2.1	0.25	0.25	0.25
RPD (%)	**1.2**	**0.0**	**21.7**	**0.0**	**0.0**	**8.7**	**0.0**	**16.7**	**2.7**	**0.0**	**3.5**	**0.0**	**10.0**	**0.0**	**0.0**	**0.0**
S27	1,600	0.2	5.1	0.05	15	1.9	4,500	2	64	0.005	5.2	0.05	3.9	0.25	0.25	0.25
DUP 3	1,600	0.2	6.8	0.05	16	2.5	4,700	2.8	62	0.005	6.7	0.05	4.1	0.25	0.25	0.25
RPD (%)	**0.0**	**0.0**	**28.6**	**0.0**	**6.5**	**27.3**	**4.3**	**33.3**	**3.2**	**0.0**	**25.2**	**0.0**	**5.0**	**0.0**	**0.0**	**0.0**
S35	1,500	0.2	8.8	0.05	15	2.8	4,700	2.6	68	0.005	7.5	0.05	3.9	0.25	0.25	0.25
DUP 4	1,500	0.3	6.5	0.05	14	2.1	4,200	2.2	57	0.005	5.7	0.05	3.8	0.25	0.25	0.25
RPD (%)	**0.0**	**40.0**	**30.1**	**0.0**	**6.9**	**28.6**	**11.2**	**16.7**	**17.6**	**0.0**	**27.3**	**0.0**	**2.6**	**0.0**	**0.0**	**0.0**

* Green cells are values that exceed the RPD due to concentrations close to laboratory PQLs.

Table 17 **Relative percent difference (RPD) values for the total metal concentrations in the field quality control 'split' samples.**

Analyte	*Metals* Aluminium	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc	*Organotins* Monobutyltin	Dibutyltin	Tributyltin
Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µgSn/kg	µgSn/kg	µgSn/kg
PQL (Lab 2$_o$)	50	0.50	1.00	0.1	1.0	1.0	50	1.0	10	0.01	1.0	0.1	1.0	1	1	0.5
PQL (Lab 1$_o$)	1	0.1	0.1	0.1	0.5	0.5	1	0.5	1	0.01	0.5	0.1	0.5	0.5	0.5	0.5
C10 (Lab 2$_o$)	2770	0.25	8.06	0.05	17.0	4.6	8890	2.8	126	0.005	7.5	0.2	10.8	0.5	0.5	0.25
C10 (Lab 1$_o$)	4,200	0.2	10	0.05	24	6	10,000	3.5	150	0.005	10	0.05	13	0.25	0.25	0.25
RPD (%)	**34.0**	**22.2**	**19.4**	**0**	**29.2**	**23.3**	**11.1**	**20**	**16**	**0**	**25**	**300.0**	**16.9**	**66.7**	**66.7**	**0**
B12-1 (Lab 2$_o$)	2270	0.25	4.49	0.05	15.8	3.6	7210	2.6	64	0.005	6.9	0.05	5.7	0.5	0.5	0.25
B12-1 (Lab 1$_o$)	2,400	0.5	5.1	0.05	18	3.2	5,800	2.3	71	0.005	7	0.05	4.8	0.25	0.25	0.25
RPD (%)	**5.4**	**66.7**	**12.0**	**0**	**12.2**	**12.5**	**24.3**	**13.0**	**9.9**	**0**	**1.4**	**0**	**18.75**	**66.7**	**66.7**	**0**
B17 (Lab 2$_o$)	580	0.25	2.87	0.05	11.1	0.5	2780	1.2	34	0.005	2.7	0.2	1.9	0.5	0.5	0.25
B17 (Lab 1$_o$)	630	0.1	2.9	0.05	12	0.9	2,500	1	30	0.005	2.6	0.05	2.2	0.25	0.25	0.25
RPD (%)	**7.9**	**85.7**	**1.0**	**0**	**7.5**	**57.1**	**11.2**	**20**	**13.3**	**0**	**3.8**	**300.0**	**13.6**	**66.7**	**66.7**	**0**
S26 (Lab 2$_o$)	1250	0.25	3.95	0.05	13.5	2.4	9700	1.8	64	0.005	7.5	0.05	4.3	0.5	0.5	0.25
S26 (Lab 1$_o$)	1,300	0.2	4.1	0.05	15	1.7	4,000	1.9	48	0.005	4.4	0.05	3.3	0.25	0.25	0.25
RPD (%)	**3.8**	**22.2**	**3.7**	**0**	**10**	**41.2**	**142.5**	**5.3**	**33.3**	**0**	**70.5**	**0**	**30.3**	**66.7**	**66.7**	**0**
S30B (Lab 2$_o$)	730	0.25	3.12	0.05	12.2	0.5	6760	1.2	37	0.005	3.0	0.05	2.0	0.5	0.5	0.25
S30B (Lab 1$_o$)	1,400	0.3	8.7	0.05	16	1.9	6,000	1.7	72	0.005	3.8	0.05	2.9	0.25	0.25	0.25
RPD (%)	**47.9**	**18.2**	**64.1**	**0**	**23.8**	**116.7**	**12.7**	**29.4**	**48.6**	**0**	**21.1**	**0**	**31.0**	**66.7**	**66.7**	**0**

Red shaded cells identify values above the specified RPDs not due to differences in PQLs between Laboratories. Green cells are values that exceed the RPD due to difference between laboratory PQLs.

At the primary laboratory (ARL), all holding times were met and laboratory quality control procedures were followed in accordance with NATA accreditation, including:

- Method blank limits were met.
- Laboratory duplicates limits were met.
- Matrix spike limits were met
- Laboratory Control and Certified Reference Material criteria were met

At the secondary laboratory (ALS) all holding times were met and laboratory quality control procedures were followed in accordance with NATA accreditation, including:

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control outliers occur.
- Matrix Spike outliers exist.
- For all regular sample matrices, no surrogate recovery outliers occur.
- No Analysis Holding Time Outliers exist.
- No Quality Control Sample Frequency Outliers exist.

Matrix spike recoveries were not determined for aluminium and iron in one sample (B12-1) as the background level was 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. A matrix spike outlier value was also obtained for dibutyltin and monobutyltin in one sample; this data was from a field QC sample (Split) and was below the PQLs. Although laboratory QC did not pass the matrix spike outlier test the recorded concentrations were below the PQL indicating a low likelihood that analysis error has implications for potential exceedances.

5. Conclusions

Excluding QAQC samples, a total of 48 samples were collected during the field survey (10 from the Channel, 22 from the Basin (including 4 obtained during the geotechnical survey), 11 from the Sand Trap and 5 Terrestrial). The sediments were dominated by the sand size fraction (60 µm–2 mm) and the proportion of gravel reduced with distance offshore.

Many of the analytes were below the PQL. All metals, hydrocarbon, organotin and pesticide concentrations were below the relevant guideline values. Three samples (C02, B12-2, S29-B2) exceed the acid sulfate soil action criteria of 0.03%S. However, the Acid Neutralising Capacity of these samples was sufficient to ensure no PASS would be generated on exposure to air. No Asbestos or asbestos containing material was found in any of the terrestrial soil samples.

The field and laboratory QA/QC indicated iintra-site and intra-laboratory variability was low. All laboratory QC limits were met, except for one sample with a matrix spike for dibutyltin and monobutyltin. The RPD threshold was exceeded at two sites (Site S26 - copper, iron and nickel and S30 - aluminium, arsenic, manganese). The values for these analytes at these sites are recommended to be used as estimates only, although all levels reported were well below any of the guideline values

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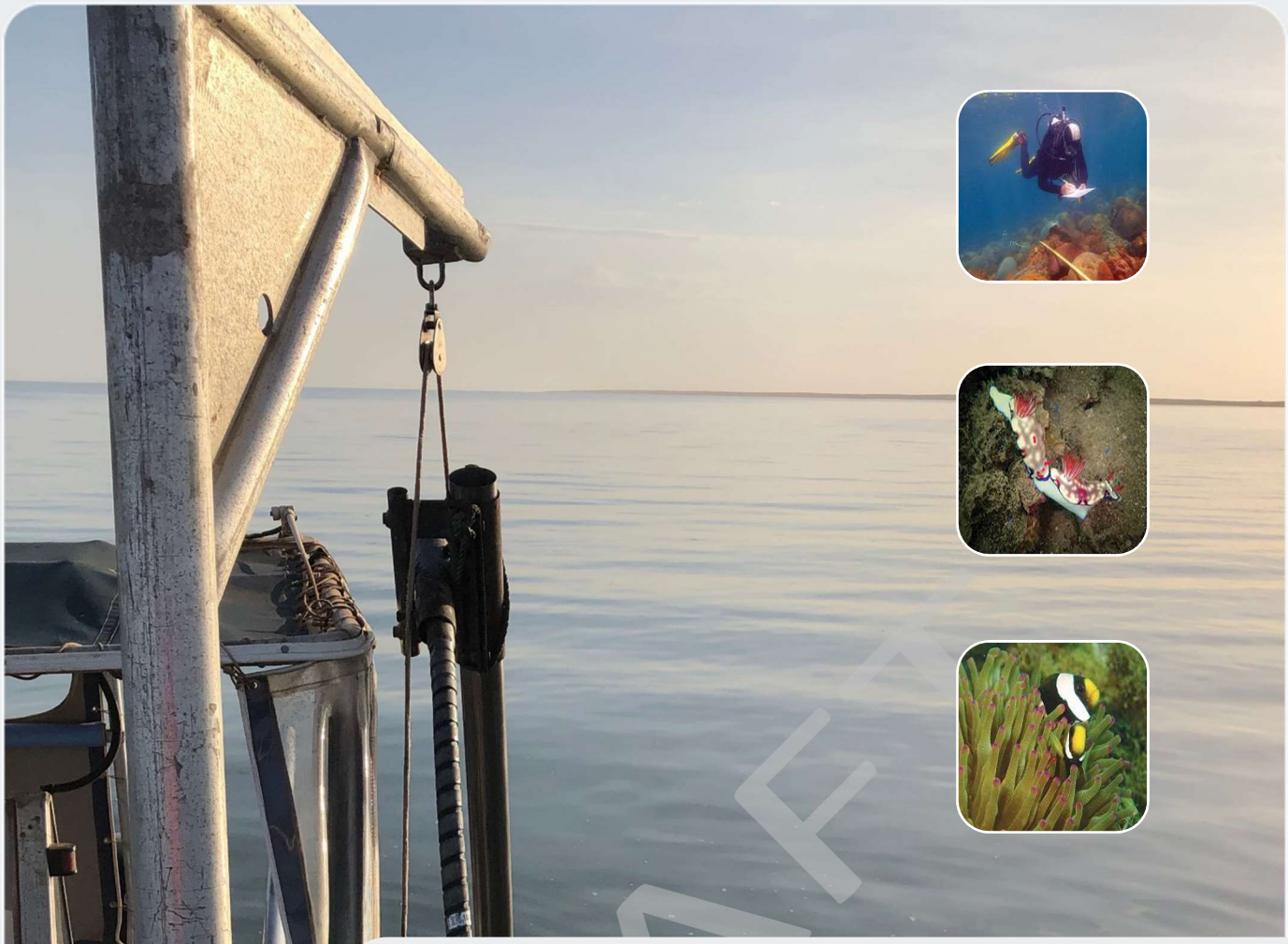
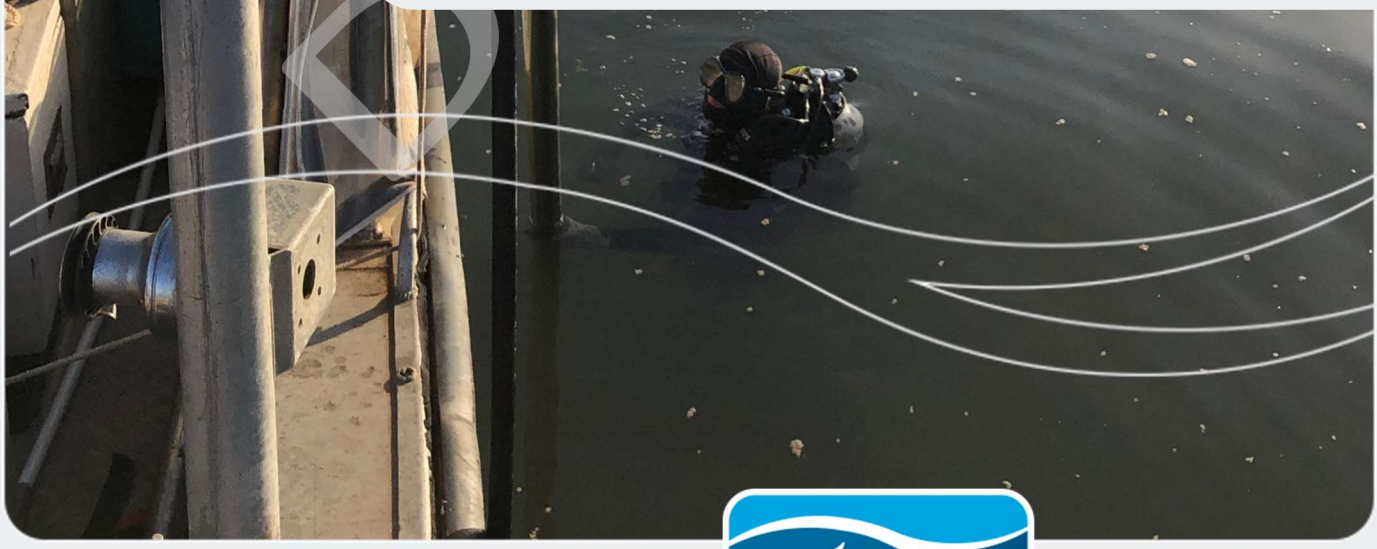
Appendix A Spoilbank Marina Sampling and Analysis Plan



Port Hedland Spoilbank Marina

Sediment Sampling and Analysis Plan



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O2 MARINE

TEAL SOLUTIONS environmental advisory

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Acronyms and Abbreviations

Acronyms/Abbreviation	Description
^{0}C	Degrees Celsius
ADAS	Australian Diver Accreditation Scheme
ANC	Acid Neutralisation Capacity
Ag	Silver
Al	Aluminium
As	Arsenic
ASS	Acid Sulphate Soils
AS/NZS	Australian Standard / New Zealand Standard
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
Cd	Cadmium
cm	Centimetre
CoC	Chain of Custody
Cu	Copper
DBT	Dibutyltin Tributyltin
DER	Department of Environmental Regulations
DGV	Default Guideline Value
EIL	Ecological Investigation Levels
Fe	Iron
g	Grams
GPS	Global Positioning System
Hg	Mercury
HIL	Health Investigation Levels
HSE	Health, Safety and Environment
ID	Identification
JSEA	Job Safety and Environmental Analysis
km	Kilometres
L	Litres
m	Metres
m^2	Square metres
m^3	Cubic metres
MBT	Monobutyltin
Mg	Magnesium
mg/kg	Milligrams per kilogram
Mn	Manganese
NAGD	National Assessment Guidelines for Dredging 2009
NATA	National Association of Testing Authorities

Acronyms/Abbreviation	Description
Ni	Nickel
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PQL	Practical Quantitative Limits
PSD	Particle Size Distribution
PVC	Polyvinyl chloride
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SAP	Sample and Analysis Plan
SCR	Inorganic Sulphur Content
TBT	Tributyltin
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
TRH	Total Recoverable Hydrocarbons
UCL	Upper Confidence Limit
µg/L	Micrograms per Litre
V	Vanadium
QA/QC	Quality Assurance and Quality Control
Zn	Zinc

Contents

Figures

Tables

1. Introduction

1.1. Background

The Town of Port Hedland, together with LandCorp and the Pilbara Development Commission, has been progressing planning for the development of a marina in Port Hedland. They have developed a concept design for a marina on the western side of the Spoilbank, adjacent to the Port Hedland Yacht Club, incorporating four lanes of boat ramp and up to 80 boat pens (Figure 1-1). The Department of Transport (DoT) is responsible for the coordination of the design of marine facilities for the Spoilbank Marina and is undertaking several marine technical investigations to support an environmental impact assessment and referral for the Spoilbank Marina. The Project will require dredging and onshore disposal of approximately 850,000 m^3 of dredging material.

Figure 1-1 Concept plan for Spoilbank Marina

1.2. Scope

This document outlines the Sampling and Analysis Plan (SAP) for baseline assessment and characterisation of sediments associated with the dredging proposal for the Port Hedland Spoilbank Marina and access channel. The outcome of this sediment sampling and analysis will enable a

determination of the contaminant status of the materials and suitability for onshore disposal as well as provide input on sediment characteristics for dredge plume modelling.

1.3. Regulations and Guidelines

This document has been prepared with consideration of the following guidelines:

- The Department of Environment Regulation (DER): Assessment and Management of Contaminated Sites, Contaminated Sites Guidelines December 2014 (DER 2014);
- National Environment Protection (Assessment of Site Contamination) Amendment Measure (NEPM) 2011, Volume 2, Schedule B1, Guideline on Investigation Levels for Soil and Groundwater (NEPM 2011);
- National Environment Protection (Assessment of Site Contamination) Amendment Measure (NEPM) 2013, Volume 3, Schedule B2, Guideline on Site Characterisation (NEPM 2013);
- National Environment Protection (Assessment of Site Contamination) Amendment Measure (NEPM) 2013, Volume 8, Schedule B5c, Guideline on Ecological Investigation Levels for Arsenic, Chromium (III), Copper, DDT, Lead, Naphthalene, Nickel and Zinc (NEPM 2013a);
- The Department of Environment Regulation (DER): Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes, June 2015 (DER 2015);
- The National Assessment Guidelines for Dredging (NAGD), 2009 (NAGD 2009); and
- ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

1.3.1. Objectives

Sediment investigations are required to adequately characterise the level of contamination in the sediments to be dredged. This requires the samples collected to be representative of the sediments to be dredged. Use of the appropriate collection, transportation, storage and analysis techniques is also critical to the investigation, as outlined in NAGD (2009).

Specific objectives of the sediment sampling program are:

- To determine the suitability of the dredged sediment for onshore disposal;
- To identify the risk to marine environmental quality resulting from disturbance and mobilisation of the sediments;
- To identify the risk to terrestrial environmental quality resulting from placement of the dredge material to land; and
- To identify the Acid Sulfate Soils (ASS) risk posed by placing the dredge sediment on and land and subsequent exposure of the sediment to air;

2. Project Description

2.1. Spoilbank Marina – Proposed Dredging

Dredging for the Spoilbank Marina will be undertaken for the following project elements: access channel, the harbour basin, the inner breakwater, the inner revetment and a sand trap (Figure 2-1). At present two channel alignments are being considered and sediments from both will be characterised during this sediment sampling work.

Table 2-1 Dredging required for the Spoilbank Marina

Zone	Area (ha)	Design Depth (m CD)	Dredge Volume for Design (m^3)
Primary Channel	2.75	2.5m	108,500
Alternate Channel	1.27	2.5m	40,000
Harbour Basin	2.99	2.5m	332,000
Breakwater*	2.11	2.5m	107,000
Revetment*	2.3	2.5m	110,000
Send Trap	6.83	2m	100,000
Project Total	18.5ha		**797,500**

* Dredging for the breakwater and revetment will be undertaken to enable foundation of the footings

Figure 2-1 Dredging areas

3. Site Description

3.1. Site Identification, History and Use

The project site (Figure 2-1) is located on the western flank of the Port Hedland Spoilbank which was created from disposal material derived from previous dredging campaigns undertaken for the Port Hedland shipping channel and inner harbour. The southern portion of the project site is currently utilised by the Pilbara Navy Cadets the Port Hedland RSL and the Port Hedland Sailing Club while the remaining of the site is used for recreational activities such as fishing, kitesurfing and picnicking.

3.2. Previous Sediment Quality Investigations in Port Hedland

Port Hedland and surrounding marine areas have been subject of extensive sediment quality investigations over at least the past 40 years and extensive information is available to characterise the marine sediment chemical and physical properties (GHD 2018). Most of these sediment quality investigations have been associated with capital dredging programs and, have been focussing on the quality of sediments at specific areas in the Port Hedland inner harbour and shipping channel (Table 3-1). There have also been several studies to investigate sediment quality at reference locations to determine the quality of the natural sediment, including a broad sediment quality investigation across the Port Hedland area (DEC 2006) and an investigation for acid sulfate soil on the Spoilbank (RPS 2014).

Table 3-1 Maintenance and capital dredging of Port Hedland since 1974

Year	Type of Dredging	Proponent	Volume [m^3]	Sediment sampling conducted
1997	Maintenance	PPA*	150,000	N
1981	Maintenance	PPA	268,000	Y
1985	Capital and Maintenance	PPA	7,000,000	Y
1986	Capital	PPA	13,600,000	Y
1990	Maintenance	PPA	350,000	Y
1993	Maintenance	PPA	200,000	Y
1994	Maintenance	PPA	114,000	Y
1997	Maintenance	PPA	330,000	Y
2001	Maintenance	PPA	580,000	Y
2002	Capital	BHP	460,000	Y

2004	Maintenance	PPA	550,000	Y
2006	N/A	DEC	N/A	Y
2006-07	Capital	FMG	5,000,000	Y
2007	Maintenance	PPA	730,000	Y
2008	Capital	FMG	3,400,000	Y
2009	Capital	BHP	3,900,000	Y
2010	Capital	BHP	6,000,000	Y
2010	Capital	PPA	8,800,000#	Y
2010	Maintenance	PPA	930,000	Y
2012	Capital	PPA	5,880,000#	Y
2012	Maintenance	PPA	312,850	Y
2012	Capital	BHP	1,720,000#	Y
2013	Maintenance	PPA	680,839	Y
2014	Maintenance	PPA	344,789	Y
2014	Detail Site Investigation for Contaminants and Acid Sulfate Soils	RPS	N/A	Y
2015	Maintenance	PPA	473,395	Y
2016	Maintenance	PPA	272,048	Y
2017	Capital	PPA	1,913,000	Y
2018	Capital	PPA	400,000	Y

Source GHD 2018 (modified O2 Marine 2019)

** PPA was previously known as Port Hedland Port Authority*
 # Volumes approved for dredging, but not necessarily dredged

3.2.1. Summary of Historical Data

The long history of dredging and associated sediment sampling around Port Hedland demonstrates that the sediments are largely uncontaminated, apart from a small number of locations inside the Port and adjacent to some of the older berths (Table 3-2).

Table 3-2 Summary of historical sediment sampling

Year	Study	Location of Sediment	Comments
1997	BHP	Inner Harbour and Shipping Channel	All contaminants of concern where either below screening guidelines or within natural background ranges for the region of Port Hedland.
1999 2000 2002 2003	BHP from URS (2004a)	Inner Harbour and Shipping Channel, plus 8 subtidal sites adjacent to the export wharves (including Nelson Point, Finucane Island Wharf and PH 1 and entrance Channel). Reference location sampled on each occasion	Sampling involved the collection of single samples at various locations and statistical analysis was not conducted.
2001	PHPA Maintenance Dredging Sea Dumping Application	Inner Harbour and Shipping Channel	Arsenic, cadmium, chromium, copper, lead, mercury, zinc and tributyltin were below NAGD (low) screening levels. Nickel was above screening levels at the majority of sample sites, but comparable to background levels. Study included toxicity testing by Curtin University that concluded that the amphipod and mollusc bioassays that were (the only ones) undertaken showed the sediments to be not more toxic than reference sediment.
2003	Sampling and Analysis Plan for Maintenance Dredging (URS 2004a)	Shipping Channel Inner Harbour, Nelson Point, PH 3, Western Turning Basin PH 1	All channel sediments had metals below (current) NAGD (low) screening levels.
2004	PHPA maintenance dredging Sea Dumping Permit Application (URS, 2004b)	Inner Harbour and Shipping Channel Reference Location (RS09)	Current NAGD (low) screening levels were exceeded by the 95% UCL concentrations for: • Arsenic in the channel • Chromium at Nelson Point and No 3 Wharf • Nickel in almost all areas • Tributyltin at Nelson Point, No 3 wharf and No 1 wharf approach
2006	Department of Environment and Conservation-Marine technical report series MTR1-	Port Hedland: Offshore	Arsenic: Exceeded at PH2 for NAGD (low) screening levels and was deemed naturally occurring, all other metals did not exceed the current NAGD (low) screening levels.

Year	Study	Location of Sediment	Comments
	Background quality of the marine sediment of the Pilbara Coast		
2007	PHPA Maintenance Dredging SAP implementation in support of Sea Dumping Permit Application (Koskela Group 2007)	Inner Harbour, Shipping Channel and Spoil Ground "I"	Exceedances of current NAGD (low) screening levels of arsenic, tributyltin, nickel and copper in sediments from PPA wharves with exceedances of arsenic and nickel in channel sediments. Elutriate and bioavailability testing was undertaken and all sediments were approved as suitable to be disposed of to offshore Spoil Ground "I".
2008	FMG Anderson Point (URS, 2008)	Anderson Point and adjacent areas	Only exceedance of NAGD (low) screening level was nickel which was determined to be naturally-occurring.
2011	BHPB Outer Harbour Development (BHPB, 2009)	Large areas in the offshore areas around Port Hedland including the spoil grounds.	95% UCLs for all metals, tributyltin and polycyclic aromatic hydrocarbons were below screening levels.
2011	Stingray Creek Cyclone Moorings (PHPA and BHPB)	Stingray Creek near to the area of the proposed dredging of the SCSSB area	No exceedances of the NAGD (low) screening levels for any parameters measured.
2012	Port Hedland Maintenance Dredging (WorleyParsons, 2012a)	Inner Harbour, Shipping Channel and Spoil Ground "I"	Exceedances of NAGD screening level (low) for arsenic, nickel and chromium in almost all areas sampled. Copper exceeded NAGD (low) screening levels at PPA wharves
2012	Port Hedland Maintenance Dredging (WorleyParsons, 2012b) Post-dredging Survey.	PH 1, 2, 3 and 4 Nelson Point Spoil Ground "I"	Copper and tributyltin above NAGD (low) screening levels at Nelson Point and PPA Berth 4.
2014	Port Hedland Marina Development Detail Site Assessment for Acid Sulfate Soil	Spoilbank and proposed channel	No acid was detected across the site. Pyritic acidity (CRS) was only identified within one location however significant concentration of neutralising capacity were observed within the soil unit. As such PASS was not identified at the site, with net acidities complying with DER action management criteria. Significant ANC were identified at all locations and across all depths at the site
2015	Port Hedland Maintenance Dredging sampling	Anderson Point, Stanley Point and Spoil Ground "I"	Exceedances of NAGD screening level (low) for arsenic, nickel and chromium. No exceedances of any other parameters.

Year	Study	Location of Sediment	Comments
	(Jacobs 2015)		
2016	Port Hedland Maintenance Dredging sampling (GHD 2016)	Channel Inner Harbour, various berth pockets and Spoil Ground "I" extension	Exceedances of NAGD screening level (low) for arsenic, nickel and chromium. No exceedances of any other parameters.
2017	CROP Sampling and Analysis Plan Implementation (Jacobs 2017)	Channel Inner Harbour, Spoil Grounds 7 and 9	No exceedances of any parameters.
2017	Port Hedland Maintenance Dredging sampling (MScience 2017)	Nelson Point, Finucane Island and PH 1 and 2 berth pockets	Exceedances of NAGD (low) screening level for nickel at all sites. Exceedances of NAGD (low) screening level for barium, copper, manganese and tributyltin at PPA Wharfs 1 & 2, however elutriate and bioavailability testing found the sediments to be suitable for unconfined ocean disposal.
2018	Port Hedland Capital Dredging sampling	Stingray Creek Southern Swing Basin SAP Implementation	The 95% UCL of metal concentrations were below the NAGD low level screening guidelines for all contaminants of concerns with exception of nickel and chromium. Organic contaminant concentrations including hydrocarbons and pesticides were very low and generally below the limits of reporting for almost all samples tested. Similarly, the concentrations of TBT were very low with only one sample (out of 19) recording a value above the limit of reporting. All results were consistent with findings from previous sediment investigations in Port Hedland, where the concentrations of both chromium and nickel have been shown to correlate very strongly with particle size and have been shown to be naturally high because they are lithogenically derived and naturally occurring.

3.3. Potential Sources of Contamination

The potential contaminants of concern in the sediments of Port Hedland have been determined from a review of the previous sediment quality investigation, land uses and the Port cargo profile (Table 3-3). Sampling and analysis identified that sediments were classified as 'probably clean' (GHD 2018) based on the 95% Upper Confidence Limit (UCL) calculated from a suite of contaminants (metals, organotins, PAHs, or organochlorine and organophosphate pesticides).

The concentration of nickel, arsenic and chromium in marine sediments in the Port Hedland area have been found to naturally exceed the NAGD screening levels in the harbour, channel and at reference locations during all previous sediment sampling and analysis plan and similar level are expected at the Spoilbank.

Organotins from antifouling paints, which have been banned for application on Australian vessels since 2003, are only likely to be present in existing shipping berths as a relic of historic contamination.

Table 3-3 Potential contaminant of concern

Class of Constituent	Chemical Constituent	Potential or Likely Source of Contaminant
Metals	Arsenic (As) Antimony (Sb) Mercury (Hg) Cadmium (Cd) Chromium (Cr) Copper (Cu) Lead (Pb) Nickel (Ni) Manganese (Mn) Zinc (Zn) Silver (Ag) Antimony (Sb)	Naturally occurring in northern Australian marine sediments, the metals nickel, arsenic, cadmium and chromium have all been found at times exceeding the NAGD screening levels in the sediments of both the port and channel and in reference locations.
Hydrocarbons	Total Petroleum Hydrocarbons (TPHs) Polycyclic Aromatic Hydrocarbons (PAHs) BTEX	Sources are likely to be accidental fuel spills and potential for sediment contamination is very low. Have never been at concentrations above the PQLs outlined in Table 1 of the NAGD.
Organotins	Monobutyltin (MBT) Dibutyltin (DBT) Tributyltin	Antifouling paints. Banned for application in Australia on all vessels since 2003. Likely present in existing shipping berths only as a result of historic contamination. Breaks-down naturally in sediments.
Pesticides	Organochlorine Organophosphorus	No likely source. Have never been recorded at concentrations above the PQLs outlined in Table 1 of the NAGD.

4. Sampling Design

This Sampling and Analysis Plan will investigate sediment and soil quality from a total of 40 sampling locations. Respectively 35 and 5 sampling locations were identified to analyse marine sediment and onshore soil.

4.1. Marine Sediment Investigation

4.1.1. Contaminants of Investigation

Based on historical data sources and identified potential or likely source of contaminant (Table 3-3), recommendation from Appendix A of NAGD (2009) and naturally occurring acid generating potential for land reclamation, the following analytes will be investigated:

- Metals (Aluminium, Antimony, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Mercury, Nickel, Silver, Zinc).
- Organotin: TBT, DBT, MBT
- Acid Sulphate Soils[1]
- Total Organic Carbon (TOC); and
- Particle Size Distribution (PSD)

In addition to the above analytes, surface sediments (0m to 1 m) will be analysed at sampling locations C2, C4, C9, S34, B24 and B15 (see Figure 4-1) for these additional contaminants:

- Total Petroleum Hydrocarbon (TPH);
- BTEX;
- Polycyclic Aromatic Hydrocarbon (PAH);
- Organochlorine pesticides and organophosphate pesticide;

4.1.2. Sampling design and rational

The estimated volume to be dredged for the Spoilbank Marina project is approximately 800,000 m^3 over an area of approximately 18.5ha (Table 2-1).

This dredging is largely of areas which have not previously been dredged and is therefore classified as a capital dredging campaign and the material will be placed onshore around the project site. The number of sampling locations has been calculated in accordance with National Assessment Guidelines for Dredging (NAGD 2009; Table 6 Appendix D). For the proposed volume of dredging the guidelines specify sampling at 70 locations. However, previous sampling suggest that the sediment may be

[1] *Field ASS analysis shall be completed on all samples and laboratory ASS analysis will only be undertaken if the field screening test identifies PASS.*

classified as 'probably clean' and therefore the NAGD allows for the number of sampling locations to be halved to 35. For capital dredging projects, where contamination is not suspected, the NAGD does not require sediment sampling deeper than 1 metre below the existing seabed. However, we proposed to attempt coring to the full depth of proposed dredging at six (6) locations within the dredge footprint to characterise the underlying sediments; particularly for acid sulfate soil presence due to the proposed onshore disposal.

4.1.3. Sampling sites and depths

In accordance with the NAGD the proposed dredging footprint was divided into three areas based on hydrodynamic conditions, seabed morphology and likely dredging method (cutter suction dredge, backhoe and land-based excavation methods may be used during the works) (Figure 4-1):

1. Channel;
2. Inner Basin; and
3. Sand Trap

Samples will be collected from a total of 35 sites, 10 from the channel; 15 from the inner basin and 10 from the sand trap in accordance with the NAGD (Table 4-1). In addition, 10 L of ambient waters will be collected offshore for use in elutriate analysis if required.

Table 4-1 Sampling intensity as determined with reference to the NAGD

Area	Sub areas	Volumes (m^3)	NAGD Reference	Total number of sampling locations required as per Table 6 NAGD	Number of halved* sampling locations for 'probably clean' sediment
Channel	Primary channel Optional channel Route	108,500 40,000	Table 6 volume range: 141,000-182,000	**20**	**10**
	Total	**148,500**			
Inner Basin	Inner breakwater 107,000 inner revetment 110,000 Marina Basin 332,000		For volume exceeding 500,000m^3 the following equation shell be used y = 0.025x + 15.547 (where x is the proposed dredging volume)	**29**	**15**

Area	Sub areas	Volumes (m^3)	NAGD Reference	Total number of sampling locations required as per Table 6 NAGD	Number of halved* sampling locations for 'probably clean' sediment
	Total	**549,000**			
Sand Trap	Send trap	100,000	Table 6 volume range: 100,000–141,000	**19**	**10**
	Total	**100,000**			
Total number of sampling locations				**69**	**35**
*The number of sampling locations have been calculated in accordance with table 6 Appendix D of the NAGD 2009. However, based on available data, the dredge site can be classified as 'probably clean. Therefore, the number of sampling sites have been halved in accordance with the NAGD 2009.					

The location of the sampling sites was determined in accordance with the NAGD using a grid (with five times the number of squares as the number of the sampling locations was prepared. The 35 sampling locations were selected from the grid at random using a GIS (Figure 4-1 and Table 4-2).

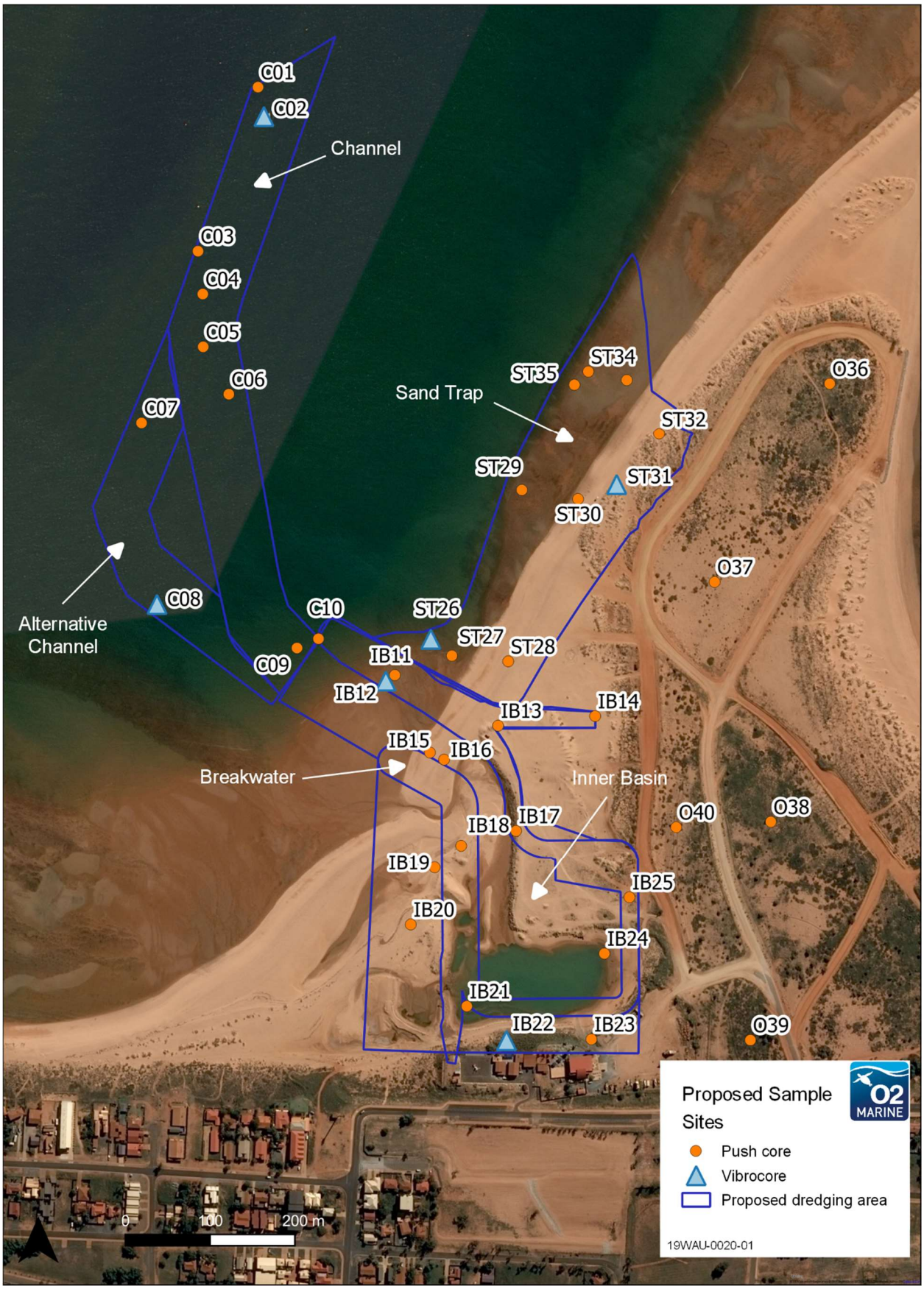

Figure 4-1 Proposed sediment sampling sites

Table 4-2 Proposed sediment sampling sites

Sediment Sampling Locations						
Site ID	**Latitude** (WGS 84 Zone 50)	**Longitude** (WGS 84 Zone 50)	**Sample Location**	**Sample Method**	**Sample Depth**	**Field QA/QC**
C01	20° 17' 54.7563" S	118° 35' 14.4480" E	Channel	PC	1m	Triplicate
C02	20° 17' 57.1526" S	118° 35' 12.0225" E	Channel	VC	2.5m	
C03	20° 17' 58.9164" S	118° 35' 13.0151" E	Channel	PC	1m	Duplicate / Split
C04	20° 18' 4.0009" S	118° 35' 11.3511" E	Channel	PC	1m	
C05	20° 18' 7.0054" S	118° 35' 9.0399" E	Channel	PC	1m	
C06	20° 18' 7.6988" S	118° 35' 11.7671" E	Channel	PC	1m	
C07	20° 18' 9.5477" S	118° 35' 8.1155" E	Channel	PC	1m	
C08	20° 18' 12.4135" S	118° 35' 13.0613" E	Channel	VC	2.5m	
C08	20° 18' 12.4135" S	118° 35' 13.0613" E	Channel	PC	1m	
C09	20° 18' 14.2548" S	118° 35' 10.4318" E	Channel	PC	1m	Triplicate
C10	20° 18' 15.9599" S	118° 35' 13.7187" E	Channel	PC	1m	Duplicate / Split
IB11	20° 18' 17.7754" S	118° 35' 15.3263" E	Inner Basin	PC	1m	
IB12	20° 18' 17.4981" S	118° 35' 19.3939" E	Inner Basin	VC	2.5m	
IB13	20° 18' 19.3470" S	118° 35' 18.5156" E	Inner Basin	PC	1m	
IB14	20° 18' 20.9648" S	118° 35' 20.5032" E	Inner Basin	PC	1m	

Sediment Sampling Locations						
IB15	20° 18' 22.5364" S	118° 35' 23.2304" E	Inner Basin	PC	1m	
IB16	20° 18' 23.6457" S	118° 35' 19.9023" E	Inner Basin	PC	1m	Triplicate
IB17	20° 18' 24.8475" S	118° 35' 23.0455" E	Inner Basin	PC	1m	Duplicate / Split
IB18	20° 18' 24.2004" S	118° 35' 26.7433" E	Inner Basin	PC	1m	
IB19	20° 18' 27.8058" S	118° 35' 18.7005" E	Inner Basin	PC	1m	
IB20	20° 18' 27.5285" S	118° 35' 22.5833" E	Inner Basin	PC	1m	
IB21	20° 18' 28.2680" S	118° 35' 27.0669" E	Inner Basin	PC	1m	
IB22	20° 18' 30.0245" S	118° 35' 25.7727" E	Inner Basin	VC	2.5m	
IB23	20° 18' 24.3669" S	118° 35' 17.9431" E	Inner Basin	PC	1m	
IB24	20° 18' 29.9321" S	118° 35' 20.8730" E	Inner Basin	PC	1m	
IB25	20° 18' 31.2507" S	118° 35' 23.4598" E	Inner Basin	PC	1m	
ST26	20° 18' 4.1947" S	118° 35' 26.3144" E	Sand Trap	VC	2.5m	
ST27	20° 18' 6.6934" S	118° 35' 28.1069" E	Sand Trap	PC	1m	
ST28	20° 18' 16.3211" S	118° 35'23.5067" E	Sand Trap	PC	1m	
ST29	20° 18' 9.8135" S	118° 35' 28.6616" E	Sand Trap	PC	1m	Triplicate
ST30	20° 18' 7.1435" S	118° 35' 24.5641" E	Sand Trap	PC	1m	Duplicate / Split
ST31	20° 18' 8.9815" S	118° 35' 25.4722" E	Sand Trap	VC	2.5m	

Sediment Sampling Locations						
ST32	20° 18' 11.1308" S	118° 35' 26.7896" E	Sand Trap	PC	1m	
ST33	20° 18' 12.0322" S	118° 35' 23.6002" E	Sand Trap	PC	1m	
ST34	20° 18' 13.0722" S	118° 35' 24.9869" E	Sand Trap	PC	1m	
ST35	20° 18' 15.4296" S	118° 35' 23.3922" E	Sand Trap	PC	1m	

VC – Vibrocore
PC – Push Core

4.1.4. Sampling Techniques

Sediment sampling will be undertaken using either vibrocorer or push corer fitted with stainless steel core catchers to maximise the recovery of the sample.

Sediment Coring

A vibro-corer (Figure 4-2a) will be used to recover sediments to a depth of 2.5 m (or refusal) below the seabed from six sites. This method allows the bottom conditions to be observed by the diver which can aid in sample recovery. Divers will use either a manual push corer or vibro-corer as per Table 4-2. This sampling method is approved in the NAGD (2009) and provides rapid and flexible mobilisation to site and efficient collection of samples. If core refusal occurs above the proposed dredging depth the core will be sampled to the maximum possible depth. A bung will be inserted in the top of the corer and filled with water before extraction from the seabed. Homogenised samples will be obtained from the following depths below the surface:

- 0 to 1 m
- 1 m to 2 m
- 2 m to 2.5 m

Push Coring

A push corer (Figure 4-2b) will be used at 29 sites to recover cores to a depth of 1 m (or refusal). The push corer consists of a 1.2m polycarbonate tube that is advanced manually into the seabed or, if required, using a sleeve hammer. A bung will be inserted in the top of the corer before extraction from the sampled substrate and transported to the surface by the diver ensure the upright position is maintained to avoid disturbance or loss of fine particles. On return of the sample to the surface the water will be carefully drained, and sample extruded from the inner sleeve and a photographic and observation record of the sample will be taken before sample extraction. Samples will be extracted from the vibrocore at depth intervals (0–1 m, 1–2 m and 2–2.5 m) homogenised (with exception of sampled collected for volatile analysis) and placed into laboratory containers.

a) 

b) 

Figure 4-2 a) Vibrocoring using a concrete vibrator and (76 mm Ø) stainless steel sleeve; and b) push core method

4.1.5. Field equipment

The following sampling equipment shall be used:

- Suitable Vessel;
- Tape measure
- Dive gear according to ADAS standard 2299.2;
- Pony bottles;
- Tethers for the divers;
- Oxy-viva and first aid kit;
- Vessel dive flag;
- Vessel GPS system;
- Handheld GPS (back-up);
- Vibrocorer (76 mm Ø);
- 5 x stainless steel core catchers;
- Polycarbonate core tubes (1.8m length)
- Piston Corer;
- Catch bags;
- Internal rubber bung and rod to extrude samples;
- Core trays;
- Rinsed sample containers provided by the laboratory;
- Eskies and ice;
- Nitrile gloves;
- Pyrex glass bowls;
- Plastic Spoons and bowls;
- Decon 90 (or equivalent cleaning agent);
- Plastic tubs and brushes for washing;
- Waterproof marker pens;
- Camera;
- Ice blocks for sample transport to the laboratory;
- Chain of Custody forms; and
- Field logs

4.1.6. Sampling Procedure

The general sampling procedure will include the following:

- The vessel to be used for sampling will be decontaminated before commencement of sampling and suitable for the purpose. A GPS unit with a minimum five metres of horizontal accuracy will be used to navigate and record the sampling location. If environmental and safety conditions do not allow site access, the site will be revisited (where possible) later or the sample site repositioned as close as possible to the original location, but within a safe distance for operations. GPS locations of all sampled sites will be recorded.
- Each sample will be photographed prior to homogenization in the mixing bowl and again following homogenization. Photographs shall be taken such as both sample and core sheet plate are captured in the image with information such as; sample ID, date, time, location, visible
- Recording of site observations including: benthic/terrestrial habitat, surface features, fauna.
- A visual description of each sample will be recoded on the log sheet in accordance with AS 1726 – Geotechnical Site Investigations, including: physical appearance, plasticity, colour, sand grain size, odour, and presence of organic matter, mineral ore, marine organisms, shell and other relevant features.
- Prior to obtaining each sample, the sampling equipment, processing equipment and workspace shall be decontaminated by scrubbing initially with seawater collected on site, second scrub using Deacon 90, and final rinse with freshwater.

- All sample handling shall be undertaken using fresh pair of nitrile gloves and samples will be homogenised in a glass bowl, with the exception of the samples to be collected for the hydrocarbon analysis which will be extracted from the middle of the cores and not mixed in accordance with procedures described in the NAGD (2009). The samples will then be placed directly into labelled clean containers supplied by the laboratory. For hydrocarbons analyses, sediment will be placed into the jars with zero headspace to minimise volatilisation;
- Samples will be placed in eskies at < 4º C immediately after collection. Chain of Custody (CoC) documentation shall be completed at the end of each survey day;
- Sampling, handling, transportation, storage, preservation and labelling techniques will be conducted in accordance with the NAGD (2009) and samples shall be delivered for analysis sealed, within the recommended holding time and with a temperature recoded at the time of delivery to the laboratory.

4.2. Terrestrial Soil Investigation

To investigate the soil quality across the proposed disposal area 5 onshore sampling locations have been selected for sampling and analysis.

4.2.1. Contaminants of Investigation

The following sediment analytes will be tested as part of the onshore soil investigation:

- Metals (Aluminium, Antimony, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Mercury, Nickel, Silver, Zinc).
- Organotin: TBT, DBT, MBT
- Total Petroleum Hydrocarbon (TPH);
- BTEX
- Asbestos Fines/Fibres;
- Polycyclic Aromatic Hydrocarbon (PAH);
- Organochlorine pesticides and organophosphate pesticide;
- Acid Sulphate Soils[2].

Elutriate analysis will also be undertaken for any analytes in samples which exceed the relevant guideline.

4.2.2. Sampling Design and Rational

Soil samples will be collected across the site to characterize the quality of soil and to identify the presence of any Potential ASS (PASS). Samples will be collected in accordance with NEPM (2013) and results compared against the Assessment and Management of Contaminated Site guidelines 2014.

The sampling design and rational has been based on site history and previous environmental investigations at the site, specifically: Detailed Site Investigation for Contamination, Port Hedland Marina Development (RPS 2014b); and a Detailed Site Assessment for Acid Sulfate Soils at the Port Hedland Marina Development site (RPS 2014a). RPS (2014b) found that soils at the site were generally clean, with only isolated impacts of TBT identified within the yacht club and storage facility which is located outside of disturbance area for this project. No asbestos fibres were found, however, some asbestos containing material (ACM) was identified at three locations across the site. The soils were considered suitable for reuse on the site (RPS 2014b). The area of investigation is proposed to have dredge material deposited at the surface, with minimal disturbance to the soil. Therefore, minimal risk to human health or environmental contamination is expected to exist within the underlying site sediments.

Sample for ASS at seven onshore locations within the proposed development footprint to a 12 m below ground level found no actual acidity across the site (RPS 2015a). Pyritic acidity was identified at one

[2] *Field ASS analysis shall be completed on all samples and laboratory ASS analysis will only be undertaken if the field screening test identifies PASS*

site, however significant concentrations of neutralising capacity were observed within the soil (RPS 2014a). Therefore, PASS was not identified at the site, with net acidities complying with department of Environment Regulation (DER) action management criteria (RPS 2014a).

4.2.3. Sampling Locations and Analytes

Based on a desktop assessment and results from previous soil investigations from the site it is proposed to sample 5 terrestrial sites across the proposed development area (Figure 4-1and Table 4-3).

Table 4-3 Terrestrial sample locations

Site ID	Latitude (**WGS 84 Zone 50**)	Longitude (**WGS 84 Zone 50**)	Sample Location	Sample Method	Field QA/QC
OS01	20° 18' 5.7054" S	118° 35' 36.5311" E	Onshore	Surface Grab/Trowel	
OS02	20° 18' 13.2976" S	118° 35' 31.8510" E	Onshore	Surface Grab/Trowel	
OS03	20° 18' 22.4497" S	118° 35' 34.1390" E	Onshore	Surface Grab/Trowel	Triplicate
OS04	20° 18' 30.7699" S	118° 35' 33.3070" E	Onshore	Surface Grab/Trowel	Duplicate/Split
OS05	20° 18' 22.6577" S	118° 35' 30.2910" E	Onshore	Surface Grab/Trowel	

4.2.4. Sampling Technique

Samples will be collected from the surface to a maximum depth of 0.2 m below ground level. Samples will be collected via a hand trowel and laid on a clean tarpaulin (Figure 4-3), with soil characteristics noted and photographed prior to being placed into laboratory supplied containers.

Figure 4-3 Surface sample laid on clean tarpaulin

4.2.5. Field Equipment

The equipment used for the terrestrial soil sampling includes:

- Handheld GPS;
- Tape Measure
- Hand trowel;
- Tarpaulin;
- Rinsed sample containers provided by the laboratory
- Eskies and ice;
- Nitrile gloves;
- Decon 90 (or Equivalent);
- Plastic tubs and brushes for washing;
- Waterproof marker pens;
- Camera;
- Ice blocks for sample transport to the laboratory;
- Chain of Custody forms; and
- Field logs.

4.2.6. Sampling Procedure

- The vessel to be used for sampling will be decontaminated before commencement of sampling and suitable for the purpose. A GPS unit with a minimum five metres of horizontal accuracy will be used to navigate and record the sampling location. If environmental and safety conditions do not allow site access, the site will be revisited (where possible) later or the sample site repositioned as close as possible to the original location, but within a safe distance for operations. GPS locations of all sampled sites will be recorded.
- Record site observation including: benthic/terrestrial habitat, surface features, fauna.

- Surface soil samples will be collected via a hand trowel down to a depth of 0.2m below ground level. The soil sample will be laid out onto a clean tarpaulin;
- A visual description of each sample will be recoded on appropriate log sheet in accordance with AS 1726 – Geotechnical Site Investigations. Recorded information will include; physical appearance, plasticity, colour, sand grain size, odour, and presence of organic matter, mineral ore, marine organisms, shell and other relevant features. Each sample will be photographed;
- The sampling equipment, processing equipment and workbench will be decontaminated with Decon 90, then rinsed with deionised water prior to collecting the sample. This will be repeated between each sample location;
- Samples will be placed into laboratory supplied containers which shall be labelled with sample ID, date and time
- Samples will be placed in eskies at < 4º C immediately after collection. Chain of Custody (CoC) documentation shall be completed at the end of each survey day;
- Sampling, handling, transportation, storage, preservation and labelling techniques will be conducted in accordance with the NAGD and samples delivered to the lab sealed, with in the recommended holding time and temperature recoded at the time of delivery to the laboratory.

4.2.7. Cross-contamination control

To avoid cross contamination between samples, all sample equipment will be washed in Decon 90 and energetically brushed to remove trace of previous sample after each sample collection. The corer will be thoroughly washed with seawater to remove remnant sediment. Samplers will use a fresh pair of nitrile gloves when handling samples and sampling equipment.

4.2.8. Field logging

Data and metadata collected in the field will be entered onto a field log, including:

- Date and time of sampling;
- Site photos;
- Site number;
- Actual depth;
- Co-ordinates of each site;
- QA/QC samples;
- Sampler identity;
- Sediment/Soil characteristics, including colour, odour, sediment type, presence of foreign material, vegetation and shell fragments; and
- Sample identification.

All sample containers will be clearly labelled with sample ID (including duplicate number if applicable), date and time of collection and project number, on the container using an indelible marker.

4.2.9. Sample storage and transport

Sample volumes, storage and transport requirements, will be in accordance with NAGD (2009) and the laboratory recommendations. The sample containers will be stored on ice until they can be transferred to a refrigerator or freezer at the completion of the day's sampling. The samples will remain in the refrigerator/freezer until being transported to Perth. During transport the samples will be kept in eskies with ice bricks.

4.2.10. Chain of Custody

Prior to the samples being sent for analysis, a detailed chain of custody (CoC) form will be prepared and will accompany the samples when sent to each laboratory. The CoC will keep track of each individual sample to ensure that correct analysis and storage is undertaken, and that the recommended holding times are adhered to.

The CoC forms will include the following:

- Place of sampling;
- Sample ID, client name and project reference number;
- Sampling date;
- Requested analysis;
- Required LoR;
- Sample storage request; and

- Sample transport details including date of dispatch.

Sediment samples shall be analysed by the laboratory for the contaminates of concern (see Section 4.1.1). Elutriate analysis will also be undertaken for any analytes in samples which exceed the relevant guideline. The laboratories shall be instructed to retain a portion of each sample to enable this elutriate analysis if required.

4.2.11. Data Management Procedures

All data will be backed up on the O2 Marine data base, QC, and analytical comparison of data will be undertaken against NAGD and ANZG (2018) data quality criteria to confirm that the data is suitable for the purpose of environmental approval for dredging and disposal.

4.2.12. Health and Safety

All diving will be conducted to AS/NZS 2299.2 standards with a minimum of a three-person team dive team, including Dive Coordinator, Standby Diver and Diver's Attendant. A project specific HSE Plan will be completed prior to mobilising to the field. The plan will include a dive plan, JSEA/risk assessment and a dive log will be maintained throughout the dive operations.

The sampling equipment to be used is thought to pose low risk of personal injury. Similarly, the sediments to be sampled are considered to pose no risk to the health of the field personnel. No chemicals will be used in the field, apart from Decon 90 for decontamination purposes. This is a biodegradable concentrate combining anionic and non-anionic surface-active agents with stabilising agents, alkalis and non-phosphate detergent builders, to produce a highly effective cleaning compound. Nitrile gloves will be worn by personnel involved in the handling of sediments, and safety boots will be worn by all field personnel.

4.2.13. Contingency

In the event of bad weather or critical equipment (vessel) failure, sampling will cease and be continued as soon as possible. In this instance, samples already collected will be submitted for laboratory analysis rather than being held until completion of the entire sampling programme.

4.3. QA/QC

4.3.1. Field QA/QC

The following QA/QC procedures shall be undertaken during field work in accordance with NEPM (1999), ANZG (2018) and NAGD (2009) guidelines, including:

- Use suitably qualified environmental staff experienced in sediment sampling, field supervision and sediment logging;
- Samples handling using gloved hands (nitrile gloves). New gloves shall be used for each sample to avoid potential cross-contamination;
- All sampling equipment, including mixing bowls etc. shall be decontaminated between sampling locations via a decontamination procedure involving a wash with ambient seawater and a laboratory grade detergent, and successive rinsing with freshwater;
- Logs shall be 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 the survey;
- Samples shall be contained in appropriately cleaned, pre-treated and labelled sample containers;
- Samples shall be 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).

4.3.2. 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. This container will be kept closed for the whole duration of the survey and transport to the lab and will be analysed for the contaminants of concern to assess any issues arising from sample transport procedures;
- One (1) field blanks filled with inert chromographic sand; This container will be open and kept on site in proximity of processing bench during sample handling and will then be analysed to assess any contamination that may arise due to environmental conditions and/or processing procedures
- Two (2) rinsate blanks filled with deionised water; At the end of each survey day all equipment will be decontaminated as per decontamination procedure described in section 4.2.7. After the decontaminant is competed the equipment is rinsed with deionised water which will be collected and analysed to assess the effectiveness of the decontamination procedure.
- Four (4) field triplicates (three separate samples taken at the same location) to determine the variability of the sampling method;
- Four (4) field duplicates (two separate samples taken at the same location) to determine the variability of the analytical method (intra-lab variability) ; and
- Three (3) field splits (samples thoroughly mixed then split into two sub-samples with one of the samples sent to a secondary laboratory) to assess variability between laboratories methods;

4.3.3. Laboratory QA/QC

Both the primary and secondary laboratories will be NATA-accredited for the relevant analytes and have comprehensive best practice QA/QC programs designed to provide highly defensible analytical data in accordance with NEPM (1999), ANZG(2018) 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.

4.4. Data Analysis

4.4.1. Comparison of Data to Screening Levels

The results shall be compared to the Default Guideline Values (DGV) as defined in ANZG (2018).The recommended sediment quality guidelines (SQGs) for the Pilbara coastal waters shall also be applied for parameters in which no DGV 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 ANZG (2018) shall be applied.

Based on NAGD (2009), a screening level is exceeded if the upper 95% upper confidence limit (95% UCL) exceeds the DGV. 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 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 shall proceed through the decision-tree described in NAGD (2009). For any analytes which exceed the NAGD sediment screening level an elutriate will be extracted from that sample for comparison against the relevant ANZG (2018) water quality guideline value.

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 C for recreational areas will be applied, as this material would be disposed to an area potentially accessible by the public. Whilst NEPM (1999) recommends these values should not be directly applied to assess the contamination of marine sediments, these values are recognised for the fact that they will inform the site contamination status once the material is placed on land.

Normalising to a reference element naturally occurring ion the area will be 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 (ANZG 2018). 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. Use of geochemical normalisers such as aluminium or iron concentrations (which represent proxies for clay mineral content) are also accepted practices (ANZG 2018; Kersten and Smedes, 2002).

4.4.2. Calculation of the 95% UCL for trace metal concentrations

It is proposed to pool the data on metal concentration from the three discrete proposed sampling areas identified for the project for assessment purposes (i.e. probably clean).

The pooled data will then be tested for normality using the software ProUCL 4.1 (USEPA). Depending on the distribution of the data and the size of the data set, including the proportion of values below the limit of reporting (which introduce statistical complexities into the analysis) the software will recommend the most appropriate method for calculating the 95% UCL. This may include parametric (such as student's t-UCL) or non-parametric (such as boot-strap) methods.

If the 95% UCLs for all testing requirements from each distinct layer fall below the NAGD (2009) Screening Levels.

4.4.3. PASS Field Screening Test

The combined results obtained from three (3) PASS field screening tests will be used to identify sediments likely to contain sulphides and as such warrant further analysis using the Chromium Reducible Sulfur Suite method:

- 'A 'High' or greater reaction rating with hydrogen peroxide (as defined in Table 4-4)
- Actual value of pHFOX <6; and
- Difference in pHFOX and pHF value of >2 units.

Table 4-4 Reaction observations to determine appropriate rating

Reaction Rating	Key	Observations
Low	L	Little to no reaction, languid bubble formation
Medium	M	Languid bubble formation two or more layers
High	H	Active bubble formation inside test tube, mild effervescence
Extreme	X	Foaming inside test tube, moderate effervescence, faint sulfuric odour
Volcanic	V	Vigorous foaming & overflow/ eruption, strong effervescence, strong sulfuric odour

4.4.4. Chromium Reducible Sulfur Suite

This analysis will only be required if a sample fails the ASS Field Screening Test.

The chromium reducible sulfur suite method involves a series of steps that yield an estimate of the actual and potential acidity, the acid neutralising capacity (ANC) and the total net acidity of a sediment sample. The soil pH, in potassium chloride suspension (pH_{KCl}), gives an estimate of the actual acidity of the sediment. The reduced inorganic sulfur content (S_{Cr}) provides an estimate of the potential sulfidic acidity of the sediment, which is assessed against an Action Criteria (DER 2015). Titratable Actual Acidity (TAA_{KCl}) and/or Net Acid Soluble Sulfur (S_{NAS}) are analysed if pH_{KCl} is <6.5. The ANC provides an estimate of the ability of the sediment to naturally neutralise any acid produced (e.g. due to the presence of carbonate material).

The total net acidity is calculated via Acid-Base Accounting (ABA), using the following equation (Ahern et al. 2004):

Net Acidity = Potential Sulfidic Acidity + Existing Acidity -ANC/FF

Where:

Potential Sulfidic Acidity is represented by SCr
(converted from %S to mol H+/tonne by multiplying by 623.7).

If there is no existing acidity, i.e. the sample has a pHKCl greater than 6.5, the TAAKCl is assumed to be zero and the Existing Acidity term is neglected. If the pHKCl is less than 6.5, the TAAKCl is measured and used for the Existing Acidity term in mol H+/tonne.

ANC is represented by ANCBT
(converted from %CaCO3 to mol H+/tonne by multiplying by 199.8).

FF is the fineness factor.

As the samples are finely ground in the laboratory, the ANC likely to be experienced in the field could be overestimated and therefore the net acid risk, underestimated. To allow for this, the measurements of ANC are divided by a fineness factor (FF) during ABA. A fineness factor of 1.5 was selected for this study to ensure a conservative calculation of the neutralising capacity for the fine shell and carbonate silts.

4.4.5. QA/QC Assessment

The precision of the sediment analyses shall be 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) shall be calculated for analyte concentrations in the sample splits (both inter-laboratory and intra-laboratory splits) and field duplicates as follows:

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

The RPD of sample splits should be less than ±35% for field splits and ±50% for field duplicates, although the guidelines note that this may not always be the case where the sediments are very heterogeneous or greatly differing in grain size and/or in very low concentration (NAGD 2009). Where three (3) or more samples were collected from the one location (e.g. triplicate) the relative standard deviation (RSD) shall be 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 shall be flagged as an estimate rather than a precise value (NAGD 2009).

The RSD shall be calculated as follows:

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

5. Reporting

A sediment sampling and analysis implementation reports shall be prepared and shall include the following content:

- Introduction
- Methods
    - Sampling and Analysis Procedures
    - Figures showing the sampling locations
- QA/QC
    - Field QA/QC Procedures
    - Laboratory QA/QC Procedures
- Results
    - Colour graphical representations of results with the ANZG (2018) (a) DGV and DGV-High (where available) superimposed on the graph
    - Tabulated analytical results highlighting exceedances of (a) Screening and (b) Maximum Levels
    - Data Validation – comparison of analytical data against the Data Quality Criteria identified for the SAP and confirming compliance with QA/QC procedures and confirmation that the data is suitable for the purpose for which it has been collected.
- Conclusions
- Appendices:
    - Site and sample photographs
    - Laboratory reports including QA/QC

6. References

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WorleyParsons (2018) Lumsden Point General Cargo Facility Sediment Quality Report. Report to PHPA

Appendix B Geotechnical Sampling Field Logs, Chain of Custody and Site Locations

AT CORRECT SCALE THIS IS 100 mm

AT CORRECT SCALE THIS IS 100 mm

LEGEND:

- BOREHOLE TEST
- TEST PITS
- INFILTRATION TEST
- CBR TEST

TEST PITS LOCATIONS (MGA94 Z50)		
#	EASTING	NORTHING
1	666,223.1	7,753,905.6
2	666,150.4	7,753,844.1
3	666,291.1	7,753,834.2
4	666,228.1	7,753,809.8
5	666,153.6	7,753,747.9
6	666,292.0	7,753,760.1
7	666,230.1	7,753,721.5
8	666,168.9	7,753,688.7
9	666,300.3	7,753,669.0
10	666,231.8	7,753,648.1
11	666,176.7	7,753,584.5
12	666,298.3	7,753,614.3
13	666,255.7	7,753,578.9
14	666,180.6	7,753,509.7
15	666,332.8	7,753,513.0
16	666,398.0	7,754,332.0
17	666,258.0	7,754,292.0
18	666,311.0	7,754,126.0
19	666,166.0	7,754,125.0
20	666,095.0	7,753,966.0

BOREHOLE TEST LOCATIONS (MGA94 Z50)		
#	EASTING	NORTHING
10	665,911.3	7,753,648.7
11	666,024.8	7,753,753.3
12	665,905.0	7,753,938.3
13	666,083.4	7,753,648.7
14	665,824.6	7,753,742.4
15	665,844.4	7,754,021.8
16	665,742.4	7,754,047.8
17	665,685.7	7,754,176.6
18	665,693.5	7,754,367.6
19	665,731.2	7,754,612.7
20	665,831.1	7,754,290.6
21	665,789.9	7,753,624.3
22	666,062.4	7,754,201.1
23	666,163.8	7,754,434.2

INFILTRATION TEST LOCATIONS (MGA94 Z50)		
#	EASTING	NORTHING
35	666,150.8	7,753,831.1
36	666,162.6	7,753,678.5
37	666,294.7	7,753,626.3
38	666,330.9	7,753,523.9

CBR TEST LOCATIONS (MGA94 Z50)		
#	EASTING	NORTHING
39	666,293.2	7,753,748.3
40	666,173.7	7,753,678.3
41	666,344.0	7,753,548.7

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coastal and port engineers

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Osborne Park 6017
Western Australia

t: +61 8 9254 6600
admin@coastsandports.com.au

DRAWN R BORJA

CHECKED A CLAPIN

GEOTECHNICAL INVESTIGATION LOCATIONS

PORT HEDLAND – SPOILBANK MARINA

SCALE AT A3 1:5,000

OCTOBER 2019

SK1660-99D

P:\MRA Paying Jobs\K1660 DoT – Spoil Bank Marina Design Development\5 MRA Dwgs\Sketches\SK1660 Geotech BH Locations-D

Chain of Custody (CoC) Record

Project:	Port Hedland Spoilbank Sediment Sampling		
Client:	DoT	**Job No.:**	19WAU-0020
Lab Quote No.:		**Turnaround Time:**	Standard
O2M Project Manager	Claudio Del Deo	**Email Address:**	claudio.deldeo@o2marine.com.au

Laboratory:	ARL
Address:	46-48 Banksia Rd, Welshpool WA 6106
Lab. Contact:	Doug Todd

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: ASS Screening Test	Analyse = A; Hold = H: ASS (Scr)	Comments
-1	19-19181	BH12	7.45-7.55m	2/11/19	15.~~05~~20	S	P	1	A	H	All Soil samples are marine sediment
-2		BH12	8.30-8.35	5/11/19	12.20	S	P	1	A	H	All samples frozen on day of sampling
-3		BH13	5.40-5.50	9/11/19	12.25	S	P	1	A	H	
-4		BH11	10.50-10.55	11/11/19	13.30	S	P	1	A	H	

Sampled By:	T. Robinson	**Date/Time:**	see above
Received By Lab:	Ryan Seah	**Date/Time:**	13/11/19 @ 09:10
Sample Cold (Yes/No):	15.6°C	**Sample Container Sealed (Yes/No):**	
Relinquished By:	T. Robinson	**Courier:**	

Appendix C Field Sampling Photos


Project No 19-0020
Date 27-9-19
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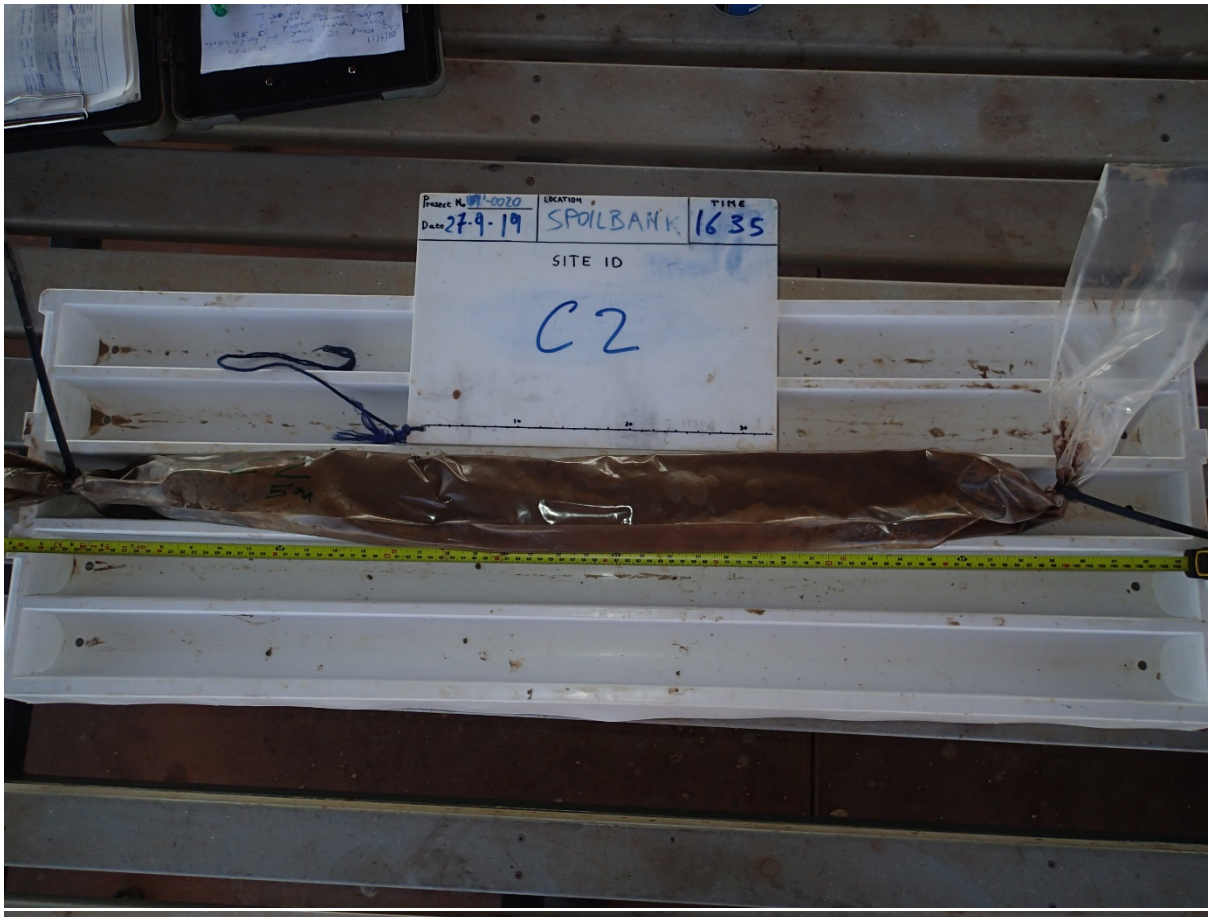
ALS
C1
27-9-19 16:1
COD - C1
DANGER
MAY CAUSE CANCER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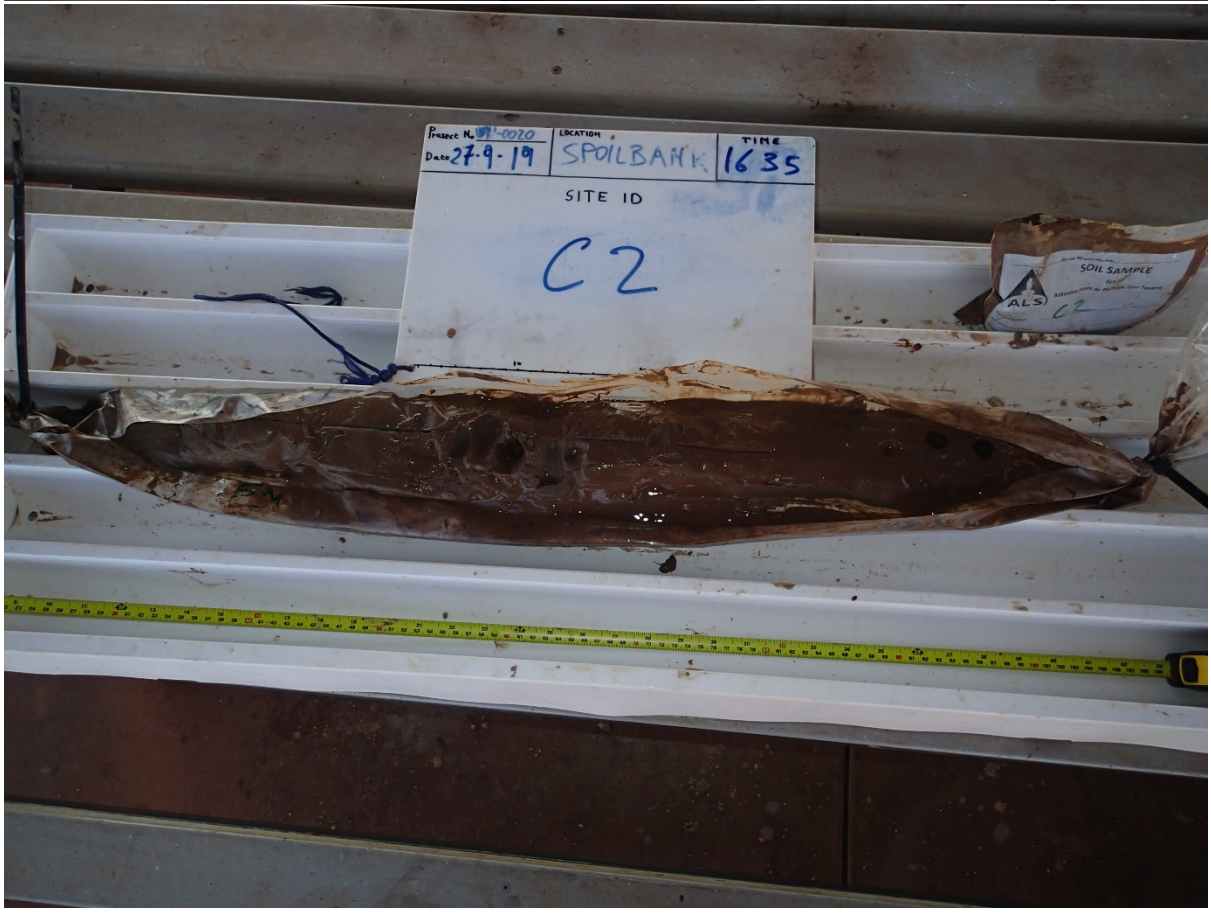
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SOIL SAMPLE
ALS
C2


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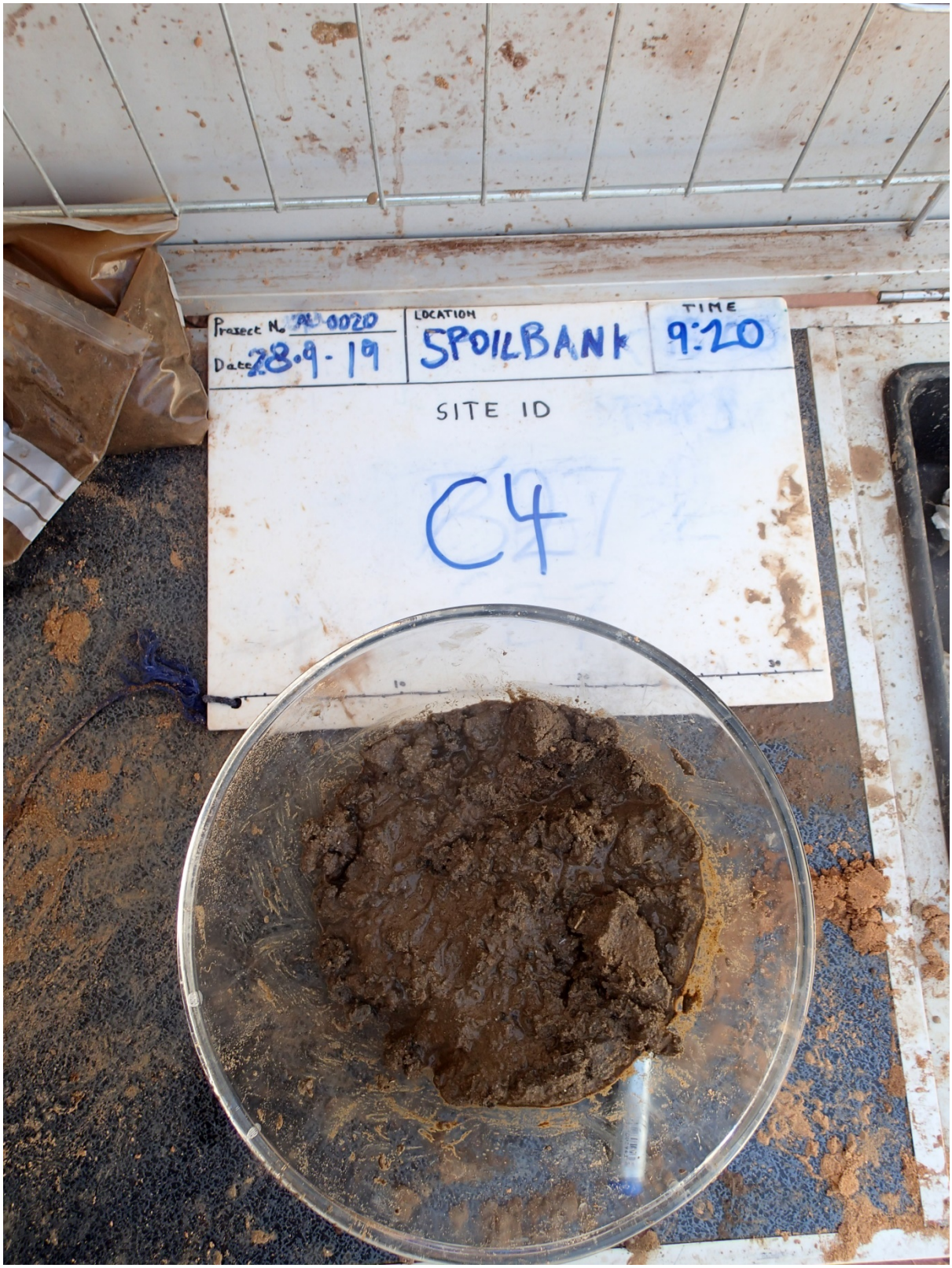
TIME
1725
SITE ID
C3
SOIL SAMPLE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TIME
9:00
SITE ID
C5


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LOCATION SPOILBANK
TIME 14:45
SITE ID TRIP1
C6


Project No. AU-0020
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SITE ID
C7


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LOCATION
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SITE ID
C8
C8
13:50
26.9.19
C8
26.9.19
13:50


Project No -0020
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TIME
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SITE ID
C9


Project No -0020
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LOCATION
SPOILBANK
TIME
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SITE ID
C9


Project No. -0020
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TIME
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SITE ID
SPCIT
C10


LOCATION
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TIME
10:20
Date 28.9.19
SITE
B11
28/9 10:20
B11 B11
B11
28.9.19


Project N. 191-0020
Date 27.9.19
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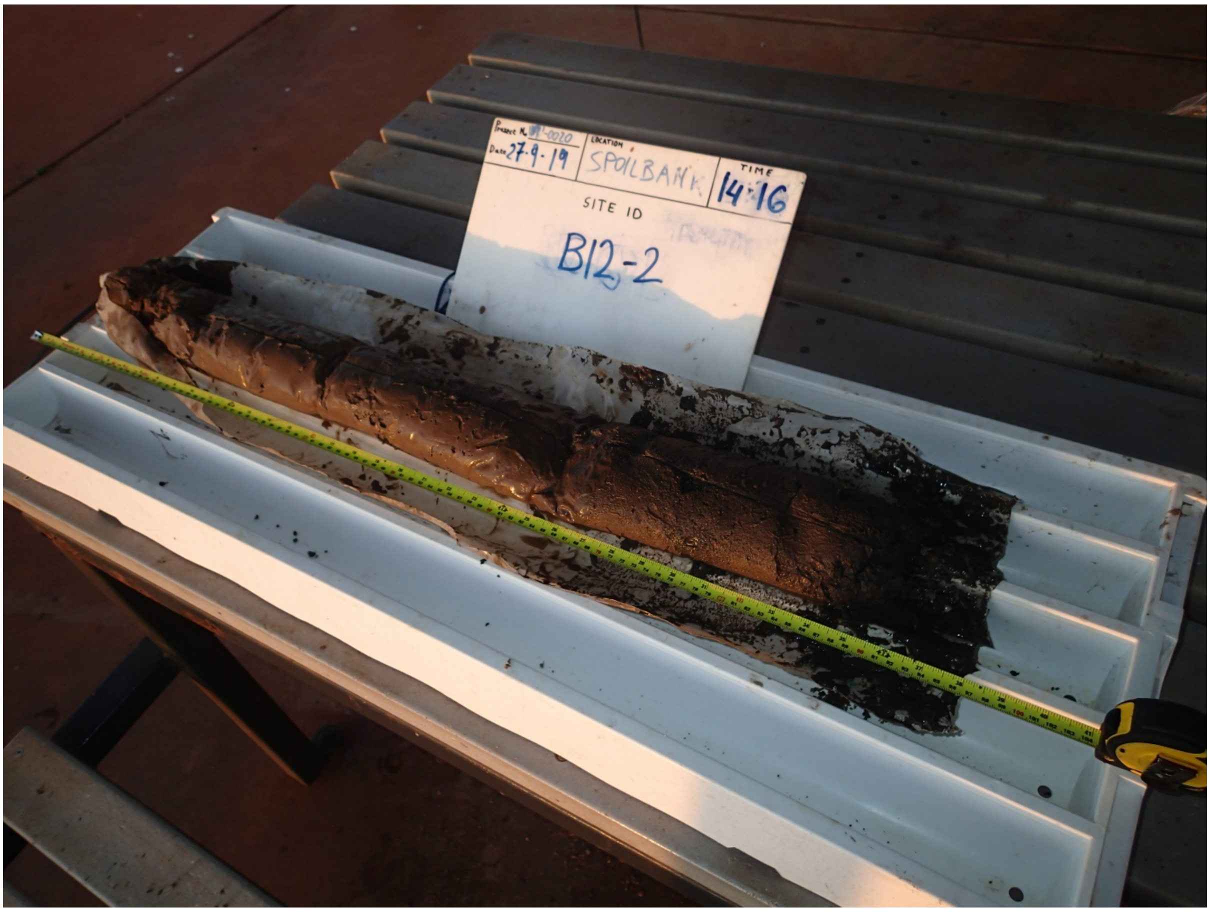
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STANLEY


Project No. MW-0020
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TIME
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SITE ID
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Project No. 19'-0020
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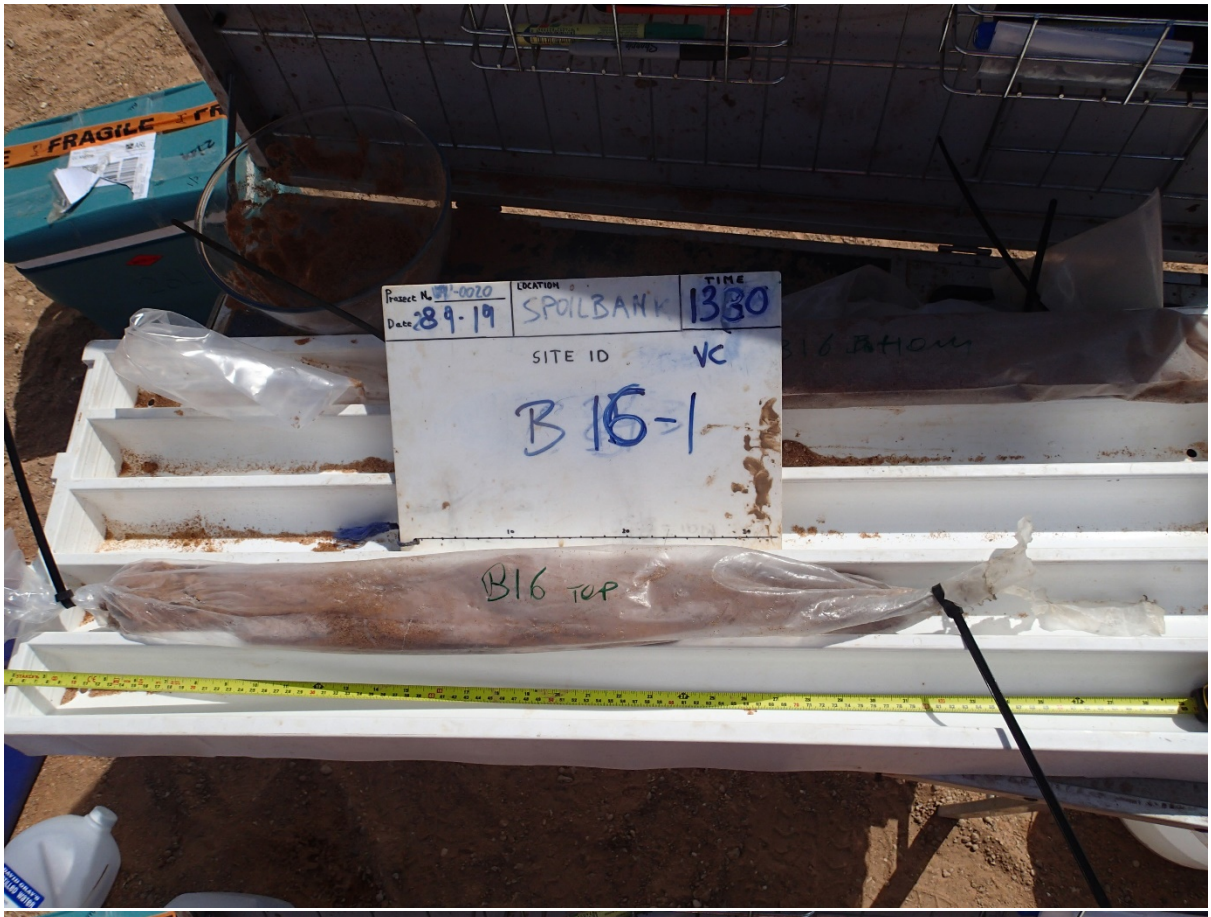
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SITE ID VC
B16-1
B16 TOP


FRAGILE
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TIME 1380
SITE ID VC
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B16 Bottom


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TIME 1380
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B 16-2


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SITE ID
B18


Project NWA0020
Date 28.9.19
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TRIP 2
ARL Group


Project NJAL0020
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S25


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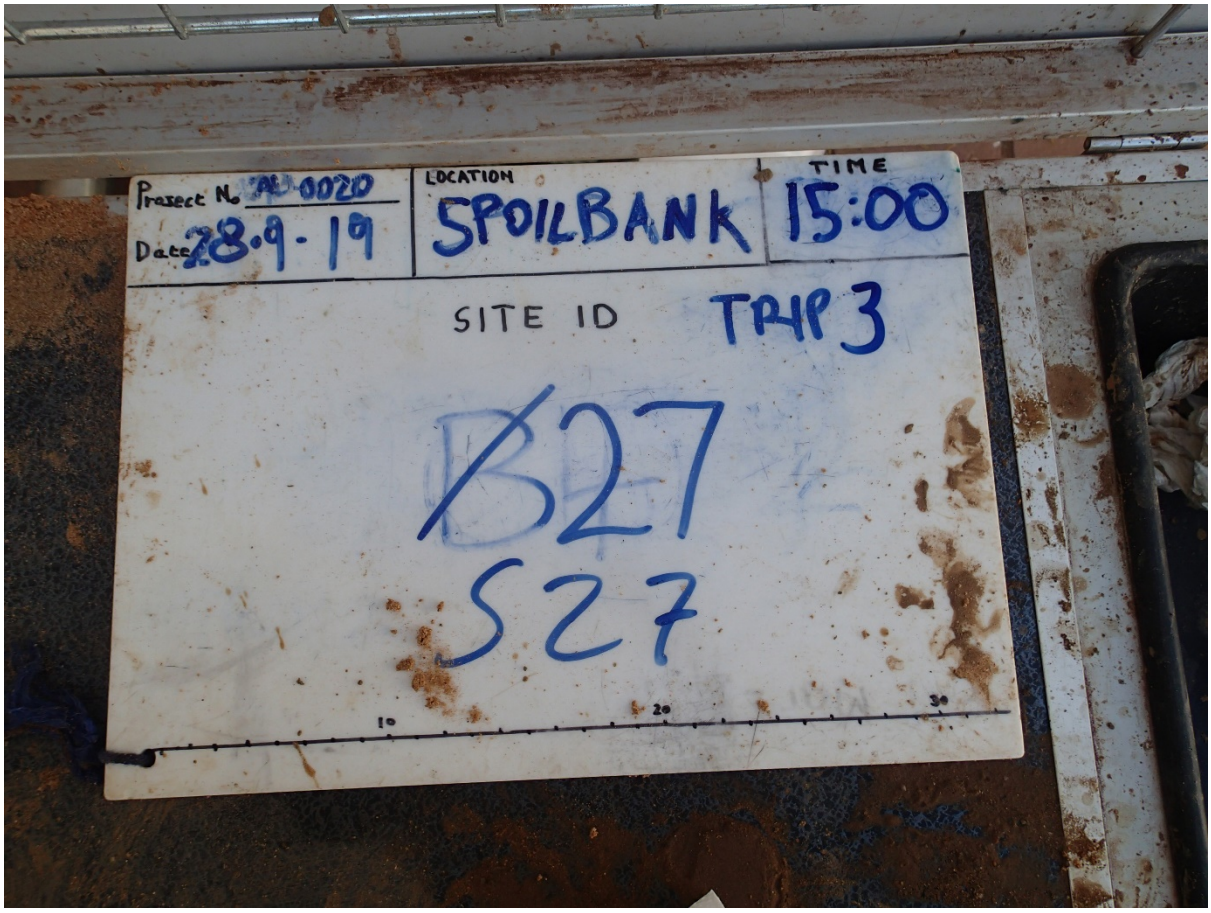
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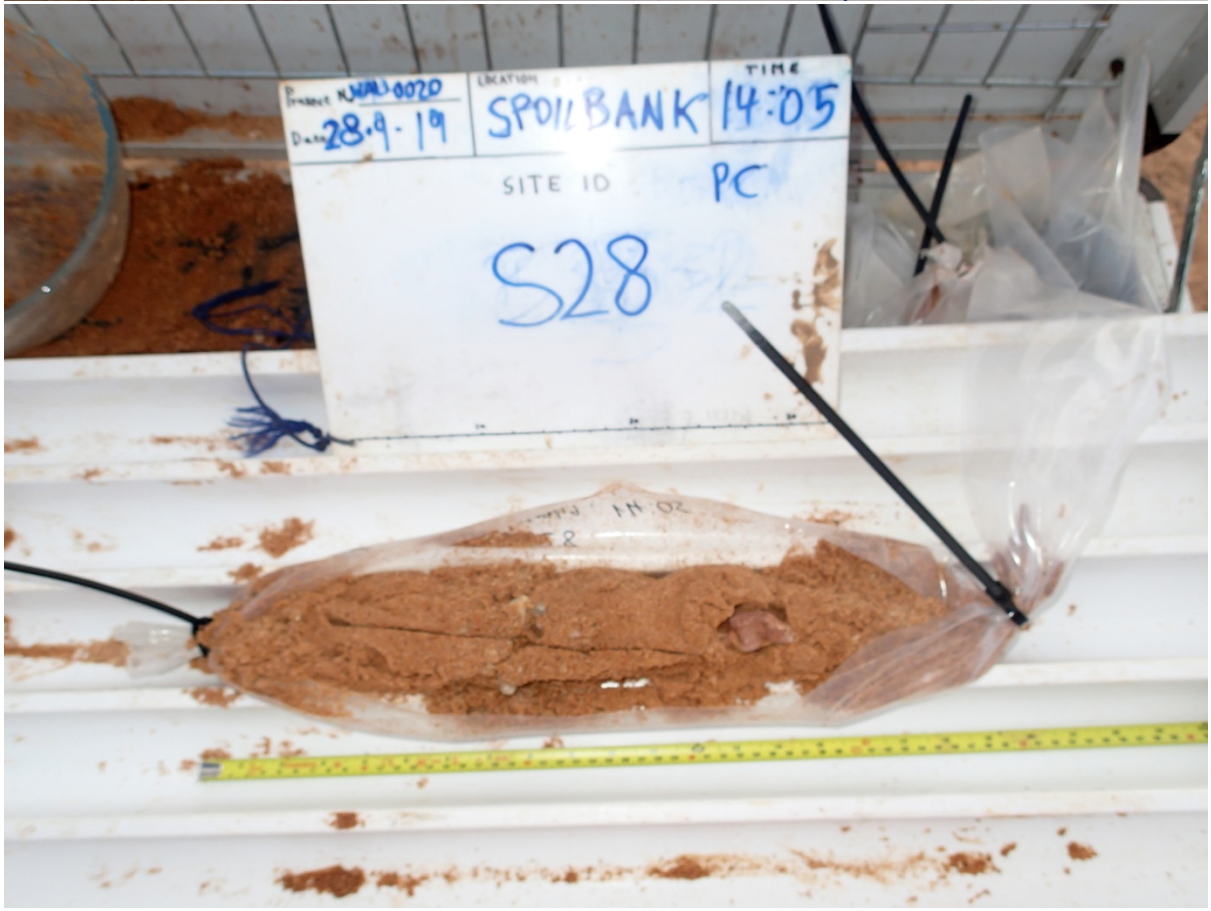
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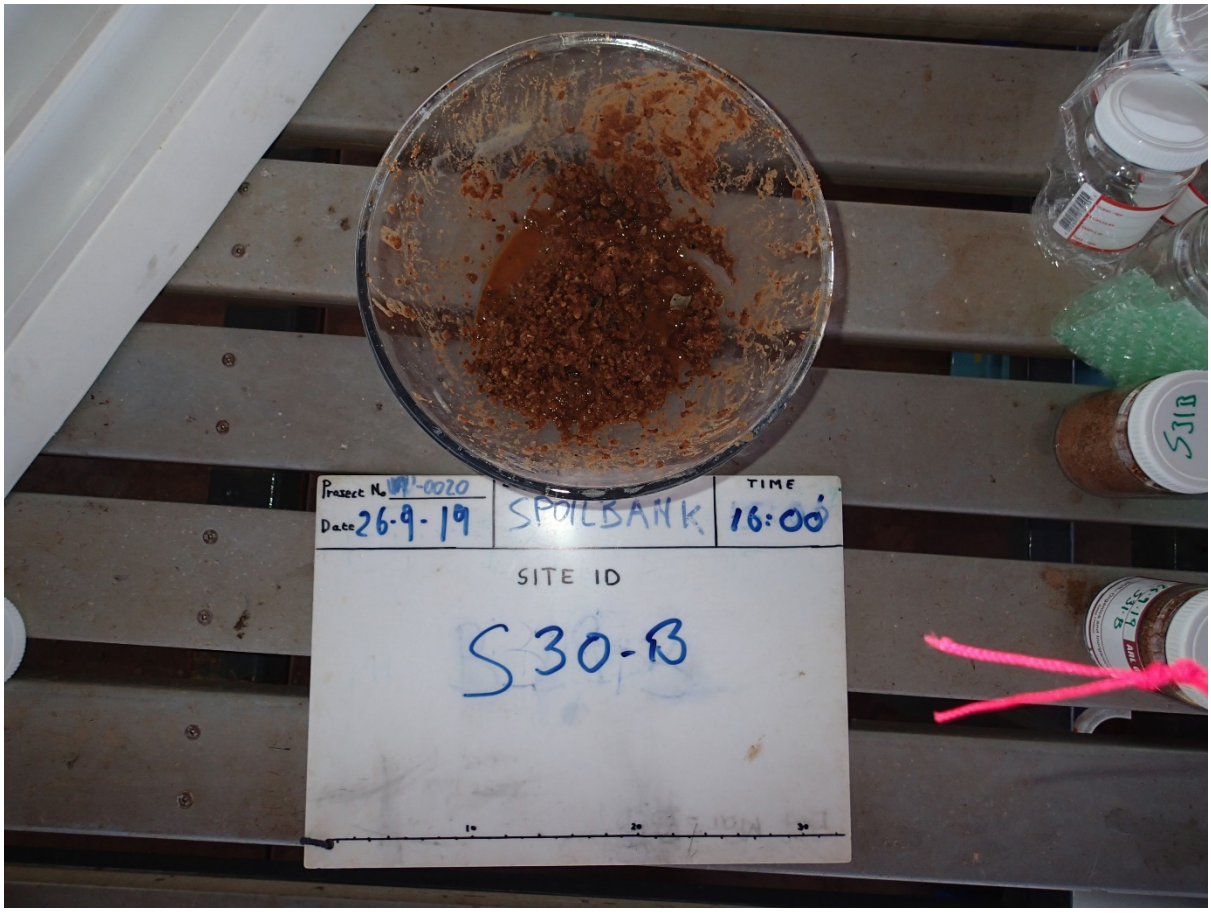
SITE ID
S29-B


Project No. 1-0070
Date 26-9-19
LOCATION
SPOILBANK
TIME
15:01
SITE ID
S29-B


Project No. 191-0020
Date 26-9-19
SPOILBANK
TIME 16:00
SITE ID
S30-B
S31B


Project No. 19-0020
Date 28-9-19
LOCATION
SPOILBANK
TIME
1400
SITE ID
PC
S32


SOIL SAMPLE
S33
28/9/19 14:00
DANGER
S33
28/9/19
14:00
Project No. -0020
Date 28-9-19
LOCATION SPOILBANK
TIME 1400
SITE ID
PC
S33


Project No. AD-0020
Date 28-9-19
LOCATION SPOILBANK
TIME 8:30
SITE ID
S34


Project N. AU 0020
Date 28-9-19
LOCATION SPOILBANK
TIME 8:10
SITE ID TRIP4
S35

O36


Do not fill past this line
SOIL SAMPLE
for
Asbestos Fines or Particle Size Testing
ALS
Sample ID/Ref: O 36
Sampling Date/Time: 28/9/19 16:40
Sampled By:
A dedicated bag is required for Asbestos Fines
DANGER
MAY CAUSE CANCER through inhalation
Pre-sieve samples for asbestos testing to 7mm
Do not overfill. Wipe exterior to remove dust.
Exclude air and transport in a sealed container
www.alsglobal.com

O37


SOIL SAMPLE
for
Asbestos Fines or Particle Size Testing
ALS
Sample ID/Ref.: O 37
Sampling Date/Time: 28/9/19 16:35
Sampled By:
DANGER

O38

O39

O40

Appendix D Laboratory Results

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP1910036**	Page	: 1 of 18
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	: 19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	Date Samples Received	: 02-Oct-2019 18:40
Order number	: ----	Date Analysis Commenced	: 04-Oct-2019
C-O-C number	: ----	Issue Date	: 14-Oct-2019 18:30
Sampler	: Claudio Deldeo		
Site	: ----		
Quote number	: EP/827/19 V3		
No. of samples received	: 42		
No. of samples analysed	: 42		

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Descriptive Results
- Surrogate Control Limits

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Diana Mesa	2IC Organic Chemist	Brisbane Organics, Stafford, QLD
Dianne Blane	Laboratory Coordinator (2IC)	Newcastle - Inorganics, Mayfield West, NSW
Vanessa Phung	Approved Asbestos Identifier	Melbourne Asbestos, Springvale, VIC

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 moisture content, insufficient sample (reduced weight employed) or matrix interference.

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

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

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

- Organotins analysis conducted by ALS Brisbane, NATA Site No. 818.
- Asbestos analysis conducted by ALS Melbourne, NATA accreditation no. 825, site no 13778
- PSD analysis conducted by ALS Newcastle, NATA accreditation no. 825, site no 1656.
- EP090: Poor matrix spike recovery due to matrix interference.
- EA200N: Asbestos weights and percentages are not covered under the Scope of NATA Accreditation.
  Weights of Asbestos are based on extracted bulk asbestos, fibre bundles, and/or ACM and do not include respirable fibres (if present)
  The Asbestos (Fines and Fibrous) weight is calculated from the extracted Fibrous Asbestos and Asbestos Fines as an equivalent weight of 100% Asbestos
  Percentages for Asbestos content in ACM are based on the 2013 NEPM default values.
  All calculations of percentage Asbestos under this method are approximate and should be used as a guide only.
- EA200 'Am' Amosite (brown asbestos)
- EA200 'Cr' Crocidolite (blue asbestos)
- EA200 'Trace' - Asbestos fibres ("Free Fibres") detected by trace analysis per AS4964. The result can be interpreted that the sample contains detectable 'respirable' asbestos fibres
- EA200: Asbestos Identification Samples were analysed by Polarised Light Microscopy including dispersion staining.
- EA200 Legend
- EA200 'Ch' Chrysotile (white asbestos)
- EA200: 'UMF' Unknown Mineral Fibres. "-" indicates fibres detected may or may not be asbestos fibres. Confirmation by alternative techniques is recommended.
- EA200N: ALS laboratory procedures and methods used for the identification and quantitation of asbestos are consistent with AS4964-2004 and the requirements of the 2013 NEPM for Assessment of Site Contamination
- EA200: For samples larger than 30g, the <2mm fraction may be sub-sampled prior to trace analysis as outlined in ISO23909:2008(E) Sect 6.3.2-2
- EA200: 'Yes' - Asbestos detected by polarised light microscopy including dispersion staining.
- EA200: 'No*' - No asbestos found, at the reporting limit of 0.1g/kg, by polarised light microscopy including dispersion staining. Asbestos material was detected and positively identified at concentrations estimated to be below 0.1g/kg.
- EA200: 'No' - No asbestos found at the reporting limit 0.1g/kg, by polarised light microscopy including dispersion staining.

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	C01	C02	C03	C04	C05
				Client sampling date / time	27-Sep-2019 16:15	27-Sep-2019 16:35	27-Sep-2019 17:25	28-Sep-2019 09:20	28-Sep-2019 09:00
Compound	CAS Number	LOR	Unit		EP1910036-001	EP1910036-002	EP1910036-003	EP1910036-004	EP1910036-005
					Result	Result	Result	Result	Result
EA150: Particle Sizing									
+75µm	----	1	%		43	58	82	89	84
+150µm	----	1	%		5	16	57	63	50
+300µm	----	1	%		1	4	27	35	23
+425µm	----	1	%		<1	3	17	27	15
+600µm	----	1	%		<1	2	12	21	11
+1180µm	----	1	%		<1	1	7	15	5
+2.36mm	----	1	%		<1	<1	3	11	2
+4.75mm	----	1	%		<1	<1	<1	6	1
+9.5mm	----	1	%		<1	<1	<1	<1	<1
+19.0mm	----	1	%		<1	<1	<1	<1	<1
+37.5mm	----	1	%		<1	<1	<1	<1	<1
+75.0mm	----	1	%		<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%		19	18	11	8	9
Silt (2-60 µm)	----	1	%		29	20	6	2	7
Sand (0.06-2.00 mm)	----	1	%		52	61	79	78	81
Gravel (>2mm)	----	1	%		<1	1	4	12	3
Cobbles (>6cm)	----	1	%		<1	<1	<1	<1	<1
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3		2.77	2.74	2.69	2.69	2.70

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	C06	C07	C08	C09	C10
				Client sampling date / time	27-Sep-2019 14:45	28-Sep-2019 09:40	26-Sep-2019 13:50	26-Sep-2019 14:34	27-Sep-2019 15:40
Compound	CAS Number	LOR	Unit		EP1910036-006	EP1910036-007	EP1910036-008	EP1910036-009	EP1910036-010
					Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	0.1	%		----	----	----	----	24.3
EA150: Particle Sizing									
+75µm	----	1	%		82	91	86	92	77
+150µm	----	1	%		41	73	80	88	28
+300µm	----	1	%		19	40	61	69	12
+425µm	----	1	%		13	28	44	50	10
+600µm	----	1	%		9	19	30	33	8
+1180µm	----	1	%		4	6	13	10	4
+2.36mm	----	1	%		1	2	6	3	1
+4.75mm	----	1	%		<1	1	4	<1	<1
+9.5mm	----	1	%		<1	<1	2	<1	<1
+19.0mm	----	1	%		<1	<1	<1	<1	<1
+37.5mm	----	1	%		<1	<1	<1	<1	<1
+75.0mm	----	1	%		<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%		9	7	11	7	12
Silt (2-60 µm)	----	1	%		10	2	3	<1	7
Sand (0.06-2.00 mm)	----	1	%		79	87	78	88	79
Gravel (>2mm)	----	1	%		2	4	8	5	2
Cobbles (>6cm)	----	1	%		<1	<1	<1	<1	<1
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3		2.79	2.58	2.64	2.67	2.72
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		----	----	----	----	2770
Iron	7439-89-6	50	mg/kg		----	----	----	----	8890
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg		----	----	----	----	<0.50
Arsenic	7440-38-2	1.00	mg/kg		----	----	----	----	8.06
Cadmium	7440-43-9	0.1	mg/kg		----	----	----	----	<0.1
Chromium	7440-47-3	1.0	mg/kg		----	----	----	----	17.0
Copper	7440-50-8	1.0	mg/kg		----	----	----	----	4.6
Lead	7439-92-1	1.0	mg/kg		----	----	----	----	2.8
Manganese	7439-96-5	10	mg/kg		----	----	----	----	126
Nickel	7440-02-0	1.0	mg/kg		----	----	----	----	7.5

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	C06	C07	C08	C09	C10
				Client sampling date / time	27-Sep-2019 14:45	28-Sep-2019 09:40	26-Sep-2019 13:50	26-Sep-2019 14:34	27-Sep-2019 15:40
Compound	CAS Number	LOR	Unit		EP1910036-006	EP1910036-007	EP1910036-008	EP1910036-009	EP1910036-010
					Result	Result	Result	Result	Result
EG020-SD: Total Metals in Sediments by ICPMS - Continued									
Silver	7440-22-4	0.1	mg/kg		----	----	----	----	**0.2**
Zinc	7440-66-6	1.0	mg/kg		----	----	----	----	**10.8**
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg		----	----	----	----	<0.01
EP090: Organotin Compounds									
Monobutyltin	78763-54-9	1	µgSn/kg		----	----	----	----	<1
Dibutyltin	1002-53-5	1	µgSn/kg		----	----	----	----	<1
Tributyltin	56573-85-4	0.5	µgSn/kg		----	----	----	----	<0.5
EP090S: Organotin Surrogate									
Tripropyltin	----	0.5	%		----	----	----	----	**94.4**

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Client sample ID	B11	B12-1	B12-2	B13	B14
			Client sampling date / time	28-Sep-2019 10:20	27-Sep-2019 14:16	27-Sep-2019 14:16	25-Sep-2019 15:30	25-Sep-2019 16:00
Compound	CAS Number	LOR	Unit	EP1910036-011	EP1910036-012	EP1910036-013	EP1910036-014	EP1910036-015
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	----	19.6	----	----	----
EA150: Particle Sizing								
+75µm	----	1	%	95	88	49	94	94
+150µm	----	1	%	95	59	12	91	89
+300µm	----	1	%	90	47	4	69	56
+425µm	----	1	%	82	39	2	54	34
+600µm	----	1	%	72	30	2	44	20
+1180µm	----	1	%	57	15	<1	36	10
+2.36mm	----	1	%	50	5	<1	34	8
+4.75mm	----	1	%	44	2	<1	31	6
+9.5mm	----	1	%	29	<1	<1	24	2
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	5	9	20	5	5
Silt (2-60 µm)	----	1	%	<1	3	24	<1	<1
Sand (0.06-2.00 mm)	----	1	%	42	80	55	60	86
Gravel (>2mm)	----	1	%	53	8	1	35	9
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.68	2.68	2.69	2.65	2.69
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	2270	----	----	----
Iron	7439-89-6	50	mg/kg	----	7210	----	----	----
EG020-SD: Total Metals in Sediments by ICPMS								
Antimony	7440-36-0	0.50	mg/kg	----	<0.50	----	----	----
Arsenic	7440-38-2	1.00	mg/kg	----	4.49	----	----	----
Cadmium	7440-43-9	0.1	mg/kg	----	<0.1	----	----	----
Chromium	7440-47-3	1.0	mg/kg	----	15.8	----	----	----
Copper	7440-50-8	1.0	mg/kg	----	3.6	----	----	----
Lead	7439-92-1	1.0	mg/kg	----	2.6	----	----	----
Manganese	7439-96-5	10	mg/kg	----	64	----	----	----
Nickel	7440-02-0	1.0	mg/kg	----	6.9	----	----	----

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	B11	B12-1	B12-2	B13	B14
				Client sampling date / time	28-Sep-2019 10:20	27-Sep-2019 14:16	27-Sep-2019 14:16	25-Sep-2019 15:30	25-Sep-2019 16:00
Compound	CAS Number	LOR	Unit		EP1910036-011	EP1910036-012	EP1910036-013	EP1910036-014	EP1910036-015
					Result	Result	Result	Result	Result
EG020-SD: Total Metals in Sediments by ICPMS - Continued									
Silver	7440-22-4	0.1	mg/kg		----	<0.1	----	----	----
Zinc	7440-66-6	1.0	mg/kg		----	**5.7**	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg		----	<0.01	----	----	----
EP090: Organotin Compounds									
Monobutyltin	78763-54-9	1	µgSn/kg		----	<1	----	----	----
Dibutyltin	1002-53-5	1	µgSn/kg		----	<1	----	----	----
Tributyltin	56573-85-4	0.5	µgSn/kg		----	<0.5	----	----	----
EP090S: Organotin Surrogate									
Tripropyltin	----	0.5	%		----	**98.8**	----	----	----

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	B15	B16-1	B16-2	B17	B18
				Client sampling date / time	28-Sep-2019 13:00	28-Sep-2019 13:30	28-Sep-2019 13:30	28-Sep-2019 13:45	28-Sep-2019 15:15
Compound	CAS Number	LOR	Unit		EP1910036-016	EP1910036-017	EP1910036-018	EP1910036-019	EP1910036-020
					Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	0.1	%		----	----	----	1.1	----
EA150: Particle Sizing									
+75µm	----	1	%		94	94	95	96	94
+150µm	----	1	%		94	94	94	95	90
+300µm	----	1	%		84	81	80	85	47
+425µm	----	1	%		70	63	62	74	25
+600µm	----	1	%		58	49	49	61	13
+1180µm	----	1	%		43	34	38	44	7
+2.36mm	----	1	%		41	31	35	40	6
+4.75mm	----	1	%		39	28	33	36	6
+9.5mm	----	1	%		31	21	28	29	5
+19.0mm	----	1	%		8	<1	15	14	3
+37.5mm	----	1	%		<1	<1	<1	<1	<1
+75.0mm	----	1	%		<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%		5	5	4	4	5
Silt (2-60 µm)	----	1	%		<1	<1	<1	<1	<1
Sand (0.06-2.00 mm)	----	1	%		54	63	60	55	89
Gravel (>2mm)	----	1	%		41	32	36	41	6
Cobbles (>6cm)	----	1	%		<1	<1	<1	<1	<1
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3		2.67	2.67	2.68	2.65	2.65
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		----	----	----	580	----
Iron	7439-89-6	50	mg/kg		----	----	----	2780	----
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg		----	----	----	<0.50	----
Arsenic	7440-38-2	1.00	mg/kg		----	----	----	2.87	----
Cadmium	7440-43-9	0.1	mg/kg		----	----	----	<0.1	----
Chromium	7440-47-3	1.0	mg/kg		----	----	----	11.1	----
Copper	7440-50-8	1.0	mg/kg		----	----	----	<1.0	----
Lead	7439-92-1	1.0	mg/kg		----	----	----	1.2	----
Manganese	7439-96-5	10	mg/kg		----	----	----	34	----
Nickel	7440-02-0	1.0	mg/kg		----	----	----	2.7	----

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	B15	B16-1	B16-2	B17	B18
				Client sampling date / time	28-Sep-2019 13:00	28-Sep-2019 13:30	28-Sep-2019 13:30	28-Sep-2019 13:45	28-Sep-2019 15:15
Compound	CAS Number	LOR	Unit		EP1910036-016	EP1910036-017	EP1910036-018	EP1910036-019	EP1910036-020
					Result	Result	Result	Result	Result
EG020-SD: Total Metals in Sediments by ICPMS - Continued									
Silver	7440-22-4	0.1	mg/kg		----	----	----	**0.2**	----
Zinc	7440-66-6	1.0	mg/kg		----	----	----	**1.9**	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg		----	----	----	<0.01	----
EP090: Organotin Compounds									
Monobutyltin	78763-54-9	1	µgSn/kg		----	----	----	<1	----
Dibutyltin	1002-53-5	1	µgSn/kg		----	----	----	<1	----
Tributyltin	56573-85-4	0.5	µgSn/kg		----	----	----	<0.5	----
EP090S: Organotin Surrogate									
Tripropyltin	----	0.5	%		----	----	----	**87.4**	----

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	B19	B20	B21	B22-B	B23
				Client sampling date / time	28-Sep-2019 15:30	28-Sep-2019 15:35	28-Sep-2019 15:40	28-Sep-2019 16:05	28-Sep-2019 15:45
Compound	CAS Number	LOR	Unit		EP1910036-021	EP1910036-022	EP1910036-023	EP1910036-024	EP1910036-025
					Result	Result	Result	Result	Result
EA150: Particle Sizing									
+75µm	----	1	%		94	93	93	92	90
+150µm	----	1	%		93	89	90	86	85
+300µm	----	1	%		71	73	82	61	57
+425µm	----	1	%		51	59	75	42	39
+600µm	----	1	%		36	47	62	25	29
+1180µm	----	1	%		21	37	31	9	22
+2.36mm	----	1	%		19	34	16	4	19
+4.75mm	----	1	%		18	33	14	2	17
+9.5mm	----	1	%		13	22	12	<1	12
+19.0mm	----	1	%		<1	2	<1	<1	<1
+37.5mm	----	1	%		<1	<1	<1	<1	<1
+75.0mm	----	1	%		<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%		5	6	5	5	5
Silt (2-60 µm)	----	1	%		<1	1	1	1	4
Sand (0.06-2.00 mm)	----	1	%		76	58	74	88	71
Gravel (>2mm)	----	1	%		19	35	20	6	20
Cobbles (>6cm)	----	1	%		<1	<1	<1	<1	<1
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3		2.67	2.64	2.66	2.64	2.66

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	B24-B1	B24-B2	B25	B26	B27
				Client sampling date / time	28-Sep-2019 12:45	28-Sep-2019 12:45	28-Sep-2019 12:30	26-Sep-2019 16:00	28-Sep-2019 15:00
Compound	CAS Number	LOR	Unit		EP1910036-026	EP1910036-027	EP1910036-028	EP1910036-029	EP1910036-030
					Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	0.1	%		----	----	----	12.7	----
EA150: Particle Sizing									
+75µm	----	1	%		95	94	93	93	93
+150µm	----	1	%		93	92	90	70	49
+300µm	----	1	%		84	80	78	58	13
+425µm	----	1	%		79	67	68	53	8
+600µm	----	1	%		74	54	57	47	5
+1180µm	----	1	%		63	44	46	30	1
+2.36mm	----	1	%		54	38	42	18	<1
+4.75mm	----	1	%		49	31	38	10	<1
+9.5mm	----	1	%		39	12	32	5	<1
+19.0mm	----	1	%		23	<1	3	3	<1
+37.5mm	----	1	%		<1	<1	<1	<1	<1
+75.0mm	----	1	%		<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%		3	3	4	4	4
Silt (2-60 µm)	----	1	%		<1	2	3	2	1
Sand (0.06-2.00 mm)	----	1	%		40	55	50	73	94
Gravel (>2mm)	----	1	%		57	40	43	21	1
Cobbles (>6cm)	----	1	%		<1	<1	<1	<1	<1
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3		2.65	2.64	2.67	2.65	2.67
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		----	----	----	1250	----
Iron	7439-89-6	50	mg/kg		----	----	----	9700	----
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg		----	----	----	<0.50	----
Arsenic	7440-38-2	1.00	mg/kg		----	----	----	3.95	----
Cadmium	7440-43-9	0.1	mg/kg		----	----	----	<0.1	----
Chromium	7440-47-3	1.0	mg/kg		----	----	----	13.5	----
Copper	7440-50-8	1.0	mg/kg		----	----	----	2.4	----
Lead	7439-92-1	1.0	mg/kg		----	----	----	1.8	----
Manganese	7439-96-5	10	mg/kg		----	----	----	64	----
Nickel	7440-02-0	1.0	mg/kg		----	----	----	7.5	----

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	B24-B1	B24-B2	B25	B26	B27
				Client sampling date / time	28-Sep-2019 12:45	28-Sep-2019 12:45	28-Sep-2019 12:30	26-Sep-2019 16:00	28-Sep-2019 15:00
Compound	CAS Number	LOR	Unit		EP1910036-026	EP1910036-027	EP1910036-028	EP1910036-029	EP1910036-030
					Result	Result	Result	Result	Result
EG020-SD: Total Metals in Sediments by ICPMS - Continued									
Silver	7440-22-4	0.1	mg/kg		----	----	----	<0.1	----
Zinc	7440-66-6	1.0	mg/kg		----	----	----	**4.3**	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg		----	----	----	<0.01	----
EP090: Organotin Compounds									
Monobutyltin	78763-54-9	1	µgSn/kg		----	----	----	<1	----
Dibutyltin	1002-53-5	1	µgSn/kg		----	----	----	<1	----
Tributyltin	56573-85-4	0.5	µgSn/kg		----	----	----	<0.5	----
EP090S: Organotin Surrogate									
Tripropyltin	----	0.5	%		----	----	----	**93.9**	----

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Client sample ID	B28	S29-B2	S30-B	S32	S33
			Client sampling date / time	28-Sep-2019 14:05	26-Sep-2019 15:01	26-Sep-2019 16:00	28-Sep-2019 14:00	28-Sep-2019 14:10
Compound	CAS Number	LOR	Unit	EP1910036-031	EP1910036-032	EP1910036-033	EP1910036-034	EP1910036-035
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	----	----	14.8	----	----
EA150: Particle Sizing								
+75µm	----	1	%	94	64	----	95	96
+150µm	----	1	%	93	15	----	91	92
+300µm	----	1	%	78	9	----	36	74
+425µm	----	1	%	61	8	----	12	67
+600µm	----	1	%	49	6	----	2	63
+1180µm	----	1	%	34	3	----	<1	53
+2.36mm	----	1	%	30	<1	----	<1	48
+4.75mm	----	1	%	28	<1	----	<1	43
+9.5mm	----	1	%	21	<1	----	<1	34
+19.0mm	----	1	%	<1	<1	----	<1	4
+37.5mm	----	1	%	<1	<1	----	<1	<1
+75.0mm	----	1	%	<1	<1	----	<1	<1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	4	18	----	4	3
Silt (2-60 µm)	----	1	%	<1	15	----	<1	1
Sand (0.06-2.00 mm)	----	1	%	65	66	----	96	47
Gravel (>2mm)	----	1	%	31	1	----	<1	49
Cobbles (>6cm)	----	1	%	<1	<1	----	<1	<1
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.66	2.73	----	2.66	2.65
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	----	730	----	----
Iron	7439-89-6	50	mg/kg	----	----	6760	----	----
EG020-SD: Total Metals in Sediments by ICPMS								
Antimony	7440-36-0	0.50	mg/kg	----	----	<0.50	----	----
Arsenic	7440-38-2	1.00	mg/kg	----	----	3.12	----	----
Cadmium	7440-43-9	0.1	mg/kg	----	----	<0.1	----	----
Chromium	7440-47-3	1.0	mg/kg	----	----	12.2	----	----
Copper	7440-50-8	1.0	mg/kg	----	----	<1.0	----	----
Lead	7439-92-1	1.0	mg/kg	----	----	1.2	----	----
Manganese	7439-96-5	10	mg/kg	----	----	37	----	----
Nickel	7440-02-0	1.0	mg/kg	----	----	3.0	----	----

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	B28	S29-B2	S30-B	S32	S33
				Client sampling date / time	28-Sep-2019 14:05	26-Sep-2019 15:01	26-Sep-2019 16:00	28-Sep-2019 14:00	28-Sep-2019 14:10
Compound	CAS Number	LOR	Unit		EP1910036-031	EP1910036-032	EP1910036-033	EP1910036-034	EP1910036-035
					Result	Result	Result	Result	Result
EG020-SD: Total Metals in Sediments by ICPMS - Continued									
Silver	7440-22-4	0.1	mg/kg		----	----	<0.1	----	----
Zinc	7440-66-6	1.0	mg/kg		----	----	**2.0**	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg		----	----	<0.01	----	----
EP090: Organotin Compounds									
Monobutyltin	78763-54-9	1	µgSn/kg		----	----	<1	----	----
Dibutyltin	1002-53-5	1	µgSn/kg		----	----	<1	----	----
Tributyltin	56573-85-4	0.5	µgSn/kg		----	----	<0.5	----	----
EP090S: Organotin Surrogate									
Tripropyltin	----	0.5	%		----	----	**81.2**	----	----

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	S34	S35	O36	O37	O38
				Client sampling date / time	28-Sep-2019 08:30	28-Sep-2019 08:10	28-Sep-2019 16:40	28-Sep-2019 16:35	28-Sep-2019 16:30
Compound	CAS Number	LOR	Unit		EP1910036-036	EP1910036-037	EP1910036-038	EP1910036-039	EP1910036-040
					Result	Result	Result	Result	Result
EA150: Particle Sizing									
+75µm	----	1	%		93	94	----	----	----
+150µm	----	1	%		63	65	----	----	----
+300µm	----	1	%		33	39	----	----	----
+425µm	----	1	%		29	36	----	----	----
+600µm	----	1	%		22	29	----	----	----
+1180µm	----	1	%		5	9	----	----	----
+2.36mm	----	1	%		<1	<1	----	----	----
+4.75mm	----	1	%		<1	<1	----	----	----
+9.5mm	----	1	%		<1	<1	----	----	----
+19.0mm	----	1	%		<1	<1	----	----	----
+37.5mm	----	1	%		<1	<1	----	----	----
+75.0mm	----	1	%		<1	<1	----	----	----
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%		3	4	----	----	----
Silt (2-60 µm)	----	1	%		2	<1	----	----	----
Sand (0.06-2.00 mm)	----	1	%		93	93	----	----	----
Gravel (>2mm)	----	1	%		2	3	----	----	----
Cobbles (>6cm)	----	1	%		<1	<1	----	----	----
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3		2.64	2.66	----	----	----
EA200: AS 4964 - 2004 Identification of Asbestos in Soils									
Asbestos Detected	1332-21-4	0.1	g/kg		----	----	No	No	No
Asbestos (Trace)	1332-21-4	5	Fibres		----	----	No	No	No
Asbestos Type	1332-21-4	-	--		----	----	-	-	-
Sample weight (dry)	----	0.01	g		----	----	478	248	247
Synthetic Mineral Fibre	----	0.1	g/kg		----	----	No	No	No
Organic Fibre	----	0.1	g/kg		----	----	No	No	No
APPROVED IDENTIFIER:	----	-	--		----	----	E.DAOS	E.DAOS	E.DAOS
EA200N: Asbestos Quantification (non-NATA)									
ø Asbestos (Fines and Fibrous <7mm)	1332-21-4	0.0004	g		----	----	<0.0004	<0.0004	<0.0004
ø Asbestos (Fines and Fibrous FA+AF)	----	0.001	% (w/w)		----	----	<0.001	<0.001	<0.001
ø Asbestos Containing Material	1332-21-4	0.1	g		----	----	<0.1	<0.1	<0.1

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	S34	S35	O36	O37	O38
				Client sampling date / time	28-Sep-2019 08:30	28-Sep-2019 08:10	28-Sep-2019 16:40	28-Sep-2019 16:35	28-Sep-2019 16:30
Compound	CAS Number	LOR	Unit		EP1910036-036	EP1910036-037	EP1910036-038	EP1910036-039	EP1910036-040
					Result	Result	Result	Result	Result
EA200N: Asbestos Quantification (non-NATA) - Continued									
ø **Asbestos Containing Material (as 15% Asbestos in ACM >7mm)**	1332-21-4	0.01	% (w/w)		----	----	<0.01	<0.01	<0.01
ø **Weight Used for % Calculation**	----	0.0001	kg		----	----	**0.478**	**0.248**	**0.247**
ø **Fibrous Asbestos >7mm**	----	0.0004	g		----	----	<0.0004	<0.0004	<0.0004

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Client sample ID	O39	O40	----	----	----
			Client sampling date / time	28-Sep-2019 16:50	28-Sep-2019 16:45	----	----	----
Compound	CAS Number	LOR	Unit	EP1910036-041	EP1910036-042	--------	--------	--------
				Result	Result	----	----	----
EA200: AS 4964 - 2004 Identification of Asbestos in Soils								
Asbestos Detected	1332-21-4	0.1	g/kg	**No**	**No**	**----**	**----**	**----**
Asbestos (Trace)	1332-21-4	5	Fibres	**No**	**No**	**----**	**----**	**----**
Asbestos Type	1332-21-4	-	--	**-**	**-**	**----**	**----**	**----**
Sample weight (dry)	----	0.01	g	**292**	**204**	**----**	**----**	**----**
Synthetic Mineral Fibre	----	0.1	g/kg	**No**	**No**	**----**	**----**	**----**
Organic Fibre	----	0.1	g/kg	**No**	**No**	**----**	**----**	**----**
APPROVED IDENTIFIER:	----	-	--	**E.DAOS**	**E.DAOS**	**----**	**----**	**----**
EA200N: Asbestos Quantification (non-NATA)								
ø **Asbestos (Fines and Fibrous <7mm)**	1332-21-4	0.0004	g	<0.0004	<0.0004	**----**	**----**	**----**
ø **Asbestos (Fines and Fibrous FA+AF)**	----	0.001	% (w/w)	<0.001	<0.001	**----**	**----**	**----**
ø **Asbestos Containing Material**	1332-21-4	0.1	g	<0.1	<0.1	**----**	**----**	**----**
ø **Asbestos Containing Material (as 15% Asbestos in ACM >7mm)**	1332-21-4	0.01	% (w/w)	<0.01	<0.01	**----**	**----**	**----**
ø **Weight Used for % Calculation**	----	0.0001	kg	**0.292**	**0.204**	**----**	**----**	**----**
ø **Fibrous Asbestos >7mm**	----	0.0004	g	<0.0004	<0.0004	**----**	**----**	**----**

Analytical Results

Descriptive Results

Sub-Matrix: **SEDIMENT**

Method: Compound	Client sample ID - Client sampling date / time	Analytical Results
EA200: AS 4964 - 2004 Identification of Asbestos in Soils		
EA200: Description	O36 - 28-Sep-2019 16:40	Red orange sandy soil with rock matter.
EA200: Description	O37 - 28-Sep-2019 16:35	Red orange sandy soil with rock matter.
EA200: Description	O38 - 28-Sep-2019 16:30	Red orange sandy soil with rock matter.
EA200: Description	O39 - 28-Sep-2019 16:50	Red orange sandy soil with rock matter.
EA200: Description	O40 - 28-Sep-2019 16:45	Red orange sandy soil with rock matter.

Surrogate Control Limits

Sub-Matrix: **SEDIMENT**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP090S: Organotin Surrogate			
Tripropyltin	----	35	130

LABORATORY REPORT

Job Number: 19-16504-A
Revision: 00
Date: 30 October 2019

ADDRESS: **O2 Marine**
Suite 2, 4B Mews Rd
Fremantle WA 6160

ATTENTION: Josh Abott

DATE RECEIVED: 3/10/2019

YOUR REFERENCE: 19WAU-0020 Port Hedland Spoilbank Marina

PURCHASE ORDER:

APPROVALS:

DouglasTodd
Laboratory Manager

REPORT COMMENTS:

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Samples are analysed on an as received basis unless otherwise noted.

METHOD REFERENCES:

Methods prefixed with "ARL" are covered under NATA Accreditation Number: 2377
Methods prefixed with "PM" are covered under NATA Accreditation Number: 2561
Methods prefixed with "EDP" are covered under NATA Accreditation Number: 19290

Method ID	Method Description
ARL No. 064	Total Organic Carbon in Sediment
ARL No. 401/403	Metals in Soil and Sediment by ICPOES/MS
ARL No. 406	Mercury by Cold Vapour Atomic Absorption Spectrophotometry
ARL No. 030	Metals in Soil and Sediment by AAS
ARL No. 135	Moisture
ARL No. 010	Total Petroleum Hydrocarbons (TPH) in Soil
ARL No. 192	Total Recoverable Hydrocarbons (C_6-C_{10}) in Soil
ARL No. 193	Total Recoverable Hydrocarbons (>C_{10}-C_{40}) in Soil

NATA
WORLD RECOGNISED ACCREDITATION
Accredited for compliance with ISO/IEC 17025 - Testing

O2 Marine
Job No: 19-16504-A

LABORATORY REPORT
Revision: 00

Date: 30/10/19

Misc. Inorganics in Soil		Sample No	19-16504-A-57	19-16504-A-58
		Sample Description	Field Blank 1	Trip Blank 1
		Sample Date	28/09/2019	28/09/2019
ANALYTE	LOR	Units	Result	Result
TOC	0.1	%	<0.1	<0.1

Metals in Soil and Sediment		Sample No	19-16504-A-57	19-16504-A-58
		Sample Description	Field Blank 1	Trip Blank 1
		Sample Date	28/09/2019	28/09/2019
ANALYTE	LOR	Units	Result	Result
Aluminium	1	mg/kg	400	390
Antimony	0.1	mg/kg	<0.1	<0.1
Arsenic	0.1	mg/kg	<0.1	<0.1
Cadmium	0.1	mg/kg	<0.1	<0.1
Chromium	0.5	mg/kg	<0.5	<0.5
Copper	0.5	mg/kg	<0.5	<0.5
Iron	1	mg/kg	23	17
Lead	0.5	mg/kg	<0.5	<0.5
Manganese	1	mg/kg	<1	<1
Mercury	0.01	mg/kg	<0.01	<0.01
Nickel	0.5	mg/kg	<0.5	<0.5
Silver	0.1	mg/kg	<0.1	<0.1
Zinc	0.5	mg/kg	<0.5	<0.5

Soil Parameters		Sample No	19-16504-A-57	19-16504-A-58
		Sample Description	Field Blank 1	Trip Blank 1
		Sample Date	28/09/2019	28/09/2019
ANALYTE	LOR	Units	Result	Result
Moisture	0.1	%w/w	0.2	0.2

TRH (C_6-C_{40}) in Soil		Sample No	19-16504-A-57	19-16504-A-58
		Sample Description	Field Blank 1	Trip Blank 1
		Sample Date	28/09/2019	28/09/2019
ANALYTE	LOR	Units	Result	Result
TPH C_{6-9}	0.2	mg/kg	<0.2	<0.2
TRH C_{6-10}	2	mg/kg	<2	<2
TRH C_{6-10} minus BTEX (F1)	2	mg/kg	<2	<2
TRH C_{10-14}	0.2	mg/kg	<0.2	<0.2
TRH C_{15-28}	0.4	mg/kg	<0.4	<0.4
TRH C_{29-36}	0.4	mg/kg	<0.4	<0.4
TRH $C_{>10-16}$	20	mg/kg	<20	<20
TRH $C_{>10-16}$ minus Naphthalene (F2)	20	mg/kg	<20	<20
TRH $C_{>16-34}$	25	mg/kg	<25	<25
TRH $C_{>34-40}$	25	mg/kg	<25	<25
Benzene	0.1	mg/kg	<0.1	<0.1
Toluene	0.1	mg/kg	<0.1	<0.1
Ethylbenzene	0.1	mg/kg	<0.1	<0.1
meta,para-Xylenes	0.2	mg/L	<0.2	<0.2
Xylenes (Total)	0.1	mg/kg	<0.1	<0.1
Naphthalene	0.5	mg/kg	<0.5	<0.5

O2 Marine *LABORATORY REPORT*
Job No: 19-16504-A *Revision: 00* *Date: 30/10/19*

Result Definitions
LOR Limit of Reporting [NT] Not Tested [ND] Not Detected at indicated Limit of Reporting
* Denotes test not covered by NATA Accreditation

FOR MICROBIOLOGICAL TESTING - The data in this report may not be representative of a lot, batch or other samples and may not necessarily justify the acceptance or rejection of a lot or batch, a product recall or support legal proceedings. Tests are not routinely performed as duplicates unless specifically requested. Changes occur in the bacterial content of biological samples. Samples should be examined as soon as possible after collection, preferably within 6 hrs and must be stored at 4 degrees Celsius or below. Samples tested after 24 hrs cannot be regarded as satisfactory because of temperature abuse and variations.

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CERTIFICATE OF ANALYSIS 234885

Client Details

Client	Analytical Reference Laboratory (WA)
Attention	Ryan Seaton
Address	46-48 Banksia Road, Welshpool, WA, 6106

Sample Details

Your Reference	**19-16504-A**
Number of Samples	2 Soil
Date samples received	23/10/2019
Date completed instructions received	23/10/2019

Analysis Details

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

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

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

Report Details

Date results requested by	29/10/2019
Date of Issue	29/10/2019

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Results Approved By
Michael Kubiak, Laboratory Manager

Authorised By

Michael Kubiak, Laboratory Manager

PAHs in Sediment (NAGD)			
Our Reference		234885-1	234885-2
Your Reference	UNITS	19-16504-A-57	19-16504-A-58
Sample ID		Field Blank 1	Trip Blank 1
Type of sample		Soil	Soil
Date extracted	-	28/10/2019	28/10/2019
Date analysed	-	28/10/2019	28/10/2019
Naphthalene	µg/kg	<5	<5
2-Methylnaphthalene	µg/kg	<5	<5
Acenaphthylene	µg/kg	<5	<5
Acenaphthene	µg/kg	<5	<5
Fluorene	µg/kg	<5	<5
Phenanthrene	µg/kg	<5	<5
Anthracene	µg/kg	<5	<5
Fluoranthene	µg/kg	<5	<5
Pyrene	µg/kg	<5	<5
Benzo(a)anthracene	µg/kg	<5	<5
Chrysene	µg/kg	<5	<5
Benzo(b,j+k)fluoranthene	µg/kg	<10	<10
Benzo(e)pyrene	µg/kg	<5	<5
Benzo(a)pyrene	µg/kg	<5	<5
Perylene	µg/kg	<5	<5
Indeno(1,2,3-c,d)pyrene	µg/kg	<5	<5
Dibenzo(a,h)anthracene	µg/kg	<5	<5
Benzo(g,h,i)perylene	µg/kg	<5	<5
Coronene	µg/kg	<5	<5
Surrogate p-Terphenyl-D_{14}	%	94	65

OCP in Sediment (NAGD)			
Our Reference	UNITS	234885-1	234885-2
Your Reference		19-16504-A-57	19-16504-A-58
Sample ID		Field Blank 1	Trip Blank 1
Type of sample		Soil	Soil
Date extracted	-	28/10/2019	28/10/2019
Date analysed	-	28/10/2019	28/10/2019
Hexachlorobenzene (HCB)	µg/kg	<1	<1
a-BHC	µg/kg	<1	<1
b-BHC	µg/kg	<1	<1
Lindane (g-BHC)	µg/kg	<1	<1
d-BHC	µg/kg	<1	<1
Heptachlor	µg/kg	<1	<1
Aldrin	µg/kg	<1	<1
Heptachlor Epoxide	µg/kg	<1	<1
a-chlordane	µg/kg	<1	<1
g-Chlordane	µg/kg	<1	<1
a-endosulphan	µg/kg	<1	<1
p,p'-DDE	µg/kg	<1	<1
Dieldrin	µg/kg	<1	<1
Endrin	µg/kg	<1	<1
p,p'-DDD	µg/kg	<1	<1
b-endosulphan	µg/kg	<1	<1
Endosulfan Sulphate	µg/kg	<1	<1
p,p'-DDT	µg/kg	<1	<1
Methoxychlor	µg/kg	<1	<1
Oxychlordane	µg/kg	<1	<1

OPP in Sediment (NAGD)			
Our Reference		234885-1	234885-2
Your Reference	UNITS	19-16504-A-57	19-16504-A-58
Sample ID		Field Blank 1	Trip Blank 1
Type of sample		Soil	Soil
Date extracted	-	28/10/2019	28/10/2019
Date analysed	-	28/10/2019	28/10/2019
Diazinon	µg/kg	<50	<50
Dimethoate	µg/kg	<50	<50
Chlorpyrifos-methyl	µg/kg	<50	<50
Parathion-methyl	µg/kg	<50	<50
Ronnel	µg/kg	<50	<50
Fenitrothion	µg/kg	<50	<50
Malathion	µg/kg	<50	<50
Chlorpyrifos	µg/kg	<50	<50
Fenthion	µg/kg	<50	<50
Parathion-ethyl	µg/kg	<50	<50
Ethion	µg/kg	<50	<50
Bromophos Ethyl	µg/kg	<50	<50
Surrogate p-Terphenyl-D_{14}	%	94	65

Organotin Compounds in Soil			
Our Reference		234885-1	234885-2
Your Reference	UNITS	19-16504-A-57	19-16504-A-58
Sample ID		Field Blank 1	Trip Blank 1
Type of sample		Soil	Soil
Date extracted	-	23/10/2019	23/10/2019
Date analysed	-	23/10/2019	23/10/2019
Surrogate Triphenyltin	%	88	95

Moisture			
Our Reference		234885-1	234885-2
Your Reference	UNITS	19-16504-A-57	19-16504-A-58
Sample ID		Field Blank 1	Trip Blank 1
Type of sample		Soil	Soil
Date prepared	-	25/10/2019	25/10/2019
Date analysed	-	28/10/2019	28/10/2019
Moisture	%	3.3	0.54

Method ID	Methodology Summary
INORG-008	Moisture content determined by heating at 105 deg C for a minimum of 12 hours.
ORG-008/015	Organophosphorus Pesticides in soil by DCM:Acetone extraction and water by DCM extraction with determination by GC-ECD/GC-MS.
ORG-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
ORG-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM draft B1 Guideline on Investigation Levels for Soil and Groundwater.
ORG-018	Based on SFS-EN ISO 17353, ISO/DIS 23161 and NIOSH 5504. Air samples are extracted with acetonitrile containing 0.1% acetic acid using sonication. Extracts are then derivatised and extracted. Soils are extracted with a mix of water and methanolic KOH solution, neutralised and then derivatised and extracted. Water samples are pH adjusted, salt added and then derivatised, extracted into hexane and concentrated to a small volume. The extracts are analysed by GC/MSMS.

QUALITY CONTROL: PAHs in Sediment (NAGD)						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	234885-2
Date extracted	-			28/10/2019	1	28/10/2019	28/10/2019		28/10/2019	28/10/2019
Date analysed	-			28/10/2019	1	28/10/2019	28/10/2019		28/10/2019	28/10/2019
Naphthalene	µg/kg	5	ORG-012	<5	1	<5	<5	0	102	103
2-Methylnaphthalene	µg/kg	5	ORG-012	<5	1	<5	<5	0	[NT]	[NT]
Acenaphthylene	µg/kg	5	ORG-012	<5	1	<5	<5	0	[NT]	[NT]
Acenaphthene	µg/kg	5	ORG-012	<5	1	<5	<5	0	[NT]	[NT]
Fluorene	µg/kg	5	ORG-012	<5	1	<5	<5	0	105	99
Phenanthrene	µg/kg	5	ORG-012	<5	1	<5	<5	0	109	109
Anthracene	µg/kg	5	ORG-012	<5	1	<5	<5	0	[NT]	[NT]
Fluoranthene	µg/kg	5	ORG-012	<5	1	<5	<5	0	110	108
Pyrene	µg/kg	5	ORG-012	<5	1	<5	<5	0	106	108
Benzo(a)anthracene	µg/kg	5	ORG-012	<5	1	<5	<5	0	[NT]	[NT]
Chrysene	µg/kg	5	ORG-012	<5	1	<5	<5	0	105	115
Benzo(b,j+k)fluoranthene	µg/kg	10	ORG-012	<10	1	<10	<10	0	[NT]	[NT]
Benzo(e)pyrene	µg/kg	5	ORG-012	<5	1	<5	<5	0	[NT]	[NT]
Benzo(a)pyrene	µg/kg	5	ORG-012	<5	1	<5	<5	0	122	132
Perylene	µg/kg	5	ORG-012	<5	1	<5	<5	0	[NT]	[NT]
Indeno(1,2,3-c,d)pyrene	µg/kg	5	ORG-012	<5	1	<5	<5	0	[NT]	[NT]
Dibenzo(a,h)anthracene	µg/kg	5	ORG-012	<5	1	<5	<5	0	[NT]	[NT]
Benzo(g,h,i)perylene	µg/kg	5	ORG-012	<5	1	<5	<5	0	[NT]	[NT]
Coronene	µg/kg	5	ORG-012	<5	1	<5	<5	0	[NT]	[NT]
Surrogate p-Terphenyl-D_{14}	%		ORG-012	81	1	94	77	20	90	84

QUALITY CONTROL: OCP in Sediment (NAGD)						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	234885-2
Date extracted	-			28/10/2019	1	28/10/2019	28/10/2019		28/10/2019	28/10/2019
Date analysed	-			28/10/2019	1	28/10/2019	28/10/2019		28/10/2019	28/10/2019
Hexachlorobenzene (HCB)	µg/kg	1	ORG-012	<1	1	<1	<1	0	[NT]	[NT]
a-BHC	µg/kg	1	ORG-012	<1	1	<1	<1	0	105	101
b-BHC	µg/kg	1	ORG-012	<1	1	<1	<1	0	106	104
Lindane (g-BHC)	µg/kg	1	ORG-012	<1	1	<1	<1	0	[NT]	[NT]
d-BHC	µg/kg	1	ORG-012	<1	1	<1	<1	0	[NT]	[NT]
Heptachlor	µg/kg	1	ORG-012	<1	1	<1	<1	0	118	122
Aldrin	µg/kg	1	ORG-012	<1	1	<1	<1	0	99	114
Heptachlor Epoxide	µg/kg	1	ORG-012	<1	1	<1	<1	0	104	109
a-chlordane	µg/kg	1	ORG-012	<1	1	<1	<1	0	[NT]	[NT]
g-Chlordane	µg/kg	1	ORG-012	<1	1	<1	<1	0	[NT]	[NT]
a-endosulphan	µg/kg	1	ORG-012	<1	1	<1	<1	0	[NT]	[NT]
p,p'-DDE	µg/kg	1	ORG-012	<1	1	<1	<1	0	109	113
Dieldrin	µg/kg	1	ORG-012	<1	1	<1	<1	0	108	114
Endrin	µg/kg	1	ORG-012	<1	1	<1	<1	0	[NT]	[NT]
p,p'-DDD	µg/kg	1	ORG-012	<1	1	<1	<1	0	99	92
b-endosulphan	µg/kg	1	ORG-012	<1	1	<1	<1	0	[NT]	[NT]
Endosulfan Sulphate	µg/kg	1	ORG-012	<1	1	<1	<1	0	101	65
p,p'-DDT	µg/kg	1	ORG-012	<1	1	<1	<1	0	[NT]	[NT]
Methoxychlor	µg/kg	1	ORG-012	<1	1	<1	<1	0	[NT]	[NT]
Oxychlordane	µg/kg	1	ORG-012	<1	1	<1	<1	0	[NT]	[NT]

QUALITY CONTROL: OPP in Sediment (NAGD)						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	234885-2
Date extracted	-			28/10/2019	1	28/10/2019	28/10/2019		28/10/2019	28/10/2019
Date analysed	-			28/10/2019	1	28/10/2019	28/10/2019		28/10/2019	28/10/2019
Diazinon	µg/kg	50	ORG-012	<50	1	<50	<50	0	[NT]	[NT]
Dimethoate	µg/kg	50	ORG-012	<50	1	<50	<50	0	[NT]	[NT]
Chlorpyrifos-methyl	µg/kg	50	ORG-012	<50	1	<50	<50	0	115	104
Parathion-methyl	µg/kg	50	ORG-012	<50	1	<50	<50	0	[NT]	[NT]
Ronnel	µg/kg	50	ORG-012	<50	1	<50	<50	0	[NT]	[NT]
Fenitrothion	µg/kg	50	ORG-012	<50	1	<50	<50	0	119	106
Malathion	µg/kg	50	ORG-012	<50	1	<50	<50	0	[NT]	[NT]
Chlorpyrifos	µg/kg	50	ORG-012	<50	1	<50	<50	0	108	100
Fenthion	µg/kg	50	ORG-012	<50	1	<50	<50	0	[NT]	[NT]
Parathion-ethyl	µg/kg	50	ORG-012	<50	1	<50	<50	0	[NT]	[NT]
Ethion	µg/kg	50	ORG-012	<50	1	<50	<50	0	99	60
Bromophos Ethyl	µg/kg	50	ORG-012	<50	1	<50	<50	0	[NT]	[NT]
Surrogate p-Terphenyl-D_{14}	%		ORG-008/015	81	1	94	77	20	90	84

QUALITY CONTROL: Organotin Compounds in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	234885-2
Date extracted	-			23/10/2019	1	23/10/2019	23/10/2019		23/10/2019	23/10/2019
Date analysed	-			23/10/2019	1	23/10/2019	23/10/2019		23/10/2019	23/10/2019
Monobutyltin	µg/kg	0.5	ORG-018	<0.5	1	<0.5	<0.5	0	[NT]	[NT]
Dibutyltin	µg/kg	0.5	ORG-018	<0.5	1	<0.5	<0.5	0	86	102
Tributyltin	µg/kg	0.5	ORG-018	<0.5	1	<0.5	<0.5	0	102	72
Surrogate Triphenyltin	%		ORG-018	100	1	88	96	9	103	103

QUALITY CONTROL: Moisture					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			25/10/2019	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Date analysed	-			28/10/2019	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Moisture	%	0.1	INORG-008	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

Result Definitions

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

Quality Control Definitions

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

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

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available).

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

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

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

LABORATORY REPORT

Job Number: 19-16504
Revision: 01
Date: 14 October 2019

ADDRESS: **O2 Marine**
Suite 2, 4B Mews Rd
Fremantle WA 6160

ATTENTION: Claudio Del Deo

DATE RECEIVED: 3/10/2019

YOUR REFERENCE: 19WAU-0020 Port Hedland Spoilbank Marina

PURCHASE ORDER:

APPROVALS:

DouglasTodd
Laboratory Manager

REPORT COMMENTS:

This report is issued by Analytical Reference Laboratory (WA) Pty Ltd. The report shall not be reproduced except in full without written approval from the laboratory.

Samples are analysed on an as received basis unless otherwise noted.

Rates of Reaction are determined by visual observation and are based on
Acid Sulphate Soils Laboratory Methods Guidelines: Section H - Table H1.1

RATES OF REACTION
Slight Reaction = X
Moderate Reaction = XX
Vigorous Reaction = XXX
Very Vigorous Reaction = XXXX

METHOD REFERENCES:

Methods prefixed with "ARL" are covered under NATA Accreditation Number: 2377
Methods prefixed with "PM" are covered under NATA Accreditation Number: 2561
Methods prefixed with "EDP" are covered under NATA Accreditation Number: 19290

Method ID	Method Description
ARL No. 064	Total Organic Carbon in Sediment
ARL No. 401/403	Metals in Soil and Sediment by ICPOES/MS
ARL No. 406	Mercury by Cold Vapour Atomic Absorption Spectrophotometry
ARL No. 030	Metals in Soil and Sediment by AAS
ARL No. 010	Total Petroleum Hydrocarbons (TPH) in Soil
ARL No. 192	Total Recoverable Hydrocarbons (C_6-C_{10}) in Soil
ARL No. 193	Total Recoverable Hydrocarbons (>C_{10}-C_{40}) in Soil
ARL No. 135	Moisture
ARL No. 208	"Field" pH measurements
23A and 23B	QASSIT et al Method Code
ARL No. 005	Polycyclic Aromatic Hydrocarbons in Water
ARL No. 002	OCOP and PCB in Water
ARL No. 009	Total Petroleum Hydrocarbons (TPH) in Water
ARL No. 190	Total Recoverable Hydrocarbons (C_6-C_{10}) in Water
ARL No. 191	Total Recoverable Hydrocarbons (>C_{10}-C_{40}) in Water
ARL No. 100	Organotins in Water
ARL No. 29/402/403	Metals in Water by AAS/ICPOES/ICPMS

NATA
WORLD RECOGNISED ACCREDITATION
Accredited for compliance with ISO/IEC 17025 - Testing

O2 Marine *LABORATORY REPORT*
Job No: 19-16504 *Revision: 01* *Date: 14/10/19*

Method ID	Method Description
ARL No. 040	Arsenic by Hydride Atomic Absorption

O2 Marine
Job No: 19-16504

LABORATORY REPORT
Revision: 01

Date: 14/10/19

Misc. Inorganics in Soil		Sample No	19-16504-1	19-16504-2	19-16504-3	19-16504-4	19-16504-5
		Sample Description	C01	C02	C03	C04	C05
		Sample Date	27/09/2019 16:15	27/09/2019 16:35	27/09/2019 17:25	28/09/2019 09:20	28/09/2019 09:00
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
TOC	0.1	%	0.9	0.7	0.4	0.3	0.4

Misc. Inorganics in Soil		Sample No	19-16504-6	19-16504-7	19-16504-8	19-16504-9	19-16504-10
		Sample Description	C06	C07	C08	C09	C10
		Sample Date	27/09/2019 14:45	28/09/2019 09:40	26/09/2019 13:50	26/09/2019 14:34	27/09/2019 15:40
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
TOC	0.1	%	0.4	0.3	0.5	0.4	0.2

Misc. Inorganics in Soil		Sample No	19-16504-11	19-16504-12	19-16504-13	19-16504-14	19-16504-15
		Sample Description	TRIP 1-0	TRIP 1-1	B11	B12.1	B12.2
		Sample Date	27/09/2019	27/09/2019	28/09/2019 10:20	27/09/2019 14:16	27/09/2019 14:16
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
TOC	0.1	%	0.4	0.4	0.2	0.3	0.5

Misc. Inorganics in Soil		Sample No	19-16504-16	19-16504-17	19-16504-18	19-16504-19	19-16504-20
		Sample Description	B13	B14	B15	B16.1	B16.2
		Sample Date	25/09/2019 15:30	25/09/2019 16:00	28/09/2019 13:00	28/09/2019 13:30	28/09/2019 13:30
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
TOC	0.1	%	<0.1	0.2	<0.1	<0.1	0.1

Misc. Inorganics in Soil		Sample No	19-16504-21	19-16504-22	19-16504-23	19-16504-24	19-16504-25
		Sample Description	B17	B18	B19	B20	B21
		Sample Date	28/09/2019 13:45	28/09/2019 15:15	28/09/2019 15:30	28/09/2019 15:35	28/09/2019 15:40
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
TOC	0.1	%	0.1	0.1	0.2	0.3	0.2

Misc. Inorganics in Soil		Sample No	19-16504-26	19-16504-27	19-16504-28	19-16504-29	19-16504-30
		Sample Description	B22.B	B23	B24.B1	B24.B2	TRIP 2-0
		Sample Date	28/09/2019 16:05	28/09/2019 15:45	28/09/2019 12:45	28/09/2019 12:45	28/09/2019
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
TOC	0.1	%	0.1	0.2	0.1	0.1	0.1

Misc. Inorganics in Soil		Sample No	19-16504-31	19-16504-32	19-16504-33	19-16504-34	19-16504-35
		Sample Description	TRIP 2-1	B25	S26	S27	S28
		Sample Date	28/09/2019	28/09/2019 12:30	26/09/2019 15:55	28/09/2019 15:00	28/09/2019 14:05
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
TOC	0.1	%	0.1	0.2	0.2	0.1	<0.1

O2 Marine
Job No: 19-16504

LABORATORY REPORT
Revision: 01

Date: 14/10/19

Misc. Inorganics in Soil		Sample No	19-16504-36	19-16504-37	19-16504-38	19-16504-39	19-16504-40
		Sample Description	S29.B1	S29.B2	S30.B	S31.B	S32
		Sample Date	28/09/2019 15:01	26/09/2019 15:01	26/09/2019 16:00	26/09/2019 14:00	28/09/2019 14:10
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
TOC	0.1	%	<0.1	0.3	0.1	0.1	0.1

Misc. Inorganics in Soil		Sample No	19-16504-41	19-16504-42	19-16504-43	19-16504-44	19-16504-45
		Sample Description	S33	S34	S35	O40	O37
		Sample Date	28/09/2019 14:20	28/09/2019 08:30	28/09/2019 08:10	29/09/2019 16:10	29/09/2019 15:48
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
TOC	0.1	%	0.1	0.2	0.1	0.1	<0.1

Misc. Inorganics in Soil		Sample No	19-16504-46	19-16504-47	19-16504-48	19-16504-49	19-16504-50
		Sample Description	O38	O36	O39	TRIP 3-0	TRIP 3-1
		Sample Date	29/09/2019 16:15	29/09/2019 15:45	29/09/2019 16:05	28/09/2019	28/09/2019
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
TOC	0.1	%	0.1	0.1	0.2	0.2	0.2

Misc. Inorganics in Soil		Sample No	19-16504-51	19-16504-52
		Sample Description	TRIP 4-0	TRIP 4-1
		Sample Date	28/09/2019	28/09/2019
ANALYTE	LOR	Units	Result	Result
TOC	0.1	%	0.2	0.1

Metals in Soil and Sediment		Sample No	19-16504-1	19-16504-2	19-16504-3	19-16504-4	19-16504-5
		Sample Description	C01	C02	C03	C04	C05
		Sample Date	27/09/2019 16:15	27/09/2019 16:35	27/09/2019 17:25	28/09/2019 09:20	28/09/2019 09:00
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Aluminium	1	mg/kg	11,000	10,000	4,800	3,400	3,900
Antimony	0.1	mg/kg	0.6	0.3	0.3	0.3	0.2
Arsenic	0.1	mg/kg	13	13	14	14	13
Cadmium	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	0.5	mg/kg	49	45	25	20	24
Copper	0.5	mg/kg	21	11	8.1	5.0	6.9
Iron	1	mg/kg	29,000	19,000	14,000	9,100	11,000
Lead	0.5	mg/kg	8.0	9.0	3.9	2.9	3.6
Manganese	1	mg/kg	260	220	180	200	210
Mercury	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	0.5	mg/kg	19	18	10	7.6	9.0
Silver	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	0.5	mg/kg	30	23	15	11	13

Metals in Soil and Sediment		Sample No	19-16504-6	19-16504-7	19-16504-8	19-16504-9	19-16504-10
		Sample Description	C06	C07	C08	C09	C10
		Sample Date	27/09/2019 14:45	28/09/2019 09:40	26/09/2019 13:50	26/09/2019 14:34	27/09/2019 15:40
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Aluminium	1	mg/kg	3,600	2,200	3,600	1,300	4,200
Antimony	0.1	mg/kg	0.2	0.2	0.2	0.2	0.2
Arsenic	0.1	mg/kg	11	11	10	4.1	10

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Metals in Soil and Sediment		Sample No	19-16504-6	19-16504-7	19-16504-8	19-16504-9	19-16504-10
		Sample Description	C06	C07	C08	C09	C10
		Sample Date	27/09/2019 14:45	28/09/2019 09:40	26/09/2019 13:50	26/09/2019 14:34	27/09/2019 15:40
Cadmium	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	0.5	mg/kg	22	17	20	15	24
Copper	0.5	mg/kg	5.4	3.2	5.3	1.9	6.0
Iron	1	mg/kg	9,000	6,200	8,200	3,700	10,000
Lead	0.5	mg/kg	3.0	2.2	2.6	1.5	3.5
Manganese	1	mg/kg	170	130	150	48	150
Mercury	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	0.5	mg/kg	8.7	5.3	7.1	4.2	10
Silver	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	0.5	mg/kg	12	8.4	12	3.3	13

Metals in Soil and Sediment		Sample No	19-16504-11	19-16504-12	19-16504-13	19-16504-14	19-16504-15
		Sample Description	TRIP 1-0	TRIP 1-1	B11	B12.1	B12.2
		Sample Date	27/09/2019	27/09/2019	28/09/2019 10:20	27/09/2019 14:16	27/09/2019 14:16
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Aluminium	1	mg/kg	3,900	4,600	630	2,400	6,500
Antimony	0.1	mg/kg	0.2	0.2	0.2	0.5	0.4
Arsenic	0.1	mg/kg	13	13	3.5	5.1	9.5
Cadmium	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	0.5	mg/kg	23	25	14	18	33
Copper	0.5	mg/kg	5.5	5.5	1.0	3.2	7.5
Iron	1	mg/kg	9,400	10,000	3,100	5,800	14,000
Lead	0.5	mg/kg	3.2	3.5	1.2	2.3	5.2
Manganese	1	mg/kg	170	180	28	71	140
Mercury	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	0.5	mg/kg	9.2	9.4	2.5	7.0	16
Silver	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	0.5	mg/kg	12	13	1.6	4.8	16

Metals in Soil and Sediment		Sample No	19-16504-16	19-16504-17	19-16504-18	19-16504-19	19-16504-20
		Sample Description	B13	B14	B15	B16.1	B16.2
		Sample Date	25/09/2019 15:30	25/09/2019 16:00	28/09/2019 13:00	28/09/2019 13:30	28/09/2019 13:30
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Aluminium	1	mg/kg	890	900	700	650	690
Antimony	0.1	mg/kg	0.2	0.2	0.2	0.2	0.2
Arsenic	0.1	mg/kg	3.2	4.3	3.3	3.0	3.2
Cadmium	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	0.5	mg/kg	14	15	13	16	12
Copper	0.5	mg/kg	1.3	1.2	1.0	1.0	1.0
Iron	1	mg/kg	3,300	3,300	3,200	3,500	3,200
Lead	0.5	mg/kg	1.7	1.9	1.2	1.7	1.5
Manganese	1	mg/kg	49	41	33	29	37
Mercury	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	0.5	mg/kg	3.1	3.4	2.6	3.0	2.6
Silver	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	0.5	mg/kg	2.3	2.5	1.6	2.3	1.8

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Metals in Soil and Sediment		Sample No	19-16504-21	19-16504-22	19-16504-23	19-16504-24	19-16504-25
		Sample Description	B17	B18	B19	B20	B21
		Sample Date	28/09/2019 13:45	28/09/2019 15:15	28/09/2019 15:30	28/09/2019 15:35	28/09/2019 15:40
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Aluminium	1	mg/kg	630	870	700	1,100	1,000
Antimony	0.1	mg/kg	0.1	0.1	0.2	0.1	0.2
Arsenic	0.1	mg/kg	2.9	5.1	4.5	4.5	6.0
Cadmium	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	0.5	mg/kg	12	12	12	13	11
Copper	0.5	mg/kg	0.9	1.2	1.3	1.6	1.5
Iron	1	mg/kg	2,500	2,800	2,800	3,800	3,800
Lead	0.5	mg/kg	1.0	1.3	1.5	1.4	1.4
Manganese	1	mg/kg	30	38	33	59	58
Mercury	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	0.5	mg/kg	2.6	2.9	3.6	3.4	3.4
Silver	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	0.5	mg/kg	2.2	1.9	2.2	2.9	3.2

Metals in Soil and Sediment		Sample No	19-16504-26	19-16504-27	19-16504-28	19-16504-29	19-16504-30
		Sample Description	B22.B	B23	B24.B1	B24.B2	TRIP 2-0
		Sample Date	28/09/2019 16:05	28/09/2019 15:45	28/09/2019 12:45	28/09/2019 12:45	28/09/2019
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Aluminium	1	mg/kg	1,500	1,600	890	880	950
Antimony	0.1	mg/kg	0.1	0.1	0.1	0.2	0.1
Arsenic	0.1	mg/kg	4.7	7.6	4.9	6.2	4.2
Cadmium	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	0.5	mg/kg	15	16	14	12	13
Copper	0.5	mg/kg	2.2	2.8	1.1	1.1	1.3
Iron	1	mg/kg	4,100	4,800	2,900	3,300	3,200
Lead	0.5	mg/kg	1.7	2.7	1.2	1.1	1.3
Manganese	1	mg/kg	51	83	43	40	42
Mercury	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	0.5	mg/kg	4.6	4.5	4.4	3.2	3.4
Silver	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	0.5	mg/kg	4.1	10	2.5	2.2	3.5

Metals in Soil and Sediment		Sample No	19-16504-31	19-16504-32	19-16504-33	19-16504-34	19-16504-35
		Sample Description	TRIP 2-1	B25	S26	S27	S28
		Sample Date	28/09/2019	28/09/2019 12:30	26/09/2019 15:55	28/09/2019 15:00	28/09/2019 14:05
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Aluminium	1	mg/kg	860	1,600	1,300	1,600	1,000
Antimony	0.1	mg/kg	0.1	0.3	0.2	0.2	0.2
Arsenic	0.1	mg/kg	4.1	4.8	4.1	5.1	3.8
Cadmium	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	0.5	mg/kg	12	15	15	15	14
Copper	0.5	mg/kg	1.1	4.0	1.7	1.9	1.3
Iron	1	mg/kg	2,800	7,400	4,000	4,500	3,400
Lead	0.5	mg/kg	1.1	2.4	1.9	2.0	1.8
Manganese	1	mg/kg	37	89	48	64	50
Mercury	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01

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Metals in Soil and Sediment		Sample No	19-16504-31	19-16504-32	19-16504-33	19-16504-34	19-16504-35
		Sample Description	TRIP 2-1	B25	S26	S27	S28
		Sample Date	28/09/2019	28/09/2019 12:30	26/09/2019 15:55	28/09/2019 15:00	28/09/2019 14:05
Nickel	0.5	mg/kg	2.8	4.6	4.4	5.2	3.9
Silver	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	0.5	mg/kg	2.1	5.3	3.3	3.9	2.2

Metals in Soil and Sediment		Sample No	19-16504-36	19-16504-37	19-16504-38	19-16504-39	19-16504-40
		Sample Description	S29.B1	S29.B2	S30.B	S31.B	S32
		Sample Date	28/09/2019 15:01	26/09/2019 15:01	26/09/2019 16:00	26/09/2019 14:00	28/09/2019 14:10
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Aluminium	1	mg/kg	2,000	7,100	1,400	680	760
Antimony	0.1	mg/kg	0.2	0.4	0.3	0.1	0.1
Arsenic	0.1	mg/kg	5.2	11	8.7	3.1	3.5
Cadmium	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	0.5	mg/kg	17	35	16	11	12
Copper	0.5	mg/kg	2.6	8.0	1.9	0.8	1.0
Iron	1	mg/kg	5,200	15,000	6,000	2,200	2,600
Lead	0.5	mg/kg	2.2	5.8	1.7	1.0	1.1
Manganese	1	mg/kg	84	150	72	31	31
Mercury	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	0.5	mg/kg	6.0	18	3.8	2.2	2.7
Silver	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	0.5	mg/kg	4.6	17	2.9	1.7	1.9

Metals in Soil and Sediment		Sample No	19-16504-41	19-16504-42	19-16504-43	19-16504-44	19-16504-45
		Sample Description	S33	S34	S35	O40	O37
		Sample Date	28/09/2019 14:20	28/09/2019 08:30	28/09/2019 08:10	29/09/2019 16:10	29/09/2019 15:48
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Aluminium	1	mg/kg	1,300	1,300	1,500	1,900	1,300
Antimony	0.1	mg/kg	0.2	0.2	0.2	0.2	0.2
Arsenic	0.1	mg/kg	7.9	8.0	8.8	5.7	5.3
Cadmium	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	0.5	mg/kg	13	16	15	17	14
Copper	0.5	mg/kg	2.9	2.0	2.8	4.7	3.2
Iron	1	mg/kg	4,500	4,300	4,700	8,900	5,500
Lead	0.5	mg/kg	2.1	2.3	2.6	3.6	2.5
Manganese	1	mg/kg	150	55	68	89	65
Mercury	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	0.5	mg/kg	5.4	5.3	7.5	7.2	5.6
Silver	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	0.5	mg/kg	2.1	3.6	3.9	5.9	3.3

Metals in Soil and Sediment		Sample No	19-16504-46	19-16504-47	19-16504-48	19-16504-49	19-16504-50
		Sample Description	O38	O36	O39	TRIP 3-0	TRIP 3-1
		Sample Date	29/09/2019 16:15	29/09/2019 15:45	29/09/2019 16:05	28/09/2019	28/09/2019
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Aluminium	1	mg/kg	2,500	890	2,900	1,600	1,600
Antimony	0.1	mg/kg	0.3	0.1	0.2	0.2	0.3

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Metals in Soil and Sediment		Sample No	19-16504-46	19-16504-47	19-16504-48	19-16504-49	19-16504-50
		Sample Description	O38	O36	O39	TRIP 3-0	TRIP 3-1
		Sample Date	29/09/2019 16:15	29/09/2019 15:45	29/09/2019 16:05	28/09/2019	28/09/2019
Arsenic	0.1	mg/kg	6.5	5.8	3.5	6.8	7.0
Cadmium	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	0.5	mg/kg	21	12	25	16	15
Copper	0.5	mg/kg	4.5	1.6	9.0	2.5	2.8
Iron	1	mg/kg	18,000	3,200	17,000	4,700	4,500
Lead	0.5	mg/kg	17	1.9	5.5	2.8	2.7
Manganese	1	mg/kg	390	39	140	62	56
Mercury	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	0.5	mg/kg	8.6	3.6	7.9	6.7	7.9
Silver	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	0.5	mg/kg	8.3	2.4	11	4.1	3.8

Metals in Soil and Sediment		Sample No	19-16504-51	19-16504-52
		Sample Description	TRIP 4-0	TRIP 4-1
		Sample Date	28/09/2019	28/09/2019
ANALYTE	LOR	Units	Result	Result
Aluminium	1	mg/kg	1,500	1,200
Antimony	0.1	mg/kg	0.3	0.2
Arsenic	0.1	mg/kg	6.5	6.4
Cadmium	0.1	mg/kg	<0.1	<0.1
Chromium	0.5	mg/kg	14	14
Copper	0.5	mg/kg	2.1	1.9
Iron	1	mg/kg	4,200	3,700
Lead	0.5	mg/kg	2.2	2.1
Manganese	1	mg/kg	57	45
Mercury	0.01	mg/kg	<0.01	<0.01
Nickel	0.5	mg/kg	5.7	5.1
Silver	0.1	mg/kg	<0.1	<0.1
Zinc	0.5	mg/kg	3.8	3.2

TRH (C_6-C_{40}) in Soil		Sample No	19-16504-1	19-16504-2	19-16504-3	19-16504-4	19-16504-9
		Sample Description	C01	C02	C03	C04	C09
		Sample Date	27/09/2019 16:15	27/09/2019 16:35	27/09/2019 17:25	28/09/2019 09:20	26/09/2019 14:34
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
TRH C_{6-9}	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
TRH C_{6-10}	2	mg/kg	<2	<2	<2	<2	<2
TRH C_{6-10} minus BTEX (F1)	2	mg/kg	<2	<2	<2	<2	<2
TRH C_{10-14}	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
TRH C_{15-28}	0.4	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
TRH C_{29-36}	0.4	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
TRH $C_{>10-16}$	20	mg/kg	<20	<20	<20	<20	<20
TRH $C_{>10-16}$ minus Naphthalene (F2)	20	mg/kg	<20	<20	<20	<20	<20
TRH $C_{>16-34}$	25	mg/kg	<25	<25	<25	<25	<25
TRH $C_{>34-40}$	25	mg/kg	<25	<25	<25	<25	<25
Benzene	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1

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TRH (C_6-C_{40}) in Soil		Sample No	19-16504-1	19-16504-2	19-16504-3	19-16504-4	19-16504-9
		Sample Description	C01	C02	C03	C04	C09
		Sample Date	27/09/2019 16:15	27/09/2019 16:35	27/09/2019 17:25	28/09/2019 09:20	26/09/2019 14:34
m/p-Xylenes	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
o-Xylenes	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

TRH (C_6-C_{40}) in Soil		Sample No	19-16504-26	19-16504-28	19-16504-42	19-16504-44	19-16504-45
		Sample Description	B22.B	B24.B1	S34	O40	O37
		Sample Date	28/09/2019 16:05	28/09/2019 12:45	28/09/2019 08:30	29/09/2019 16:10	29/09/2019 15:48
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
TRH C_{6-9}	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
TRH C_{6-10}	2	mg/kg	<2	<2	<2	<2	<2
TRH C_{6-10} minus BTEX (F1)	2	mg/kg	<2	<2	<2	<2	<2
TRH C_{10-14}	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
TRH C_{15-28}	0.4	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
TRH C_{29-36}	0.4	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
TRH $C_{>10-16}$	20	mg/kg	<20	<20	<20	<20	<20
TRH $C_{>10-16}$ minus Naphthalene (F2)	20	mg/kg	<20	<20	<20	<20	<20
TRH $C_{>16-34}$	25	mg/kg	<25	<25	<25	<25	<25
TRH $C_{>34-40}$	25	mg/kg	<25	<25	<25	<25	<25
Benzene	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
m/p-Xylenes	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
o-Xylenes	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

TRH (C_6-C_{40}) in Soil		Sample No	19-16504-46	19-16504-47	19-16504-48
		Sample Description	O38	O36	O39
		Sample Date	29/09/2019 16:15	29/09/2019 15:45	29/09/2019 16:05
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**
TRH C_{6-9}	0.2	mg/kg	<0.2	<0.2	<0.2
TRH C_{6-10}	2	mg/kg	<2	<2	<2
TRH C_{6-10} minus BTEX (F1)	2	mg/kg	<2	<2	<2
TRH C_{10-14}	0.2	mg/kg	<0.2	<0.2	<0.2
TRH C_{15-28}	0.4	mg/kg	<0.4	<0.4	<0.4
TRH C_{29-36}	0.4	mg/kg	<0.4	<0.4	<0.4
TRH $C_{>10-16}$	20	mg/kg	<20	<20	<20
TRH $C_{>10-16}$ minus Naphthalene (F2)	20	mg/kg	<20	<20	<20
TRH $C_{>16-34}$	25	mg/kg	<25	<25	<25
TRH $C_{>34-40}$	25	mg/kg	<25	<25	<25
Benzene	0.1	mg/kg	<0.1	<0.1	<0.1
Toluene	0.1	mg/kg	<0.1	<0.1	<0.1
Ethylbenzene	0.1	mg/kg	<0.1	<0.1	<0.1
m/p-Xylenes	0.2	mg/kg	<0.2	<0.2	<0.2
o-Xylenes	0.1	mg/kg	<0.1	<0.1	<0.1
Naphthalene	0.5	mg/kg	<0.5	<0.5	<0.5

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Soil Parameters		Sample No	19-16504-1	19-16504-2	19-16504-3	19-16504-4	19-16504-5
		Sample Description	C01	C02	C03	C04	C05
		Sample Date	27/09/2019 16:15	27/09/2019 16:35	27/09/2019 17:25	28/09/2019 09:20	28/09/2019 09:00
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Moisture	0.1	%w/w	46.8	32.6	21.4	26.1	31.8

Soil Parameters		Sample No	19-16504-6	19-16504-7	19-16504-8	19-16504-9	19-16504-10
		Sample Description	C06	C07	C08	C09	C10
		Sample Date	27/09/2019 14:45	28/09/2019 09:40	26/09/2019 13:50	26/09/2019 14:34	27/09/2019 15:40
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Moisture	0.1	%w/w	29.4	25.5	30.6	19.1	30.8

Soil Parameters		Sample No	19-16504-11	19-16504-12	19-16504-13	19-16504-14	19-16504-15
		Sample Description	TRIP 1-0	TRIP 1-1	B11	B12.1	B12.2
		Sample Date	27/09/2019	27/09/2019	28/09/2019 10:20	27/09/2019 14:16	27/09/2019 14:16
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Moisture	0.1	%w/w	29.9	24.9	22.0	21.9	25.7

Soil Parameters		Sample No	19-16504-16	19-16504-17	19-16504-18	19-16504-19	19-16504-20
		Sample Description	B13	B14	B15	B16.1	B16.2
		Sample Date	25/09/2019 15:30	25/09/2019 16:00	28/09/2019 13:00	28/09/2019 13:30	28/09/2019 13:30
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Moisture	0.1	%w/w	3.5	1.5	14.5	20.6	13.8

Soil Parameters		Sample No	19-16504-21	19-16504-22	19-16504-23	19-16504-24	19-16504-25
		Sample Description	B17	B18	B19	B20	B21
		Sample Date	28/09/2019 13:45	28/09/2019 15:15	28/09/2019 15:30	28/09/2019 15:35	28/09/2019 15:40
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Moisture	0.1	%w/w	0.6	17.2	19.5	10.1	20.7

Soil Parameters		Sample No	19-16504-26	19-16504-27	19-16504-28	19-16504-29	19-16504-30
		Sample Description	B22.B	B23	B24.B1	B24.B2	TRIP 2-0
		Sample Date	28/09/2019 16:05	28/09/2019 15:45	28/09/2019 12:45	28/09/2019 12:45	28/09/2019
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Moisture	0.1	%w/w	16.2	0.6	3.7	13.3	17.6

Soil Parameters		Sample No	19-16504-31	19-16504-32	19-16504-33	19-16504-34	19-16504-35
		Sample Description	TRIP 2-1	B25	S26	S27	S28
		Sample Date	28/09/2019	28/09/2019 12:30	26/09/2019 15:55	28/09/2019 15:00	28/09/2019 14:05
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Moisture	0.1	%w/w	24.4	0.2	15.8	21.4	3.9

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Soil Parameters		Sample No	19-16504-36	19-16504-37	19-16504-38	19-16504-39	19-16504-40
		Sample Description	S29.B1	S29.B2	S30.B	S31.B	S32
		Sample Date	28/09/2019 15:01	26/09/2019 15:01	26/09/2019 16:00	26/09/2019 14:00	28/09/2019 14:10
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Moisture	0.1	%w/w	15.0	25.7	10.2	22.1	6.6

Soil Parameters		Sample No	19-16504-41	19-16504-42	19-16504-43	19-16504-44	19-16504-45
		Sample Description	S33	S34	S35	O40	O37
		Sample Date	28/09/2019 14:20	28/09/2019 08:30	28/09/2019 08:10	29/09/2019 16:10	29/09/2019 15:48
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Moisture	0.1	%w/w	4.1	21.6	18.3	0.2	4.3

Soil Parameters		Sample No	19-16504-46	19-16504-47	19-16504-48	19-16504-49	19-16504-50
		Sample Description	O38	O36	O39	TRIP 3-0	TRIP 3-1
		Sample Date	29/09/2019 16:15	29/09/2019 15:45	29/09/2019 16:05	28/09/2019	28/09/2019
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Moisture	0.1	%w/w	0.1	8.6	23.2	18.1	24.5

Soil Parameters		Sample No	19-16504-51	19-16504-52
		Sample Description	TRIP 4-0	TRIP 4-1
		Sample Date	28/09/2019	28/09/2019
ANALYTE	LOR	Units	Result	Result
Moisture	0.1	%w/w	23.4	17.9

Acid Sulfate Soils		Sample No	19-16504-1	19-16504-2	19-16504-3	19-16504-4	19-16504-5
		Sample Description	C01	C02	C03	C04	C05
		Sample Date	27/09/2019 16:15	27/09/2019 16:35	27/09/2019 17:25	28/09/2019 09:20	28/09/2019 09:00
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
pH_f (23Af)	0.1	pH units	7.8	8.0	7.8	7.7	7.5
pH_{fox} (23Bf)	0.1	pH units	6.4	7.1	6.5	7.1	6.7
Rate of Reaction			XXX	XX	XXX	XXXX	XX

Acid Sulfate Soils		Sample No	19-16504-6	19-16504-7	19-16504-8	19-16504-9	19-16504-10
		Sample Description	C06	C07	C08	C09	C10
		Sample Date	27/09/2019 14:45	28/09/2019 09:40	26/09/2019 13:50	26/09/2019 14:34	27/09/2019 15:40
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
pH_f (23Af)	0.1	pH units	8.3	7.8	7.6	8.2	8.0
pH_{fox} (23Bf)	0.1	pH units	6.3	6.5	7.2	6.6	6.6
Rate of Reaction			XX	XX	XXXX	XX	XX

Acid Sulfate Soils		Sample No	19-16504-13	19-16504-14	19-16504-15	19-16504-16	19-16504-17
		Sample Description	B11	B12.1	B12.2	B13	B14
		Sample Date	28/09/2019 10:20	27/09/2019 14:16	27/09/2019 14:16	25/09/2019 15:30	25/09/2019 16:00
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
pH_f (23Af)	0.1	pH units	8.2	8.3	8.1	9.7	9.9
pH_{fox} (23Bf)	0.1	pH units	6.8	6.7	6.4	6.5	6.6
Rate of Reaction			XX	XX	XXX	XX	XX

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Acid Sulfate Soils		Sample No	19-16504-18	19-16504-19	19-16504-20	19-16504-21	19-16504-22
		Sample Description	B15	B16.1	B16.2	B17	B18
		Sample Date	28/09/2019 13:00	28/09/2019 13:30	28/09/2019 13:30	28/09/2019 13:45	28/09/2019 15:15
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
pH_f (23Af)	0.1	pH units	9.1	9.5	8.7	8.9	9.1
pH_{fox} (23Bf)	0.1	pH units	6.8	6.5	6.7	7.0	6.6
Rate of Reaction			XX	XX	XX	XX	XX

Acid Sulfate Soils		Sample No	19-16504-23	19-16504-24	19-16504-25	19-16504-26	19-16504-27
		Sample Description	B19	B20	B21	B22.B	B23
		Sample Date	28/09/2019 15:30	28/09/2019 15:35	28/09/2019 15:40	28/09/2019 16:05	28/09/2019 15:45
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
pH_f (23Af)	0.1	pH units	9.3	9.2	8.4	8.2	8.7
pH_{fox} (23Bf)	0.1	pH units	6.4	6.7	6.9	6.6	6.6
Rate of Reaction			XX	XX	XX	XX	XX

Acid Sulfate Soils		Sample No	19-16504-28	19-16504-29	19-16504-30	19-16504-31	19-16504-32
		Sample Description	B24.B1	B24.B2	TRIP 2-0	TRIP 2-1	B25
		Sample Date	28/09/2019 12:45	28/09/2019 12:45	28/09/2019	28/09/2019	28/09/2019 12:30
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
pH_f (23Af)	0.1	pH units	9.0	8.7	8.6	8.7	9.4
pH_{fox} (23Bf)	0.1	pH units	7.0	6.5	6.9	6.9	7.1
Rate of Reaction			XX	XX	XX	XX	XX

Acid Sulfate Soils		Sample No	19-16504-33	19-16504-34	19-16504-35	19-16504-36	19-16504-37
		Sample Description	S26	S27	S28	S29.B1	S29.B2
		Sample Date	26/09/2019 15:55	28/09/2019 15:00	28/09/2019 14:05	28/09/2019 15:01	26/09/2019 15:01
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
pH_f (23Af)	0.1	pH units	8.5	7.8	9.2	8.4	8.3
pH_{fox} (23Bf)	0.1	pH units	6.6	6.7	6.5	6.6	6.6
Rate of Reaction			XX	XX	XX	XX	XX

Acid Sulfate Soils		Sample No	19-16504-38	19-16504-39	19-16504-40	19-16504-41	19-16504-42
		Sample Description	S30.B	S31.B	S32	S33	S34
		Sample Date	26/09/2019 16:00	26/09/2019 14:00	28/09/2019 14:10	28/09/2019 14:20	28/09/2019 08:30
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
pH_f (23Af)	0.1	pH units	8.2	9.2	8.9	8.3	7.9
pH_{fox} (23Bf)	0.1	pH units	6.9	6.5	6.5	6.9	6.9
Rate of Reaction			XX	XX	XX	XX	XX

Acid Sulfate Soils		Sample No	19-16504-43	19-16504-44	19-16504-45	19-16504-46	19-16504-47
		Sample Description	S35	O40	O37	O38	O36
		Sample Date	28/09/2019 08:10	29/09/2019 16:10	29/09/2019 15:48	29/09/2019 16:15	29/09/2019 15:45
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
pH_f (23Af)	0.1	pH units	8.1	9.1	9.1	8.7	9.0
pH_{fox} (23Bf)	0.1	pH units	6.7	6.7	7.2	7.0	6.4
Rate of Reaction			XX	XX	XX	XX	XX

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Acid Sulfate Soils		Sample No	19-16504-48
		Sample Description	O39
		Sample Date	29/09/2019 16:05
ANALYTE	**LOR**	**Units**	**Result**
pH_f (23Af)	0.1	pH units	8.9
pH_{fox} (23Bf)	0.1	pH units	6.7
Rate of Reaction			XX

PAH in Water		Sample No	19-16504-53	19-16504-55
		Sample Description	RINS 2	RINS 3
		Sample Date	28/09/2019 18:00	26/09/2019 18:10
ANALYTE	**LOR**	**Units**	**Result**	**Result**
Naphthalene	0.1	µg/L	<0.1	<0.1
2-Methylnaphthalene	0.1	µg/L	<0.1	<0.1
Acenaphthylene	0.1	µg/L	<0.1	<0.1
Acenaphthene	0.1	µg/L	<0.1	<0.1
Fluorene	0.1	µg/L	<0.1	<0.1
Phenanthrene	0.1	µg/L	<0.1	<0.1
Anthracene	0.1	µg/L	<0.1	<0.1
Fluoranthene	0.1	µg/L	<0.1	<0.1
Pyrene	0.1	µg/L	<0.1	<0.1
Benz(a)anthracene	0.1	µg/L	<0.1	<0.1
Chrysene	0.1	µg/L	<0.1	<0.1
Benzo(b)fluoranthene	0.1	µg/L	<0.1	<0.1
Benzo(k)fluoranthene	0.1	µg/L	<0.1	<0.1
Benzo(a)pyrene	0.1	µg/L	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	0.1	µg/L	<0.1	<0.1
Dibenz(a,h)anthracene	0.1	µg/L	<0.1	<0.1
Benzo(ghi)perylene	0.1	µg/L	<0.1	<0.1

OCOP in Water		Sample No	19-16504-53	19-16504-55
		Sample Description	RINS 2	RINS 3
		Sample Date	28/09/2019 18:00	26/09/2019 18:10
ANALYTE	**LOR**	**Units**	**Result**	**Result**
Aldrin	0.001	µg/L	<0.001	<0.001
alpha-BHC (HCH)	0.001	µg/L	<0.001	<0.001
beta-BHC (HCH)	0.001	µg/L	<0.001	<0.001
delta-BHC (HCH)	0.001	µg/L	<0.001	<0.001
Bifenthrin	0.05	µg/L	<0.05	<0.05
Bromophos Ethyl	0.005	µg/L	<0.005	<0.005
Chlordane	0.002	µg/L	<0.002	<0.002
Chlorothalonil	0.01	µg/L	<0.01	<0.01
Chlorpyrifos	0.005	µg/L	<0.005	<0.005
Diazinon	0.01	µg/L	<0.01	<0.01
Dieldrin	0.001	µg/L	<0.001	<0.001
Endosulfan I	0.001	µg/L	<0.001	<0.001
Endosulfan II	0.001	µg/L	<0.001	<0.001
Endosulfan Sulfate	0.001	µg/L	<0.001	<0.001
Endrin	0.01	µg/L	<0.01	<0.01
Ethion	0.01	µg/L	<0.01	<0.01

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OCOP in Water		Sample No	19-16504-53	19-16504-55
		Sample Description	RINS 2	RINS 3
		Sample Date	28/09/2019 18:00	26/09/2019 18:10
Fenitrothion	0.01	µg/L	<0.01	<0.01
Fipronil	0.02	µg/L	<0.02	<0.02
Hexachlorobenzene (HCB)	0.001	µg/L	<0.001	<0.001
Heptachlor Epoxide	0.001	µg/L	<0.001	<0.001
Heptachlor	0.001	µg/L	<0.001	<0.001
Lindane	0.001	µg/L	<0.001	<0.001
Malathion	0.01	µg/L	<0.01	<0.01
Methoxychlor	0.02	µg/L	<0.02	<0.02
o,p-DDT	0.001	µg/L	<0.001	<0.001
Oxychlordane	0.001	µg/L	<0.001	<0.001
p,p-DDD	0.001	µg/L	<0.001	<0.001
p,p-DDE	0.001	µg/L	<0.001	<0.001
p,p-DDT	0.001	µg/L	<0.001	<0.001
Parathion Ethyl	0.02	µg/L	<0.02	<0.02
Parathion Methyl	0.02	µg/L	<0.02	<0.02
Trifluralin	0.01	µg/L	<0.01	<0.01
Vinclozolin	0.02	µg/L	<0.02	<0.02

TRH (C_6-C_{40}) in Water		Sample No	19-16504-53	19-16504-55
		Sample Description	RINS 2	RINS 3
		Sample Date	28/09/2019 18:00	26/09/2019 18:10
ANALYTE	**LOR**	**Units**	**Result**	**Result**
TRH C_{6-9}	0.02	mg/L	<0.02	<0.02
TRH C_{6-10}	0.02	mg/L	<0.02	<0.02
TRH C_{6-10} minus BTEX (F1)	0.02	mg/L	<0.02	<0.02
TRH C_{10-14}	0.02	mg/L	<0.02	<0.02
TRH C_{15-28}	0.04	mg/L	<0.04	<0.04
TRH C_{29-36}	0.04	mg/L	<0.04	<0.04
TRH $C_{>10-16}$	0.05	mg/L	<0.05	<0.05
TRH $C_{>10-16}$ minus Naphthalene (F2)	0.05	mg/L	<0.05	<0.05
TRH $C_{>16-34}$	0.1	mg/L	<0.1	<0.1
TRH $C_{>34-40}$	0.1	mg/L	<0.1	<0.1
Benzene	0.001	mg/L	<0.001	<0.001
Toluene	0.001	mg/L	<0.001	<0.001
Ethylbenzene	0.001	mg/L	<0.001	<0.001
m/p-Xylenes	0.002	mg/L	<0.002	<0.002
o-Xylenes	0.001	mg/L	<0.001	<0.001
Naphthalene	0.005	mg/L	<0.005	<0.005

Organotins in Water		Sample No	19-16504-53	19-16504-54	19-16504-55
		Sample Description	RINS 2	RINS 1	RINS 3
		Sample Date	28/09/2019 18:00	29/09/2019 17:00	26/09/2019 18:10
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**
Monobutyl tin	5	ngSn/L	<5	<5	<5
Dibutyl tin	5	ngSn/L	<5	<5	<5
Tributyl tin	2	ngSn/L	<2	<2	<2

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Metals in Water		Sample No	19-16504-53	19-16504-54	19-16504-55
		Sample Description	RINS 2	RINS 1	RINS 3
		Sample Date	28/09/2019 18:00	29/09/2019 17:00	26/09/2019 18:10
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**
Aluminium - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01
Iron - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01
Manganese - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01
Zinc - Dissolved	0.005	mg/L	<0.005	<0.005	<0.005
Antimony - Dissolved	0.001	mg/L	<0.001	<0.001	<0.001
Arsenic - Dissolved	0.001	mg/L	<0.001	<0.001	<0.001
Chromium - Dissolved	0.001	mg/L	<0.001	<0.001	<0.001
Copper - Dissolved	0.001	mg/L	<0.001	<0.001	<0.001
Lead - Dissolved	0.001	mg/L	<0.001	<0.001	<0.001
Nickel - Dissolved	0.001	mg/L	<0.001	<0.001	<0.001
Silver - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01
Cadmium - Dissolved	0.0001	mg/L	<0.0001	<0.0001	<0.0001
Mercury - Dissolved	0.0001	mg/L	<0.0001	<0.0001	<0.0001

Result Definitions
LOR Limit of Reporting [NT] Not Tested [ND] Not Detected at indicated Limit of Reporting
* Denotes test not covered by NATA Accreditation

FOR MICROBIOLOGICAL TESTING - The data in this report may not be representative of a lot, batch or other samples and may not necessarily justify the acceptance or rejection of a lot or batch, a product recall or support legal proceedings. Tests are not routinely performed as duplicates unless specifically requested. Changes occur in the bacterial content of biological samples. Samples should be examined as soon as possible after collection, preferably within 6 hrs and must be stored at 4 degrees Celsius or below. Samples tested after 24 hrs cannot be regarded as satisfactory because of temperature abuse and variations.

ARL Group
Proudly Western Australian

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LABORATORY REPORT

Job Number: 19-19181
Revision: 00
Date: 14 November 2019

ADDRESS: **O2 Marine**
Suite 2, 4B Mews Rd
Fremantle WA 6160

ATTENTION: Claudio Del Deo

DATE RECEIVED: 13/11/2019

YOUR REFERENCE: 19WAU-0020

PURCHASE ORDER:

APPROVALS:

Sam Becker
Inorganics Manager

REPORT COMMENTS:

This report is issued by Analytical Reference Laboratory (WA) Pty Ltd. The report shall not be reproduced except in full without written approval from the laboratory.

Samples are analysed on an as received basis unless otherwise noted.

Samples were dried and ground prior to CRS analysis.
Rates of Reaction are determined by visual observation and are based on
Acid Sulphate Soils Laboratory Methods Guidelines: Section H - Table H1.1

RATES OF REACTION
Slight Reaction = X
Moderate Reaction = XX
Vigorous Reaction = XXX
Very Vigorous Reaction = XXXX

METHOD REFERENCES:

Methods prefixed with "ARL" are covered under NATA Accreditation Number: 2377
Methods prefixed with "PM" are covered under NATA Accreditation Number: 2561
Methods prefixed with "EDP" are covered under NATA Accreditation Number: 19290

Method ID	Method Description
ARL No. 135	Moisture
ARL No. 201	KCL Extractable pH and TAA
ARL No. 204	Sulfur, Calcium and Magnesium by KCl Extraction
ARL No. 205	Sulfur, Calcium and Magnesium by 4M HCl Extraction
ARL No. 207	Chromium Reducible Sulfur
ARL No. 136	Lime Equivalence in Biosolids
ARL No. 210	Acid Sulfate Soils Method Codes and Further Calculations
ARL No. 208	"Field" pH measurements
23A and 23B	QASSIT et al Method Code

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O2 Marine
Job No: 19-19181

LABORATORY REPORT
Revision: 00

Date: 14/11/19

Chromium Reducible Sulfur		Sample No	19-19181-1	19-19181-2	19-19181-3	19-19181-4
		Sample Description	BH12 7.45-7.55	BH12 8.30-8.35	BH13 5.40-5.50	BH11 10.50-10.55
		Sample Date	2/11/2019 15:20	5/11/2019 12:20	9/11/2019 12:25	11/11/2019 13:30
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**
Moisture	0.1	%w/w	17.9	14.3	11.0	13.1
pH_{KCl} (23A)	0.1	pH Units	9.6	9.4	9.3	9.3
Titratable Actual Acidity (23F)	2	mol H^+/t	<2	<2	<2	<2
Sulphidic - TAA (s-23F)	0.005	% Pyrite Sulfur	<0.005	<0.005	<0.005	<0.005
KCl Extractable Sulfur (23Ce)	0.005	% S	0.078	0.052	0.013	0.016
HCl Extractable Sulfur (20Be)	0.005	% S	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
Net Acid Soluble Sulfur (23J)	0.005	% S	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
Net Acid Soluble Sulfur (a-23J)	4	mole H^+/t	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
Net Acid Soluble Sulfur (s-23J)	0.005	% Pyrite S	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
Chromium Reducible Sulfur (22B)	0.01	% S	<0.01	<0.01	<0.01	<0.01
Chromium Reducible Sulfur (a-22B)	8	mole H^+/t	<8	<8	<8	<8
Acid Neutralising Capacity BT (19A2)	0.05	% $CaCO_3$	22	6.6	1.2	1.3
Acid Neutralising Capacity BT (a-19A2)	10	mole H^+/t	4,400	1,300	240	260
Acid Neutralising Capacity BT (s-19A2)	0.02	% Pyrite S	7.1	2.1	0.38	0.42
ANC Fineness Factor	0.5	-	1.5	1.5	1.5	1.5
Net Acidity	0.01	% S	<0.01	<0.01	<0.01	<0.01
Net Acidity	10	mole H^+/t	<10	<10	<10	<10
Liming Rate	1	kg $CaCO_3$/t	<1	<1	<1	<1
Net Acidity excluding ANC	0.01	% S	<0.01	<0.01	<0.01	<0.01
Net Acidity excluding ANC	10	mole H^+/t	<10	<10	<10	<10
Liming Rate excluding ANC	1	kg $CaCO_3$/t	<1	<1	<1	<1

Acid Sulfate Soils		Sample No	19-19181-1	19-19181-2	19-19181-3	19-19181-4
		Sample Description	BH12 7.45-7.55	BH12 8.30-8.35	BH13 5.40-5.50	BH11 10.50-10.55
		Sample Date	2/11/2019 15:20	5/11/2019 12:20	9/11/2019 12:25	11/11/2019 13:30
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**
pH_f (23Af)	0.1	pH units	8.5	8.7	8.0	8.5
pH_{fox} (23Bf)	0.1	pH units	6.5	6.5	6.4	6.5
Rate of Reaction			X	X	X	X

Result Definitions
LOR Limit of Reporting [NT] Not Tested [ND] Not Detected at indicated Limit of Reporting
* Denotes test not covered by NATA Accreditation

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ARL Group
Proudly Western Australian

LABORATORY REPORT

Job Number: 19-16504-B
Revision: 00
Date: 18 November 2019

ADDRESS: **O2 Marine**
Suite 2, 4B Mews Rd
Fremantle WA 6160

ATTENTION: Max Wellington

DATE RECEIVED: 3/10/2019

YOUR REFERENCE: 19WAU-0020 Port Hedland Spoilbank Marina

PURCHASE ORDER:

APPROVALS:

Sam Becker
Inorganics Manager

REPORT COMMENTS:

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Samples are analysed on an as received basis unless otherwise noted.

Samples were analysed on a dried and ground basis.

METHOD REFERENCES:

Methods prefixed with "ARL" are covered under NATA Accreditation Number: 2377
Methods prefixed with "PM" are covered under NATA Accreditation Number: 2561
Methods prefixed with "EDP" are covered under NATA Accreditation Number: 19290

Method ID	Method Description
ARL No. 135	Moisture
ARL No. 201	KCL Extractable pH and TAA
ARL No. 204	Sulfur, Calcium and Magnesium by KCl Extraction
ARL No. 205	Sulfur, Calcium and Magnesium by 4M HCl Extraction
ARL No. 207	Chromium Reducible Sulfur
ARL No. 136	Lime Equivalence in Biosolids
ARL No. 210	Acid Sulfate Soils Method Codes and Further Calculations

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O2 Marine
Job No: 19-16504-B

LABORATORY REPORT
Revision: 00

Date: 18/11/19

Chromium Reducible Sulfur		Sample No	19-16504-B-2	19-16504-B-15	19-16504-B-20	19-16504-B-29	19-16504-B-37
		Sample Description	C02	B12.2	B16.2	B24.B2	S29.B2
		Sample Date	27/09/2019	27/09/2019	28/09/2019	28/09/2019	26/09/2019
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Moisture	0.1	%w/w	32.0	25.0	12.3	10.9	25.2
pH_{KCl} (23A)	0.1	pH Units	9.3	9.5	9.8	9.7	9.5
Titratable Actual Acidity (23F)	2	mol H^+/t	<2	<2	<2	<2	<2
Sulphidic - TAA (s-23F)	0.005	% Pyrite Sulfur	<0.005	<0.005	<0.005	<0.005	<0.005
KCl Extractable Sulfur (23Ce)	0.005	% S	0.065	0.055	0.010	0.008	0.052
HCl Extractable Sulfur (20Be)	0.005	% S	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
Net Acid Soluble Sulfur (23J)	0.005	% S	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
Net Acid Soluble Sulfur (a-23J)	4	mole H^+/t	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
Net Acid Soluble Sulfur (s-23J)	0.005	% Pyrite S	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
Chromium Reducible Sulfur (22B)	0.01	% S	0.26	0.14	<0.01	<0.01	0.15
Chromium Reducible Sulfur (a-22B)	8	mole H^+/t	160	87	<8	<8	94
Acid Neutralising Capacity BT (19A2)	0.05	% $CaCO_3$	29	25	7.8	9.3	27
Acid Neutralising Capacity BT (a-19A2)	10	mole H^+/t	5,800	5,000	1,600	1,900	5,400
Acid Neutralising Capacity BT (s-19A2)	0.02	% Pyrite S	9.3	8.0	2.5	3.0	8.7
ANC Fineness Factor	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity	0.01	% S	<0.01	<0.01	<0.01	<0.01	<0.01
Net Acidity	10	mole H^+/t	<10	<10	<10	<10	<10
Liming Rate	1	kg $CaCO_3$/t	<1	<1	<1	<1	<1
Net Acidity excluding ANC	0.01	% S	0.26	0.14	<0.01	<0.01	0.15
Net Acidity excluding ANC	10	mole H^+/t	160	90	<10	<10	90
Liming Rate excluding ANC	1	kg $CaCO_3$/t	23	12	<1	<1	13

Result Definitions
LOR Limit of Reporting [NT] Not Tested [ND] Not Detected at indicated Limit of Reporting
* Denotes test not covered by NATA Accreditation

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Appendix E Particle Size Distribution Results

Certificate of Analysis

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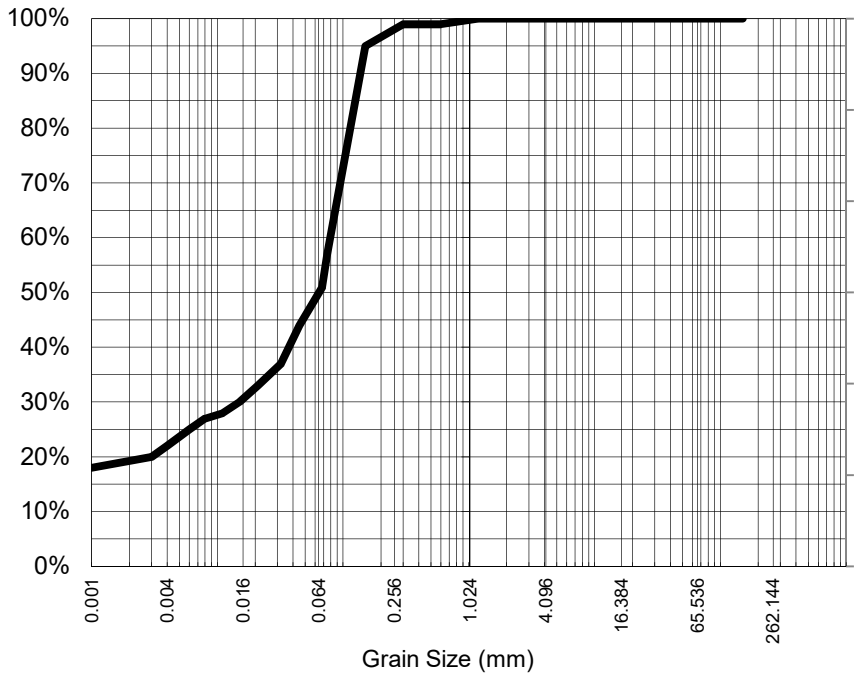
ALS Environmental

Newcastle, NSW

CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-001 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	C01

Particle Size Distribution



Particle Size (mm)	% Passing
1.18	100%
0.600	99%
0.425	99%
0.300	99%
0.150	95%
0.075	57%
Particle Size (microns)	
45	44%
32	37%
21	33%
15	30%
11	28%
8	27%
6	25%
4	22%
1	18%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.065

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

Sample Comments:

Analysed: 10-Oct-19

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, FINES, SHELL

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.77

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Dianne Blane
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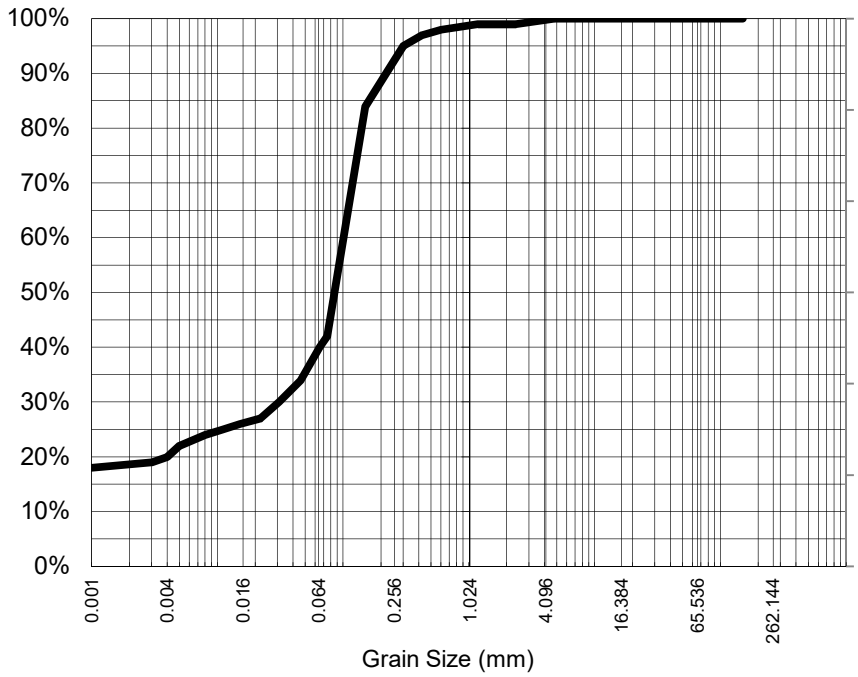
Newcastle, NSW

CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-002 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	C02

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	99%
1.18	99%
0.600	98%
0.425	97%
0.300	95%
0.150	84%
0.075	42%
Particle Size (microns)	
46	34%
31	30%
22	27%
15	26%
11	25%
8	24%
5	22%
4	20%
1	18%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.089

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

Sample Comments:		**Analysed:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.74		

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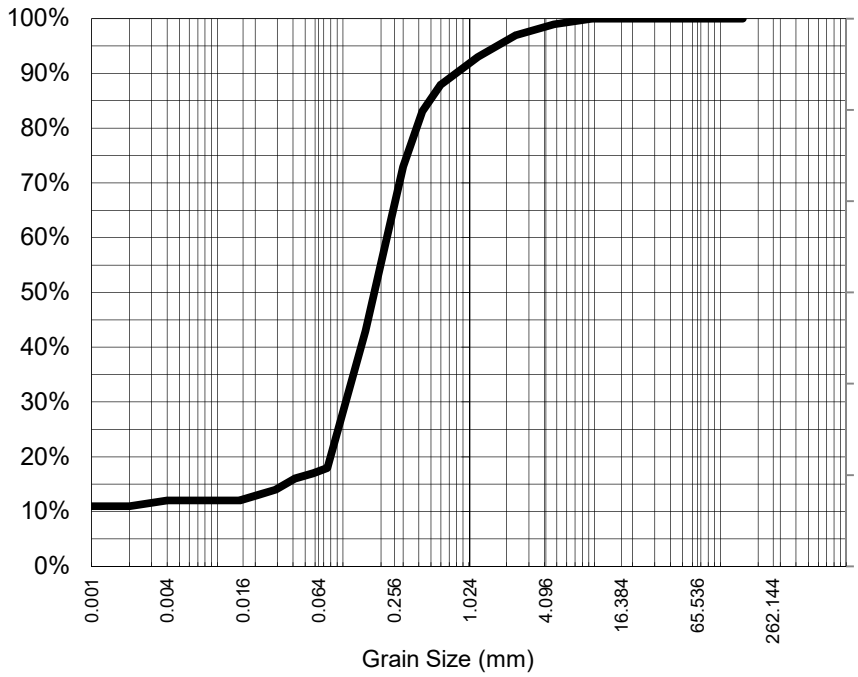
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-003 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	C03

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	99%
2.36	97%
1.18	93%
0.600	88%
0.425	83%
0.300	73%
0.150	43%
0.075	18%
Particle Size (microns)	
41	16%
29	14%
21	13%
15	12%
11	12%
8	12%
5	12%
4	12%
1	11%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.185

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

Sample Comments:		**Analysed:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.69		

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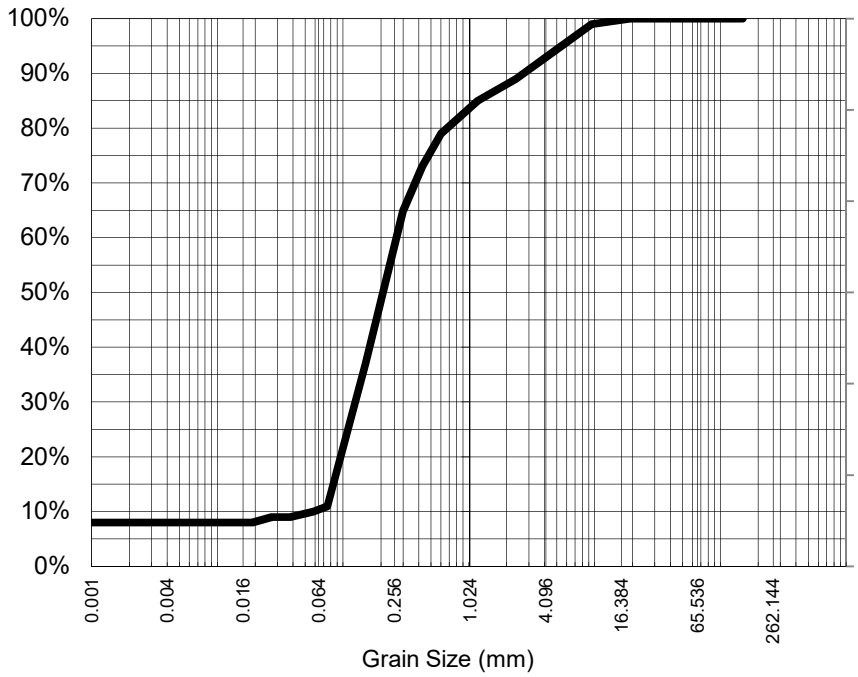
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-004 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	C04

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	99%
4.75	94%
2.36	89%
1.18	85%
0.600	79%
0.425	73%
0.300	65%
0.150	37%
0.075	11%
Particle Size (microns)	
38	9%
27	9%
19	8%
13	8%
10	8%
7	8%
5	8%
3	8%
1	8%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.220

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

Sample Comments:		**Analysed:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.69		

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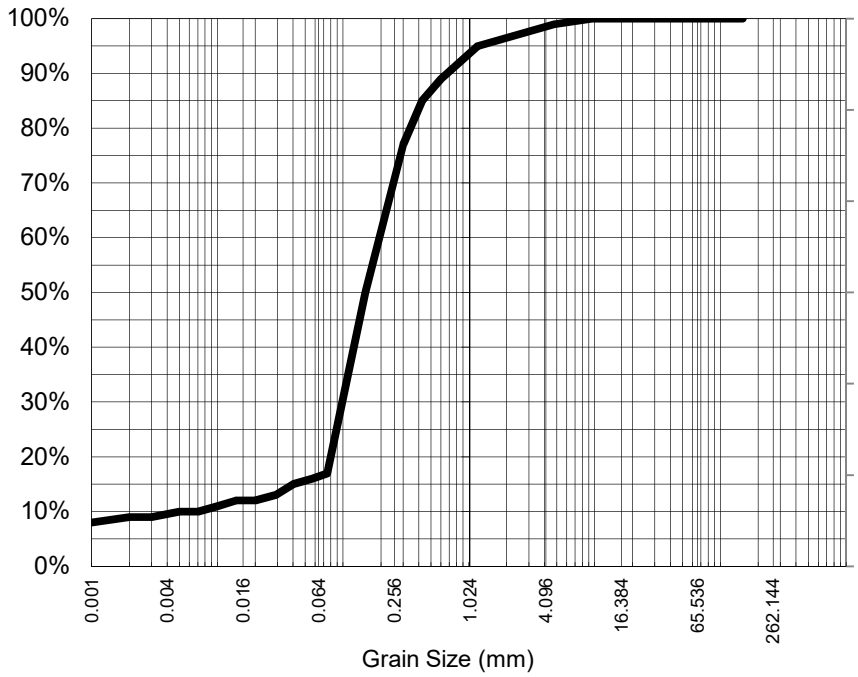
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-005 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	C05

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	99%
2.36	97%
1.18	95%
0.600	89%
0.425	85%
0.300	77%
0.150	50%
0.075	17%
Particle Size (microns)	
40	15%
29	13%
20	12%
14	12%
10	11%
7	10%
5	10%
3	9%
1	8%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.150

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

Sample Comments:		**Analysed:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.7		

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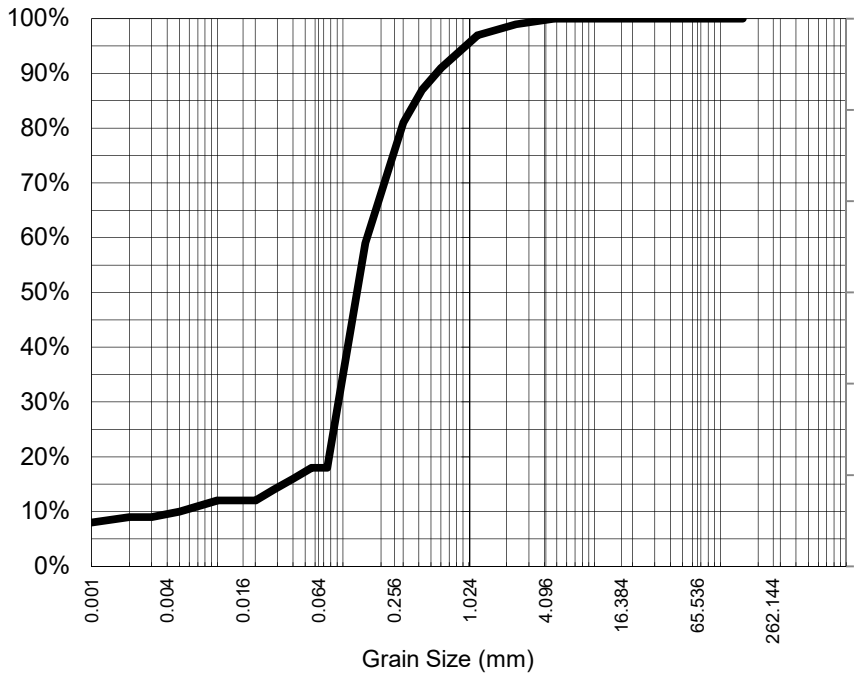
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-006 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	C06

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	99%
1.18	97%
0.600	91%
0.425	87%
0.300	81%
0.150	59%
0.075	18%
Particle Size (microns)	
40	16%
28	14%
20	12%
14	12%
10	12%
7	11%
5	10%
3	9%
1	8%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.134

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

Sample Comments:		**Analysed:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.79		

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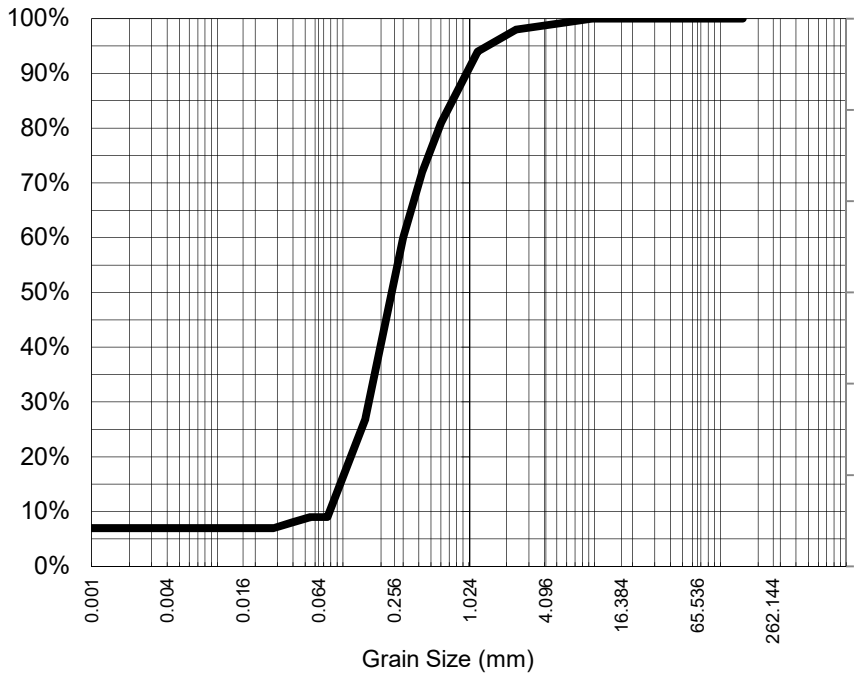
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-007 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	C07

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	99%
2.36	98%
1.18	94%
0.600	81%
0.425	72%
0.300	60%
0.150	27%
0.075	9%
Particle Size (microns)	
39	8%
28	7%
20	7%
14	7%
10	7%
7	7%
5	7%
4	7%
1	7%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.255

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.58		

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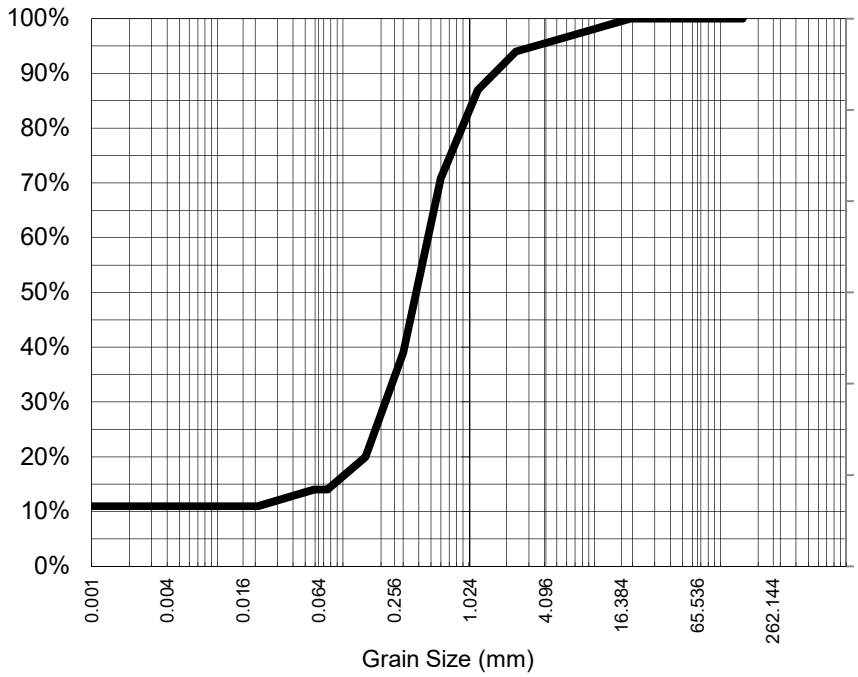
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-008 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	C08

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	98%
4.75	96%
2.36	94%
1.18	87%
0.600	71%
0.425	55%
0.300	39%
0.150	20%
0.075	14%
Particle Size (microns)	
42	13%
30	12%
21	11%
15	11%
11	11%
8	11%
5	11%
4	11%
1	11%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.386

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

Sample Comments:		**Analysed:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.64		

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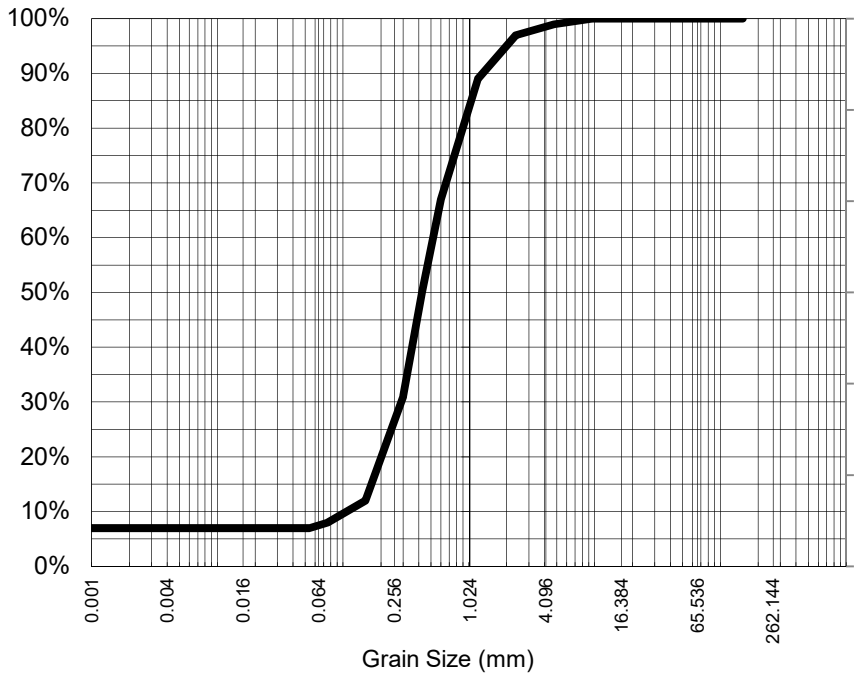
ALS Environmental

Newcastle, NSW

CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-009 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	C09

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	99%
2.36	97%
1.18	89%
0.600	67%
0.425	50%
0.300	31%
0.150	12%
0.075	8%
Particle Size (microns)	
38	7%
27	7%
19	7%
13	7%
10	7%
7	7%
5	7%
3	7%
1	7%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.425

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.67		

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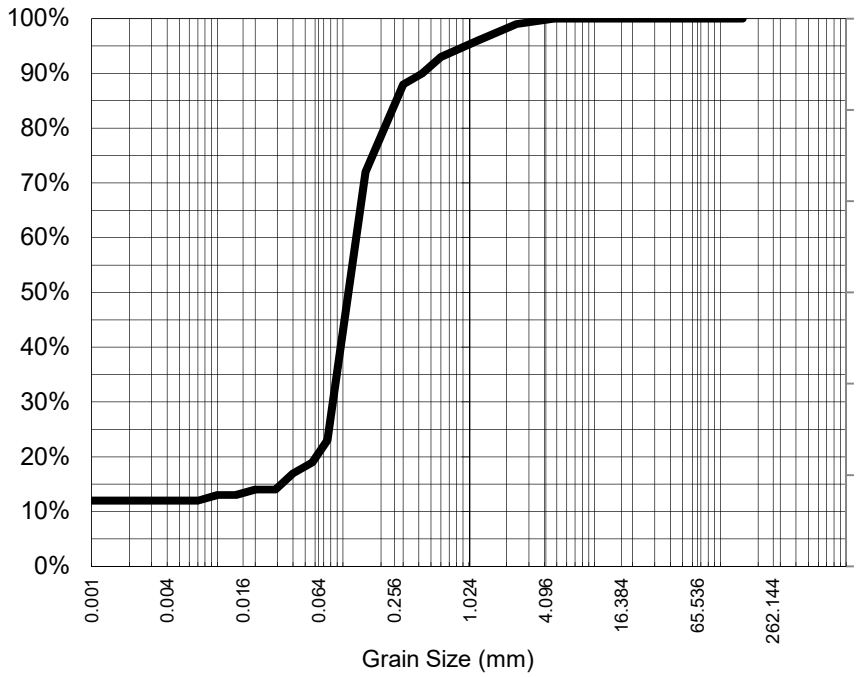
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-010 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	C10

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	99%
1.18	96%
0.600	93%
0.425	90%
0.300	88%
0.150	72%
0.075	23%
Particle Size (microns)	
40	17%
29	14%
20	14%
14	13%
10	13%
7	12%
5	12%
4	12%
1	12%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.116

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

Sample Comments:		**Analysed:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.72		

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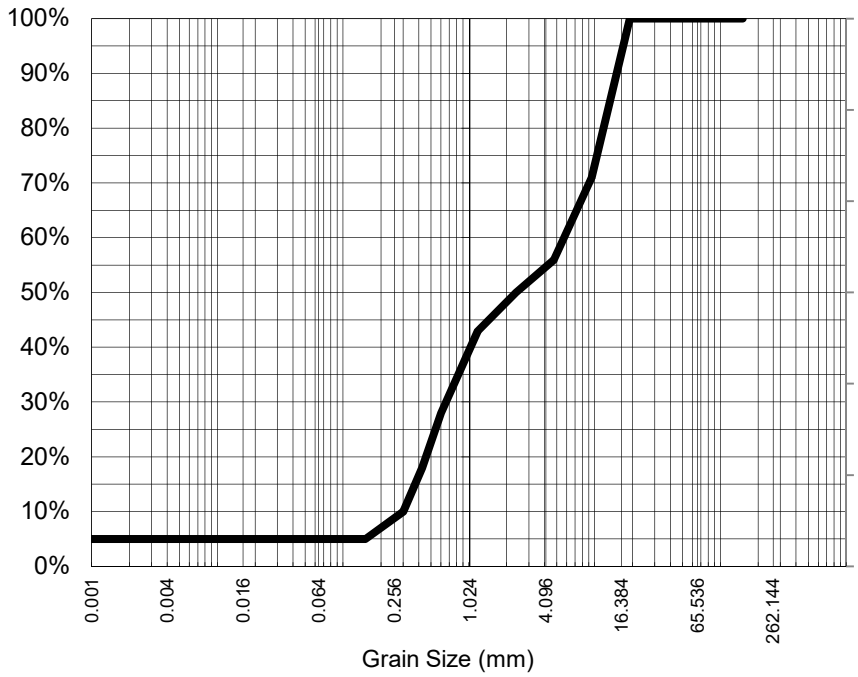
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-011 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B11

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	71%
4.75	56%
2.36	50%
1.18	43%
0.600	28%
0.425	18%
0.300	10%
0.150	5%
0.075	5%
Particle Size (microns)	
38	5%
27	5%
19	5%
13	5%
10	5%
7	5%
5	5%
3	5%
1	5%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	2.360

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.68		

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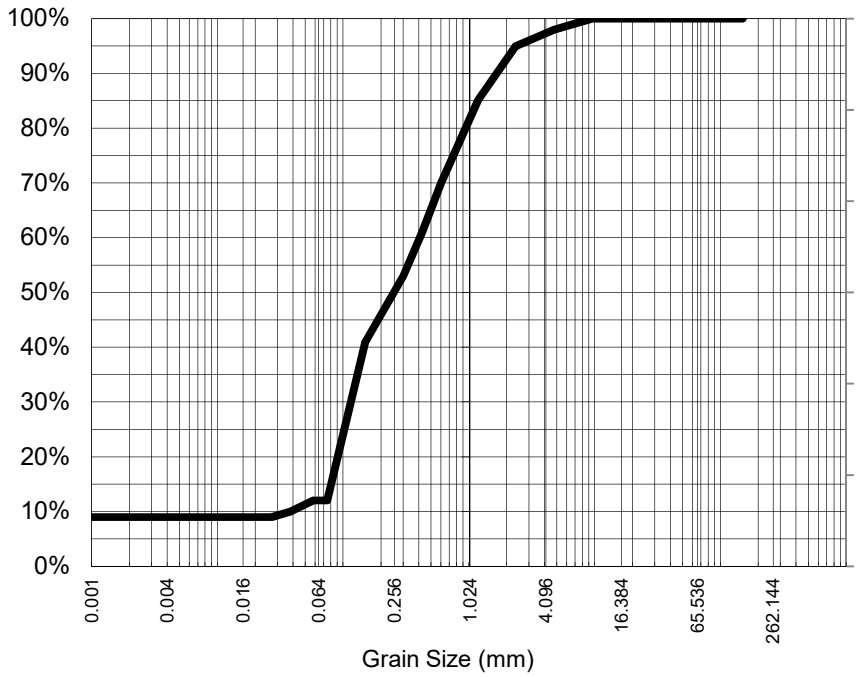
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-012 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B12-1

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	98%
2.36	95%
1.18	85%
0.600	70%
0.425	61%
0.300	53%
0.150	41%
0.075	12%
Particle Size (microns)	
38	10%
27	9%
19	9%
13	9%
10	9%
7	9%
5	9%
3	9%
1	9%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.263

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

Sample Comments:		**Analysed:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.68		

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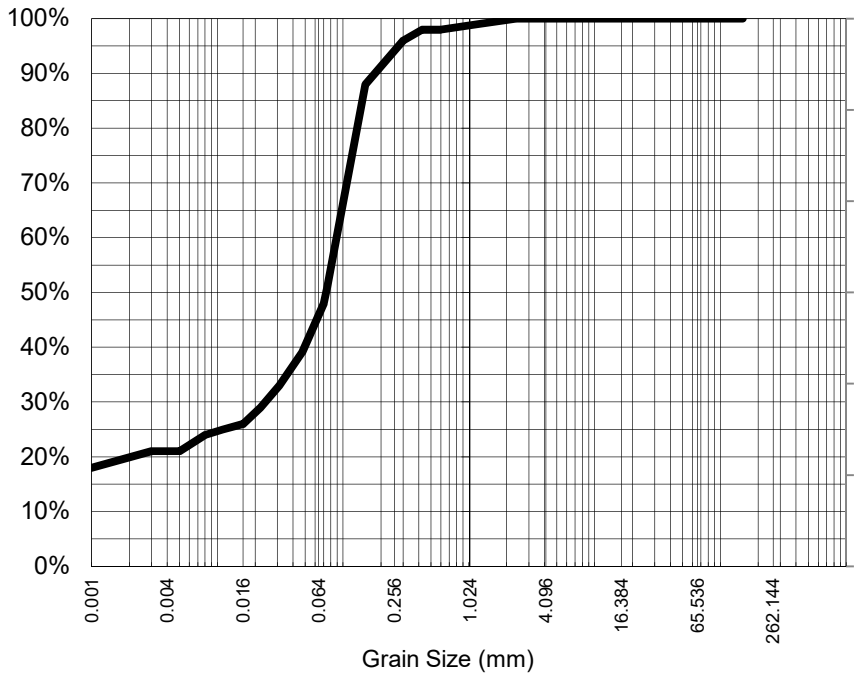
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-013 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B12-2

Particle Size Distribution



Particle Size (mm)	% Passing
2.36	100%
1.18	99%
0.600	98%
0.425	98%
0.300	96%
0.150	88%
0.075	51%
Particle Size (microns)	
47	39%
31	33%
22	29%
16	26%
11	25%
8	24%
5	21%
4	21%
1	18%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.073

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

Sample Comments:		**Analysed:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.69		

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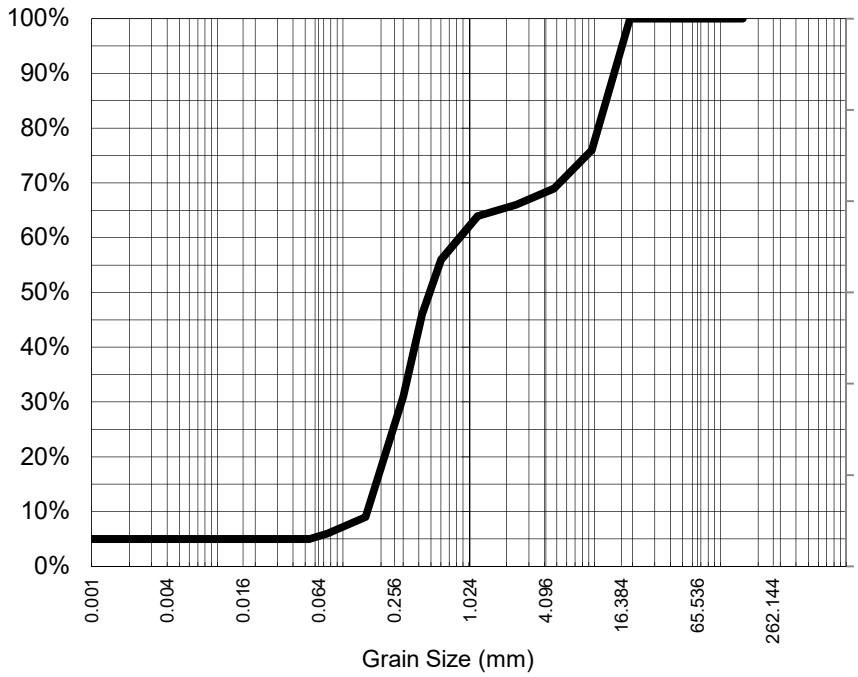
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-014 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B13

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	76%
4.75	69%
2.36	66%
1.18	64%
0.600	56%
0.425	46%
0.300	31%
0.150	9%
0.075	6%
Particle Size (microns)	
38	5%
27	5%
19	5%
13	5%
10	5%
7	5%
5	5%
3	5%
1	5%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.495

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.65		

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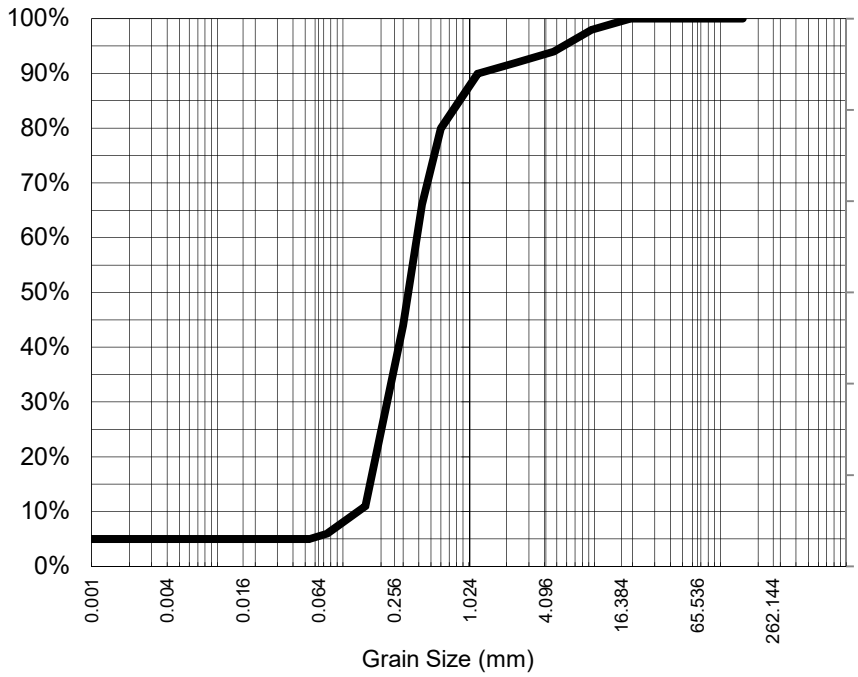
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-015 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B14

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	98%
4.75	94%
2.36	92%
1.18	90%
0.600	80%
0.425	66%
0.300	44%
0.150	11%
0.075	6%
Particle Size (microns)	
38	5%
27	5%
19	5%
13	5%
10	5%
7	5%
5	5%
3	5%
1	5%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.334

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.69		

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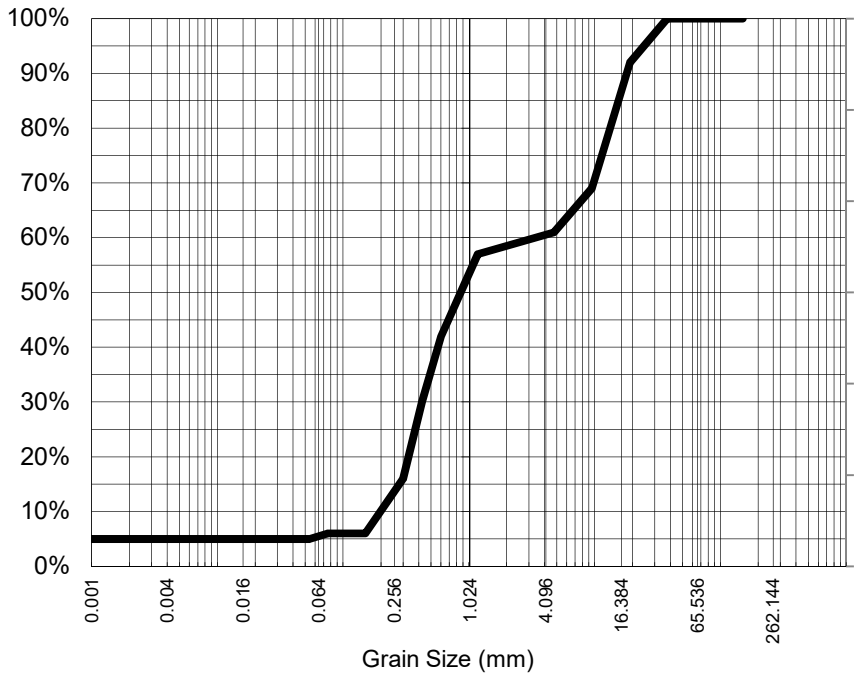
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-016 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B15

Particle Size Distribution



Particle Size (mm)	% Passing
37.5	100%
19.0	92%
9.50	69%
4.75	61%
2.36	59%
1.18	57%
0.600	42%
0.425	30%
0.300	16%
0.150	6%
0.075	6%
Particle Size (microns)	
38	5%
27	5%
19	5%
13	5%
10	5%
7	5%
5	5%
3	5%
1	5%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.909

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.67		

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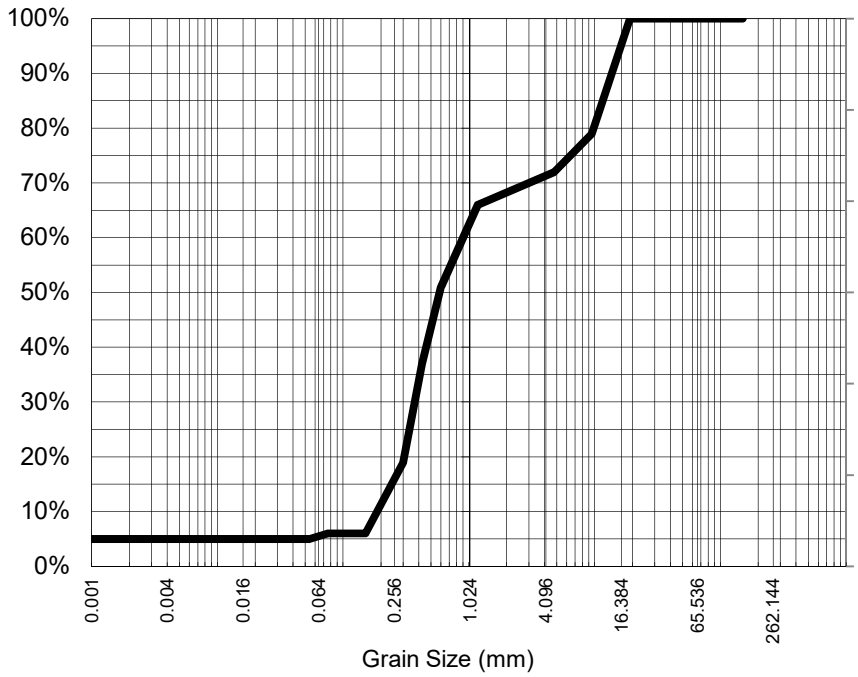
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-017 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B16-1

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	79%
4.75	72%
2.36	69%
1.18	66%
0.600	51%
0.425	37%
0.300	19%
0.150	6%
0.075	6%
Particle Size (microns)	
38	5%
27	5%
19	5%
13	5%
10	5%
7	5%
5	5%
3	5%
1	5%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.588

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.67		

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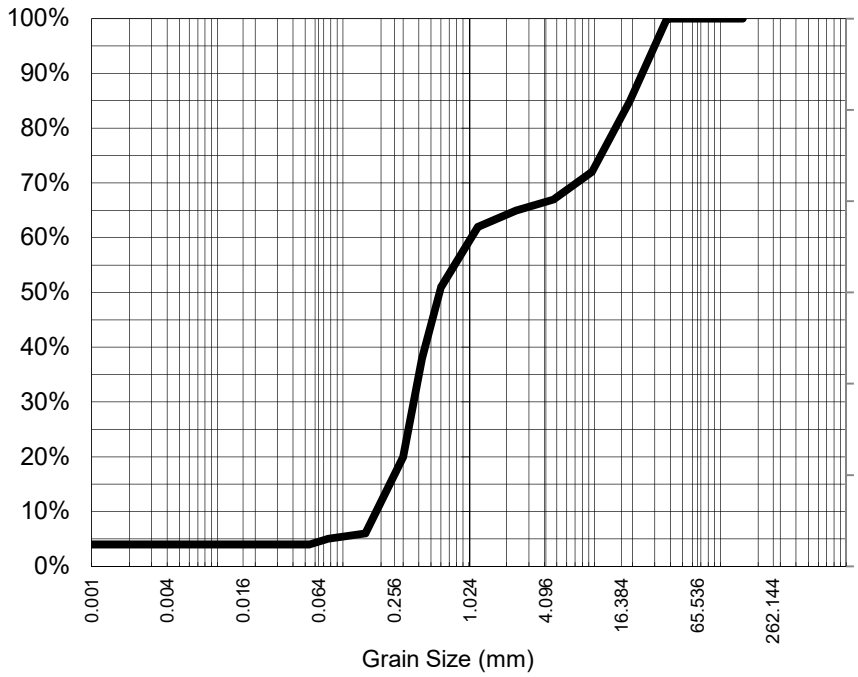
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-018 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B16-2

Particle Size Distribution



Particle Size (mm)	% Passing
37.5	100%
19.0	85%
9.50	72%
4.75	67%
2.36	65%
1.18	62%
0.600	51%
0.425	38%
0.300	20%
0.150	6%
0.075	5%
Particle Size (microns)	
38	4%
27	4%
19	4%
13	4%
10	4%
7	4%
5	4%
3	4%
1	4%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.587

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.68		

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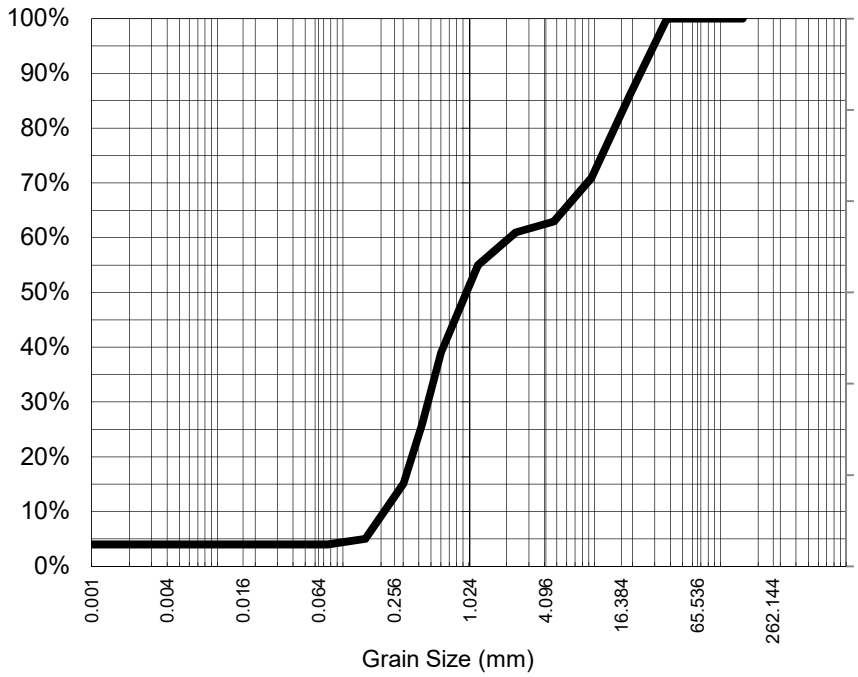
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-019 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B17

Particle Size Distribution



Particle Size (mm)	% Passing
37.5	100%
19.0	86%
9.50	71%
4.75	63%
2.36	61%
1.18	55%
0.600	39%
0.425	26%
0.300	15%
0.150	5%
0.075	4%
Particle Size (microns)	
38	4%
27	4%
19	4%
13	4%
10	4%
7	4%
5	4%
3	4%
1	4%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.999

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.65		

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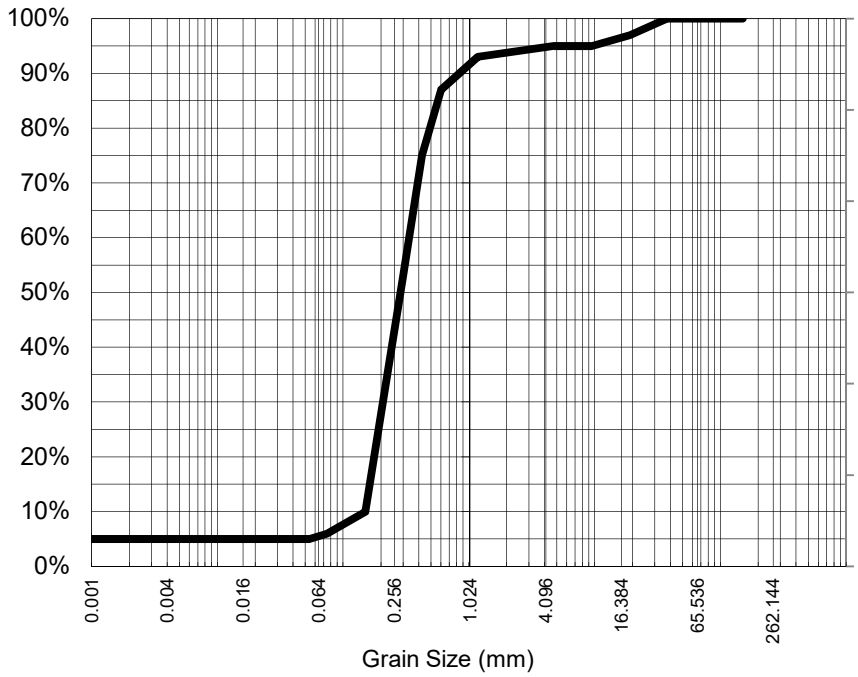
ALS Environmental

Newcastle, NSW

CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-020 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B18

Particle Size Distribution



Particle Size (mm)	% Passing
37.5	100%
19.0	97%
9.50	95%
4.75	95%
2.36	94%
1.18	93%
0.600	87%
0.425	75%
0.300	53%
0.150	10%
0.075	6%
Particle Size (microns)	
38	5%
27	5%
19	5%
13	5%
10	5%
7	5%
5	5%
3	5%
1	5%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.290

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.65		

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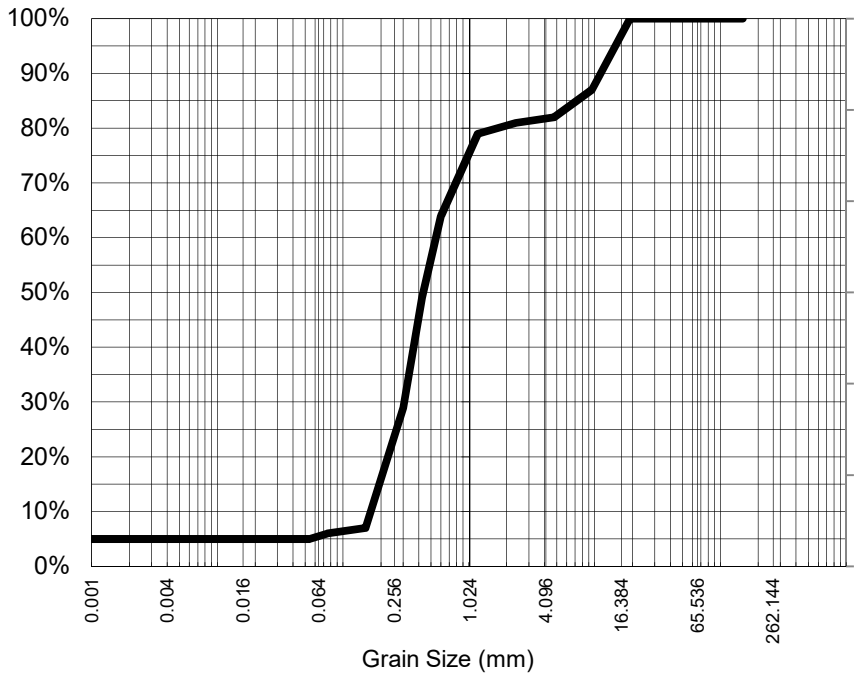
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-021 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B19

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	87%
4.75	82%
2.36	81%
1.18	79%
0.600	64%
0.425	49%
0.300	29%
0.150	7%
0.075	6%
Particle Size (microns)	
38	5%
27	5%
19	5%
13	5%
10	5%
7	5%
5	5%
3	5%
1	5%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.437

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.67		

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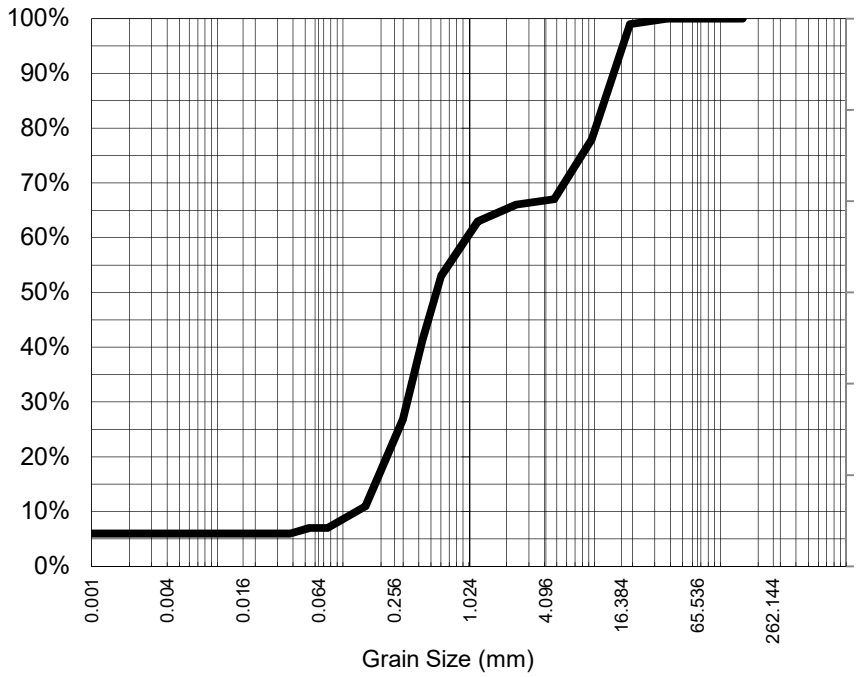
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-022 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B20

Particle Size Distribution



Particle Size (mm)	% Passing
37.5	100%
19.0	99%
9.50	78%
4.75	67%
2.36	66%
1.18	63%
0.600	53%
0.425	41%
0.300	27%
0.150	11%
0.075	7%
Particle Size (microns)	
38	6%
27	6%
19	6%
14	6%
10	6%
7	6%
5	6%
4	6%
1	6%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.556

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.64		

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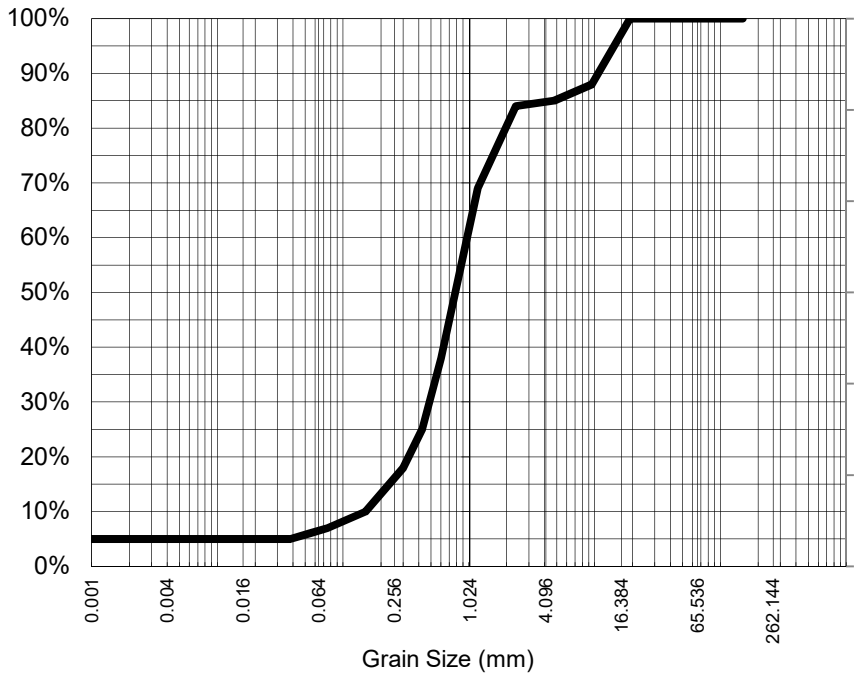
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-023 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B21

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	88%
4.75	85%
2.36	84%
1.18	69%
0.600	38%
0.425	25%
0.300	18%
0.150	10%
0.075	7%
Particle Size (microns)	
38	5%
27	5%
19	5%
13	5%
10	5%
7	5%
5	5%
3	5%
1	5%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.825

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.66		

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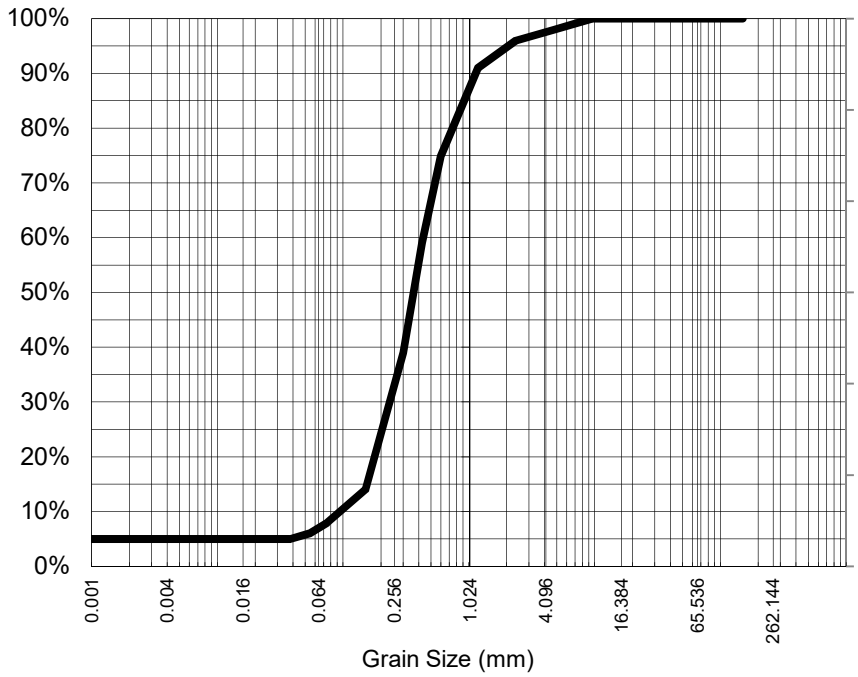
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-024 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B22-B

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	98%
2.36	96%
1.18	91%
0.600	75%
0.425	59%
0.300	39%
0.150	14%
0.075	8%
Particle Size (microns)	
38	5%
27	5%
19	5%
14	5%
10	5%
7	5%
5	5%
4	5%
1	5%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.369

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.64		

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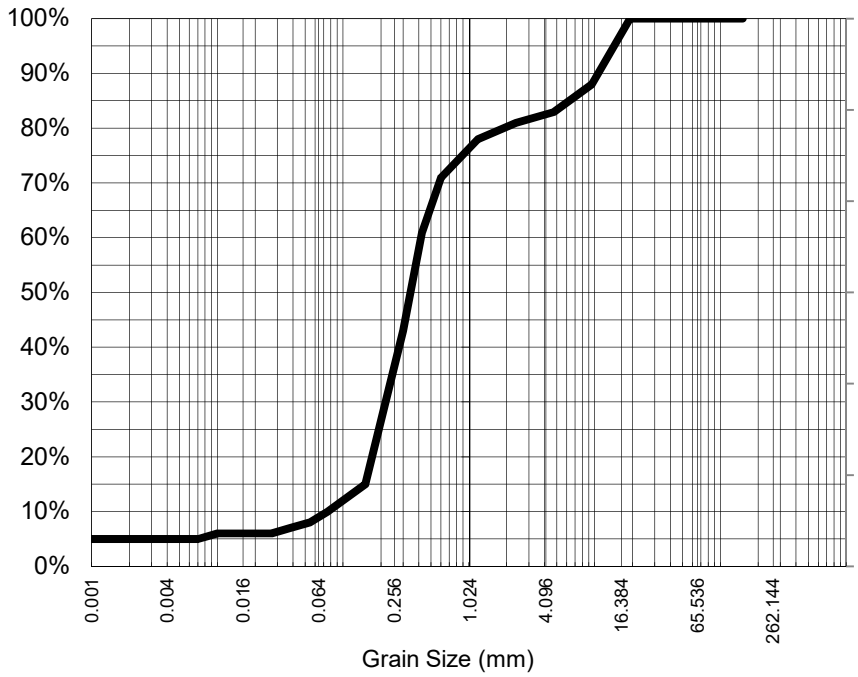
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-025 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B23

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	88%
4.75	83%
2.36	81%
1.18	78%
0.600	71%
0.425	61%
0.300	43%
0.150	15%
0.075	10%
Particle Size (microns)	
38	7%
27	6%
19	6%
13	6%
10	6%
7	5%
5	5%
3	5%
1	5%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.349

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

Sample Comments:		**Analysed:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.66		

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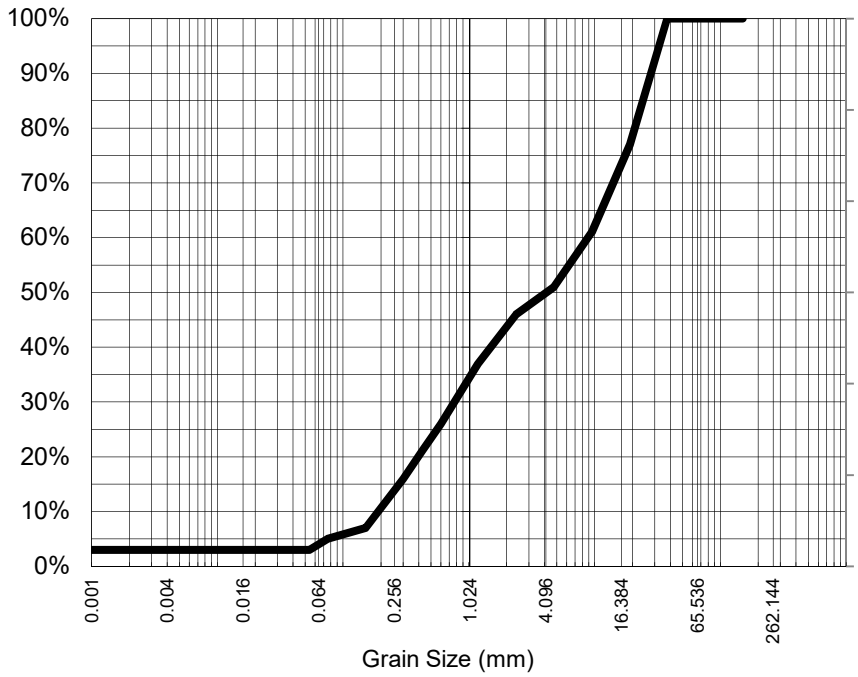
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-026 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B24-B1

Particle Size Distribution



Particle Size (mm)	% Passing
37.5	100%
19.0	77%
9.50	61%
4.75	51%
2.36	46%
1.18	37%
0.600	26%
0.425	21%
0.300	16%
0.150	7%
0.075	5%
Particle Size (microns)	
38	3%
27	3%
19	3%
13	3%
10	3%
7	3%
5	3%
3	3%
1	3%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	4.272

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.65		

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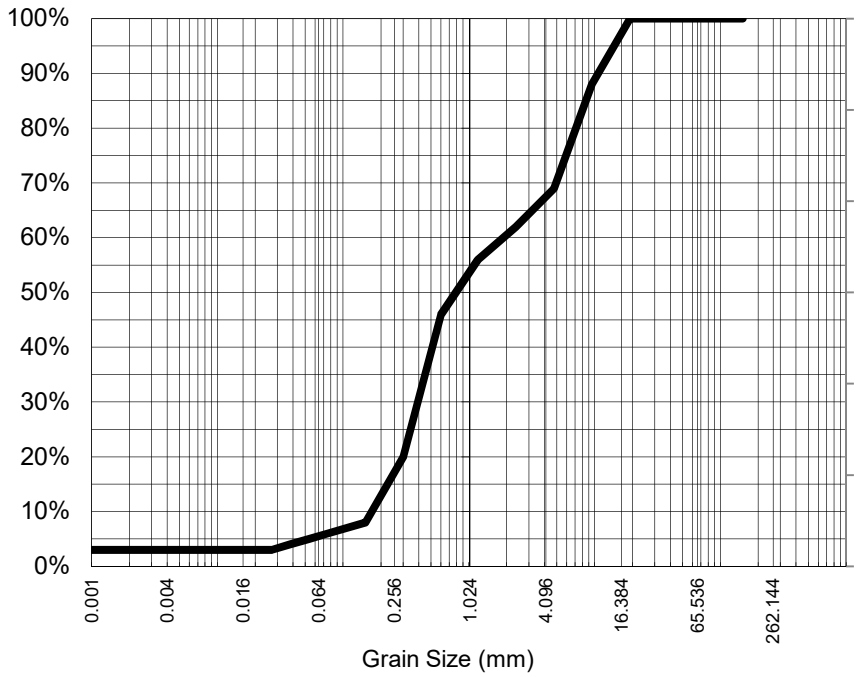
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-027 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B24-B2

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	88%
4.75	69%
2.36	62%
1.18	56%
0.600	46%
0.425	33%
0.300	20%
0.150	8%
0.075	6%
Particle Size (microns)	
38	4%
27	3%
19	3%
14	3%
10	3%
7	3%
5	3%
4	3%
1	3%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.832

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.64		

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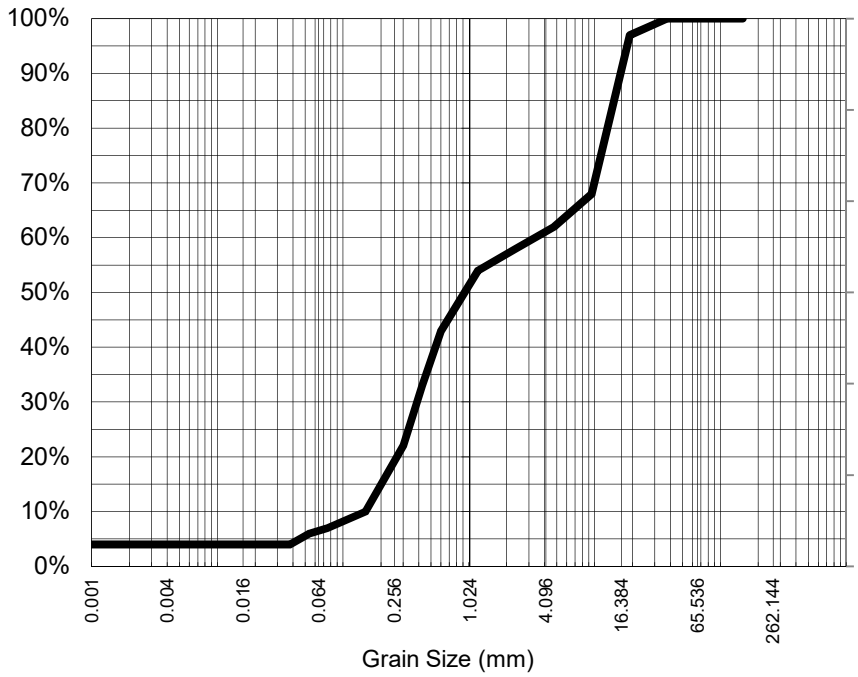
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-028 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B25

Particle Size Distribution



Particle Size (mm)	% Passing
37.5	100%
19.0	97%
9.50	68%
4.75	62%
2.36	58%
1.18	54%
0.600	43%
0.425	33%
0.300	22%
0.150	10%
0.075	7%
Particle Size (microns)	
38	4%
27	4%
19	4%
13	4%
10	4%
7	4%
5	4%
3	4%
1	4%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.969

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.67		

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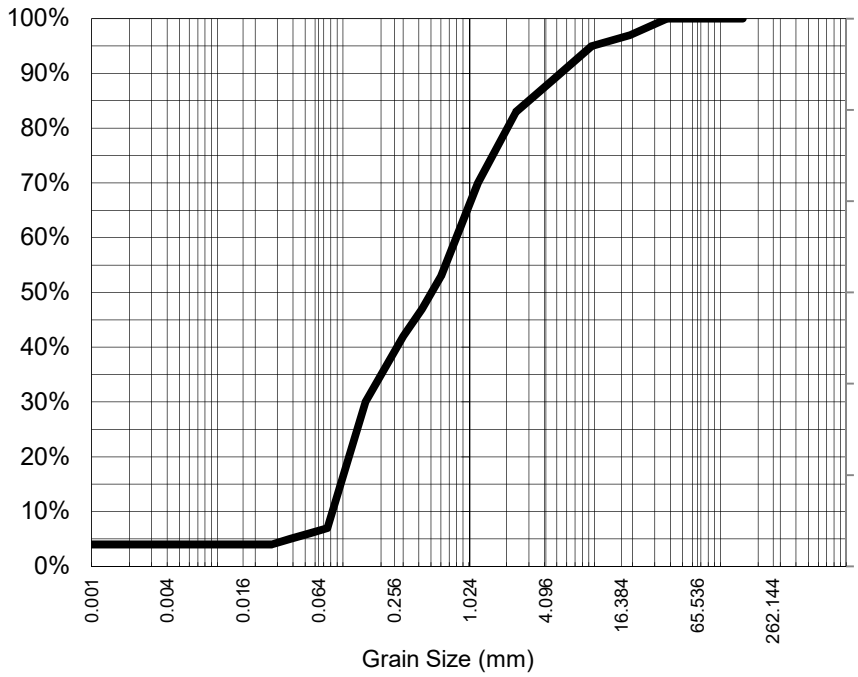
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-029 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B26

Particle Size Distribution



Particle Size (mm)	% Passing
37.5	100%
19.0	97%
9.50	95%
4.75	89%
2.36	83%
1.18	70%
0.600	53%
0.425	47%
0.300	42%
0.150	30%
0.075	7%
Particle Size (microns)	
38	5%
27	4%
19	4%
13	4%
10	4%
7	4%
5	4%
3	4%
1	4%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.513

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.65		

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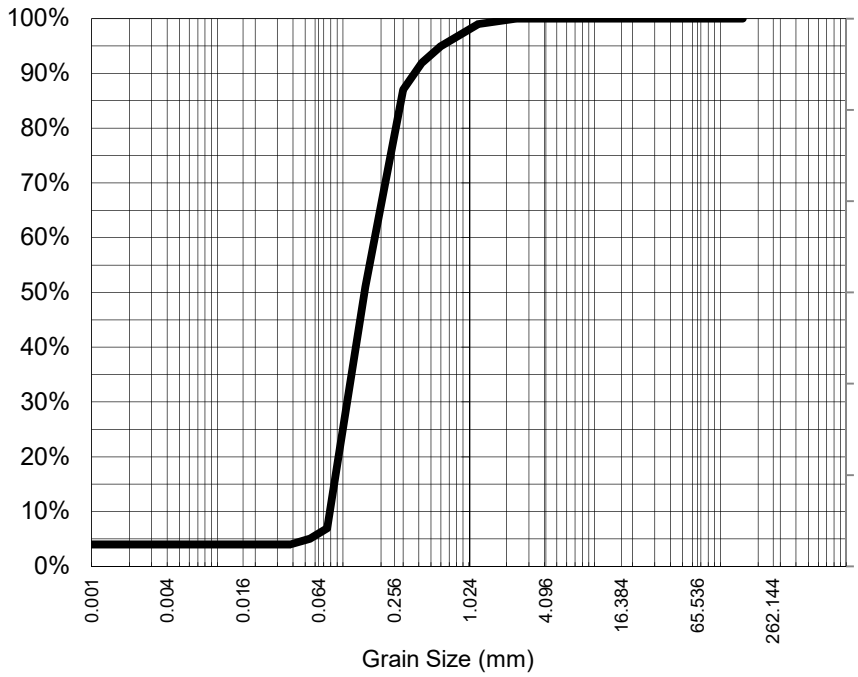
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-030 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B27

Particle Size Distribution



Particle Size (mm)	% Passing
2.36	100%
1.18	99%
0.600	95%
0.425	92%
0.300	87%
0.150	51%
0.075	7%
Particle Size (microns)	
38	4%
27	4%
19	4%
13	4%
10	4%
7	4%
5	4%
3	4%
1	4%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.148

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.67		

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WORLD RECOGNISED ACCREDITATION

Dianne Blane
Laboratory Coordinator
Authorised Signatory

Certificate of Analysis

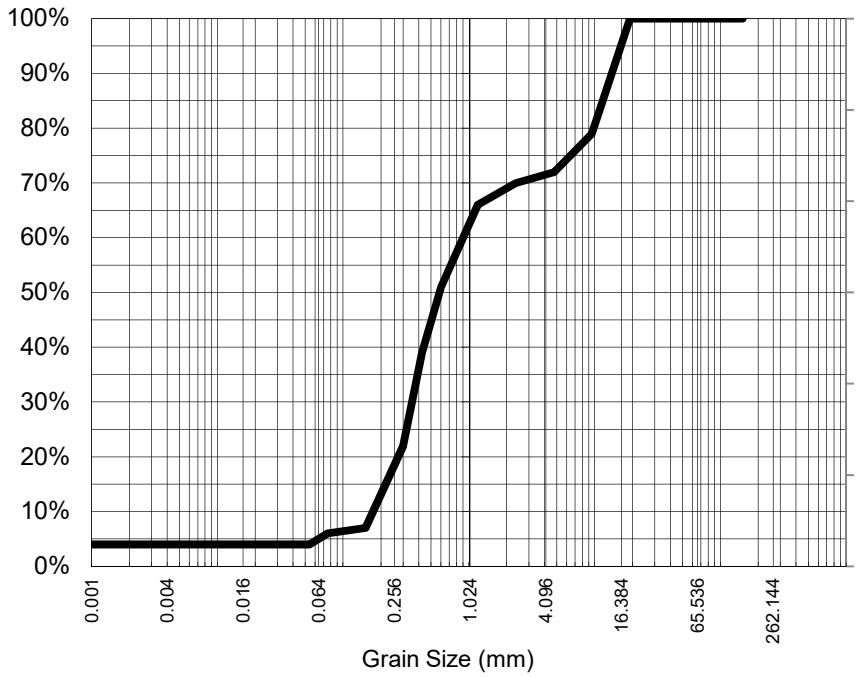
ALS Laboratory Group Pty Ltd
5/585 Maitland Road
Mayfield West, NSW 2304
pH 02 4014 2500
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-031 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	B28

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	79%
4.75	72%
2.36	70%
1.18	66%
0.600	51%
0.425	39%
0.300	22%
0.150	7%
0.075	6%
Particle Size (microns)	
38	4%
27	4%
19	4%
13	4%
10	4%
7	4%
5	4%
3	4%
1	4%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.585

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.66		

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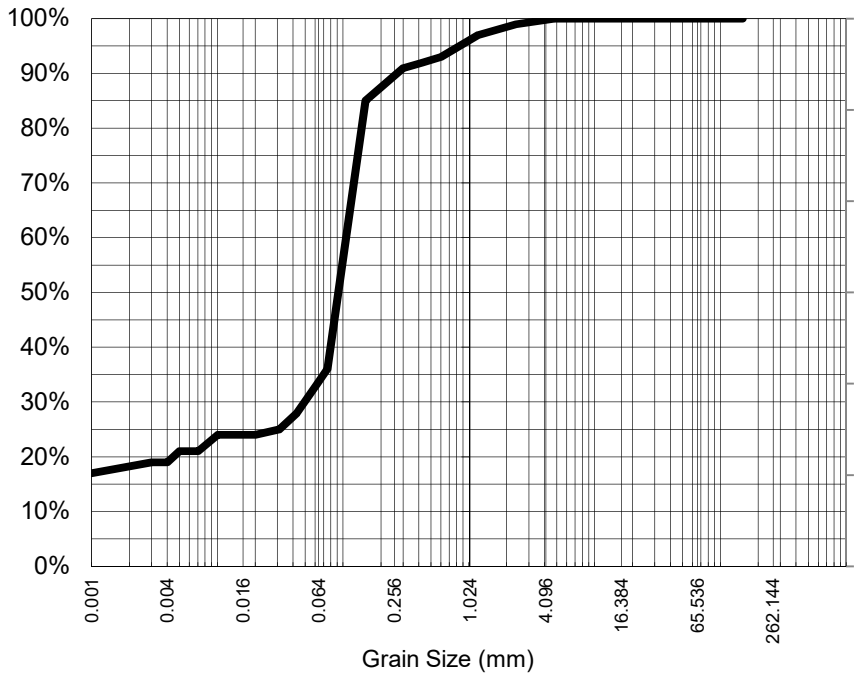
Newcastle, NSW

CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-032 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	S29-B2

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	99%
1.18	97%
0.600	93%
0.425	92%
0.300	91%
0.150	85%
0.075	36%
Particle Size (microns)	
43	28%
31	25%
20	24%
14	24%
10	24%
7	21%
5	21%
4	19%
1	17%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.096

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

Sample Comments:		**Analysed:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.73		

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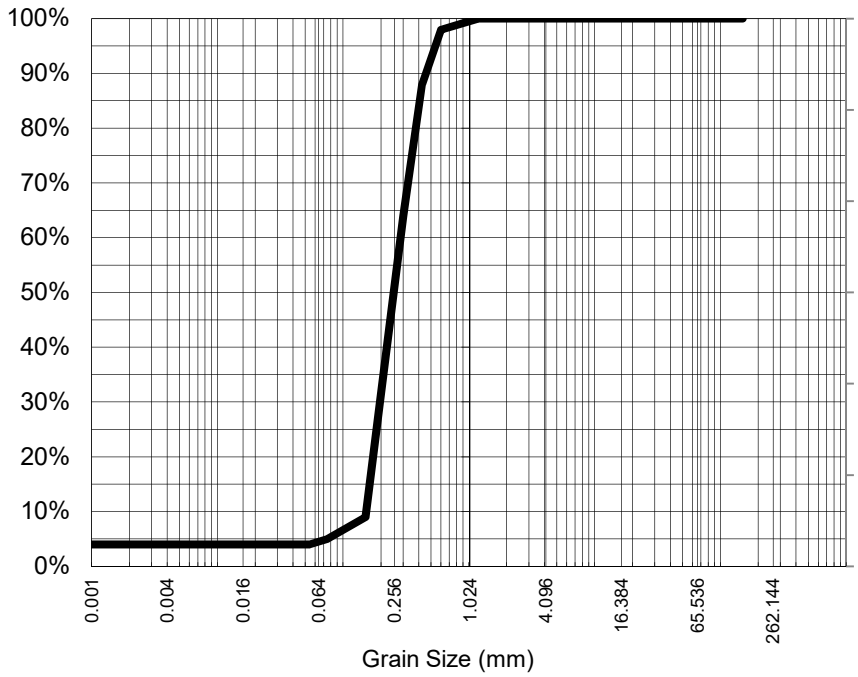
Newcastle, NSW

CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-034 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	S32

Particle Size Distribution



Particle Size (mm)	% Passing
1.18	100%
0.600	98%
0.425	88%
0.300	64%
0.150	9%
0.075	5%
Particle Size (microns)	
38	4%
27	4%
19	4%
13	4%
10	4%
7	4%
5	4%
3	4%
1	4%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.262

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.66		

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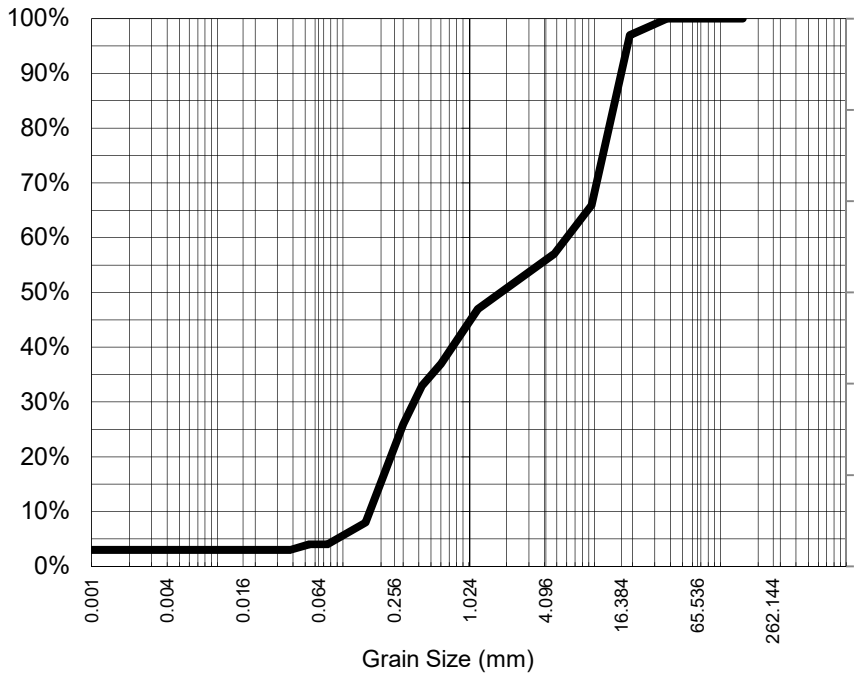
Newcastle, NSW

CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-035 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	S33

Particle Size Distribution



Particle Size (mm)	% Passing
37.5	100%
19.0	97%
9.50	66%
4.75	57%
2.36	52%
1.18	47%
0.600	37%
0.425	33%
0.300	26%
0.150	8%
0.075	4%
Particle Size (microns)	
38	3%
27	3%
19	3%
13	3%
10	3%
7	3%
5	3%
3	3%
1	3%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	1.888

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.65		

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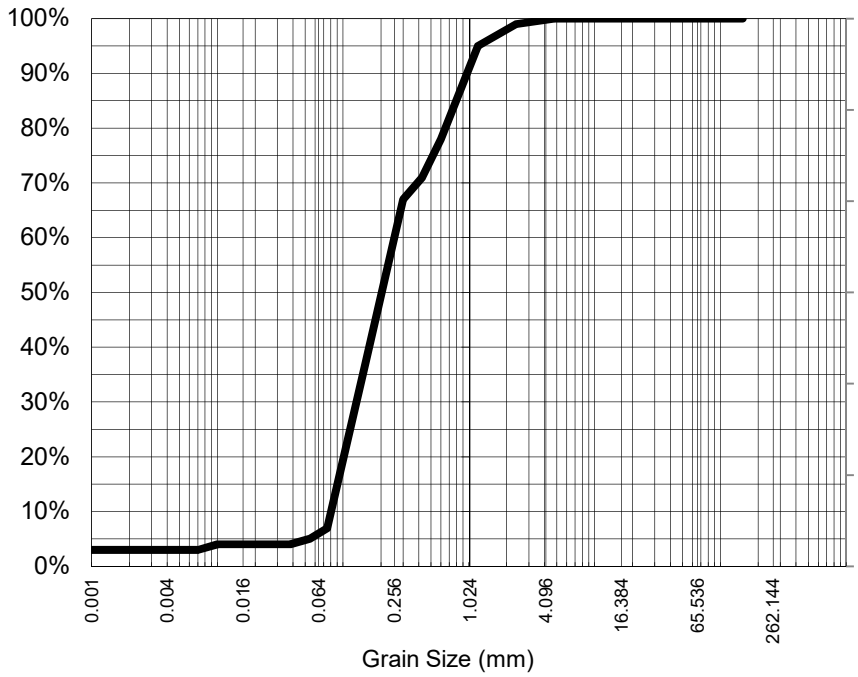
CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-036 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	S34

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	99%
1.18	95%
0.600	78%
0.425	71%
0.300	67%
0.150	37%
0.075	7%
Particle Size (microns)	
38	4%
27	4%
19	4%
14	4%
10	4%
7	3%
5	3%
4	3%
1	3%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.215

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.64		

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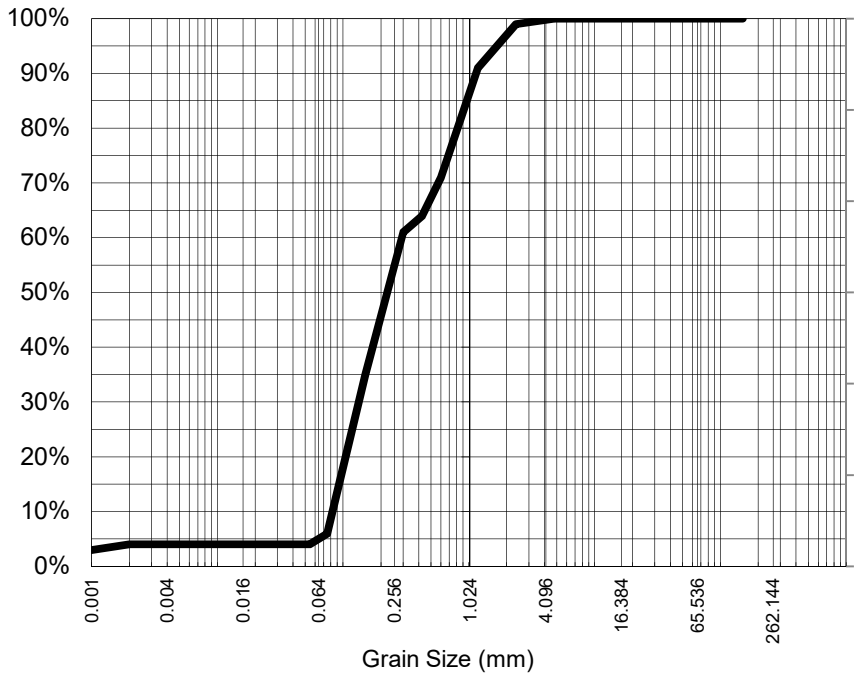
ALS Environmental

Newcastle, NSW

CLIENT:	Claudio Deldeo	**DATE REPORTED:**	14-Oct-2019
COMPANY:	WA MARINE PTY LTD	**DATE RECEIVED:**	2-Oct-2019
ADDRESS:	Suite 5, 5/18 Griffon Drive PO Box 1370 Dunsborough, Perth WA, Australia	**REPORT NO:**	EP1910036-037 / PSD
PROJECT:	19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	**SAMPLE ID:**	S35

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	99%
1.18	91%
0.600	71%
0.425	64%
0.300	61%
0.150	35%
0.075	6%
Particle Size (microns)	
38	4%
27	4%
19	4%
13	4%
10	4%
7	4%
5	4%
3	4%
1	3%

Analysis Notes

Samples analysed as received.

Median Particle Size (mm)*	0.237

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:**	10-Oct-19
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, SHELL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.66		

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Dianne Blane
Laboratory Coordinator
Authorised Signatory

Marine and Freshwater
Research Laboratory
Environmental Science
Tel: 08 93602907 Address: 90 South St, Murdoch, WA, 6150

Accreditation Number: 10603
Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations and/or measurements included is this document are traceable to Australian/national standards.

Murdoch UNIVERSITY

PARTICLE SIZE ANALYSIS REPORT

Contact: Claudio Del Deo
Customer: O2 Marine
Address: Level 1, 11 Mews Road, Fremantle, WA 6160

Date of Issue: 4/10/2019
Date Received: 1/10/2019
Our Reference: O2M19-1

Sample Name:	S29B-1
Sampling Date:	26/09/2019
Sample Type:	Sediment
MAFRL Job Code:	O2M19-1
Client Reference:	19WAU-0020
Analysis Date:	1/10/2019
Method Number:	9400

Wentworth Size Classifications	
Total Clay % (0-4µm)	**2.73**
Very Fine Silt % (4-8µm)	1.50
Fine Silt % (8-16µm)	1.58
Medium Silt % (16-31µm)	1.84
Course Silt % (31-63µm)	3.00
Total Silt (4-63µm)	**7.92**
Very Fine sand % (63-125µm)	16.07
Fine sand % (125-250µm)	22.91
Medium sand % (250-500µm)	6.29
Coarse sand % (500-1000µm)	19.45
Very Coarse sand % (1000-2000µm)	18.20
Total Sand (63-2000µm)	**82.92**
Total Gravels (>2000µm)	**6.43**

Extended range by sieving

Extended size, µm	Extended percent retained at size
500	19.45
1000	18.20
2000	4.79
4000	1.64
8000	0.00
16000	0.00

Settling Velocity calculations using Stokes Law	
Parameters	
Particle density (ρp)(g/cm^3)	2.65
Liquid density (ρf) (g/cm^3)	1.025
Acceleration due to Gravity (g) (ms^{-2})	9.81
Liquid viscosity (η) (cp)	1.074
*Liquid parameters based on seawater of 35ppt @ 20°C	
Calculations	
D50 (µm)	255.25
Minimum settling velocity of 50% of particles (mm s^1)	53.72
Time for 50% of particles to settle over 1 m (hours)	0.005
D10 (µm)	58.43
Minimum settling velocity of 90% of particles (mm s^1)	2.82
Time for 90% of particles to settle over 1 m (hours)	0.099

Settings	
SOP Name	SOP-LV-3REPS-default.msop
Analysis Model	General Purpose
Result Units	Volume
Instrument	Mastersizer3000
RI/ABS:	2.74 / 1
Dispersant	Water
Additives	10mL Sodium Hexametaphosphate
Sonication (s)	300

Sample visual assessment
Sand with some rock and mud present.

Signatory: Jamie Woodward
Date: 4/10/2019

The results only apply to the sample as received and to the sample tested.
Spare test items will be held for two months unless otherwise requested.

Marine and Freshwater
Research Laboratory
Environmental Science
Tel: 08 93602907 Address: 90 South St, Murdoch, WA, 6150

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Murdoch UNIVERSITY

PARTICLE SIZE ANALYSIS REPORT

Contact: Claudio Del Deo
Customer: O2 Marine
Address: Level 1, 11 Mews Road, Fremantle, WA 6160

Date of Issue: 4/10/2019
Date Received: 1/10/2019
Our Reference: O2M19-1

Sample Name:	S30
Sampling Date:	26/09/2019
Sample Type:	Sediment
MAFRL Job Code:	O2M19-1
Client Reference:	19WAU-0020
Analysis Date:	1/10/2019
Method Number:	9400

Wentworth Size Classifications	
Total Clay % (0-4µm)	**1.05**
Very Fine Silt % (4-8µm)	0.64
Fine Silt % (8-16µm)	0.57
Medium Silt % (16-31µm)	0.77
Course Silt % (31-63µm)	0.48
Total Silt (4-63µm)	**2.46**
Very Fine sand % (63-125µm)	7.97
Fine sand % (125-250µm)	22.86
Medium sand % (250-500µm)	11.14
Coarse sand % (500-1000µm)	10.28
Very Coarse sand % (1000-2000µm)	14.02
Total Sand (63-2000µm)	**66.26**
Total Gravels (>2000µm)	**30.24**

Extended range by sieving

Extended size, µm	Extended percent retained at size
500	10.28
1000	14.02
2000	8.01
4000	11.90
8000	10.32
16000	0.00

Settling Velocity calculations using Stokes Law	
Parameters	
Particle density (ρp)(g/cm^3)	2.65
Liquid density (ρf) (g/cm^3)	1.025
Acceleration due to Gravity (g) (ms^{-2})	9.81
Liquid viscosity (η) (cp)	1.074
*Liquid parameters based on seawater of 35ppt @ 20°C	
Calculations	
D50 (µm)	720.39
Minimum settling velocity of 50% of particles (mm s^1)	427.94
Time for 50% of particles to settle over 1 m (hours)	0.001
D10 (µm)	117.48
Minimum settling velocity of 90% of particles (mm s^1)	11.38
Time for 90% of particles to settle over 1 m (hours)	0.024

Settings	
SOP Name	SOP-LV-3REPS-default.msop
Analysis Model	General Purpose
Result Units	Volume
Instrument	Mastersizer3000
RI/ABS:	2.74 / 1
Dispersant	Water
Additives	10mL Sodium Hexametaphosphate
Sonication (s)	300

Sample visual assessment
Rocky sand with some shell and mud present.

Signatory: Jamie Woodward
Date: 4/10/2019

The results only apply to the sample as received and to the sample tested.
Spare test items will be held for two months unless otherwise requested.

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Research Laboratory
Environmental Science
Tel: 08 93602907 Address: 90 South St, Murdoch, WA, 6150

Accreditation Number: 10603
Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations and/or measurements included is this document are traceable to Australian/national standards.

Murdoch UNIVERSITY

PARTICLE SIZE ANALYSIS REPORT

Contact: Claudio Del Deo
Customer: O2 Marine
Address: Level 1, 11 Mews Road, Fremantle, WA 6160

Date of Issue: 4/10/2019
Date Received: 1/10/2019
Our Reference: O2M19-1

Sample Name:	S31B
Sampling Date:	26/09/2019
Sample Type:	Sediment
MAFRL Job Code:	O2M19-1
Client Reference:	19WAU-0020
Analysis Date:	3/10/2019
Method Number:	9400

Wentworth Size Classifications	
Total Clay % (0-4µm)	**0.01**
Very Fine Silt % (4-8µm)	0.01
Fine Silt % (8-16µm)	0.01
Medium Silt % (16-31µm)	0.01
Course Silt % (31-63µm)	0.01
Total Silt (4-63µm)	**0.04**
Very Fine sand % (63-125µm)	0.02
Fine sand % (125-250µm)	0.03
Medium sand % (250-500µm)	0.01
Coarse sand % (500-1000µm)	51.86
Very Coarse sand % (1000-2000µm)	39.19
Total Sand (63-2000µm)	**91.11**
Total Gravels (>2000µm)	**8.84**

Extended range by sieving

Extended size, µm	Extended percent retained at size
500	51.86
1000	39.19
2000	7.20
4000	1.65
8000	0.00
16000	0.00

Settling Velocity calculations using Stokes Law	
Parameters	
Particle density (ρp)(g/cm^3)	2.65
Liquid density (ρf) (g/cm^3)	1.025
Acceleration due to Gravity (g) (ms^{-2})	9.81
Liquid viscosity (η) (cp)	1.074
*Liquid parameters based on seawater of 35ppt @ 20°C	
Calculations	
D50 (µm)	981.02
Minimum settling velocity of 50% of particles (mm s^1)	793.60
Time for 50% of particles to settle over 1 m (hours)	0.000
D10 (µm)	595.37
Minimum settling velocity of 90% of particles (mm s^1)	292.30
Time for 90% of particles to settle over 1 m (hours)	0.001

Settings	
SOP Name	SOP-3REPS-default-0% obscuration.msop
Analysis Model	General Purpose
Result Units	Volume
Instrument	Mastersizer3000
RI/ABS:	2.74 / 1
Dispersant	Water
Additives	10mL Sodium Hexametaphosphate
Sonication (s)	300

Sample visual assessment
Sand with some rock and shell present.

Signatory: Jamie Woodward
Date: 4/10/2019

The results only apply to the sample as received and to the sample tested.
Spare test items will be held for two months unless otherwise requested.

Appendix F Laboratory QA/QC & Methods

Quality Control Report

Job Number: 19-16504-A

Date: 30/10/2019

Environmental and Analytical Laboratory

This Quality Control Report is issued in accordance with Section 18 of the ARL Quality Management Manual. All QC parameters are contained within the relevant ARL Method as indicated by the method reference, either on this report or the Laboratory Report.

Acceptance of Holding Times, Duplicate RPD, Spike, LCS and CRM Recoveries are determined at the time of analysis by the Signatory indicated on the Laboratory Report.

DEFINITIONS

Duplicate Analysis

A sample, chosen randomly by the analyst at the time of sample preparation, analysed in duplicate.

RPD

Relative Percent Difference is the absolute difference between the sample and a duplicate analysis compared to the average of the two analytical results. Acceptance Limits can be exceeded by matrix interference or when the result is less than 5 times the LOR.

Matrix Spike

An additional portion of sample to which known amounts of the target analytes are added before sample preparation. Acceptance Limits can be exceeded by matrix interference or when the target analytes are present in the sample.

Certified Reference Material (CRM)

A commercially available certified solution/mixture of the target analyte of known concentration.

Laboratory Control Sample (LCS)

An in-house certified solution/mixture of the target analyte of known concentration.

Analytical Reference Laboratory (WA) PTY. Ltd
46-48 Banksia Road, Welshpool, Western Australia 6106 Telephone: 08 6253 4444 Facsmile 08 6253 4440
www.arlwa.com.au ABN: 91 050 159 898

Quality Control Report

Job Number: 19-16504-A

Date: 30/10/2019

ARL
Environmental and Analytical Laboratory

TOC in Soil

Holding Time Criteria	Date	
Extracted	25/10/2019	
Analysed	25/10/2019	
Duplicate Analysis (19-16504-A-57)	**RPD (%)**	**Limits (%)**
TOC	0	200
Blank Analysis	**Result (%)**	**Limit (%)**
TOC	<0.1	0.1
Matrix Spike (19-16504-A-57)	**Recovery (%)**	**Limits (%)**
TOC	107	80 - 120
Certified Reference Material	**Recovery (%)**	**Limits (%)**
TOC	95	80 - 120

Metals in Soil and Sediment

Holding Time Criteria	Date	
Extracted	18/10/2019	
Analysed	24/10/2019	
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Aluminium	<1	1
Antimony	<2	2
Arsenic	<5	5
Cadmium	<0.1	0.1
Chromium	<1	1
Copper	<1	1
Iron	<1	1
Lead	<1	1
Manganese	<1	1
Nickel	<1	1
Silver	<1	1
Zinc	<1	1
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Aluminium	99	80 - 120
Arsenic	100	80 - 120
Cadmium	93	80 - 120
Chromium	96	80 - 120
Copper	84	80 - 120
Iron	120	80 - 120
Lead	95	80 - 120
Manganese	95	80 - 120
Nickel	80	80 - 120
Silver	94	80 - 120
Zinc	87	80 - 120

Analytical Reference Laboratory (WA) PTY. Ltd
46-48 Banksia Road, Welshpool, Western Australia 6106 Telephone: 08 6253 4444 Facsimile 08 6253 4440
www.arlwa.com.au ABN: 91 050 159 898

Quality Control Report

Job Number: 19-16504-A

Date: 30/10/2019

Environmental and Analytical Laboratory

Soil Parameters

Holding Time Criteria	Date
Analysed	24/10/19

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Quality Control Report

Job Number: 19-16504-A

Date: 30/10/2019

Environmental and Analytical Laboratory

TRH (NEPM 2013) in Soil

Holding Time Criteria	Date	
Extracted	24/10/2019	
Analysed	25/10/2019	
Duplicate Analysis (19-17576-1)	**RPD (%)**	**Limits (%)**
TRH C_{6-10}	0	200
TRH C_{6-10} minus BTEX (F1)	0	200
TRH $C_{>10-16}$	0	200
TRH $C_{>10-16}$ minus Naphthalene (F2)	0	200
TRH $C_{>16-34}$	7	50
TRH $C_{>34-40}$	15	200
Benzene	0	200
Toluene	0	200
Ethylbenzene	0	200
Xylenes (Total)	0	200
Naphthalene	0	200
Duplicate Analysis (19-17576-22)	**RPD (%)**	**Limits (%)**
TRH C_{6-10}	0	200
TRH C_{6-10} minus BTEX (F1)	0	200
TRH $C_{>10-16}$	0	200
TRH $C_{>10-16}$ minus Naphthalene (F2)	0	200
TRH $C_{>16-34}$	0	200
TRH $C_{>34-40}$	0	200
Benzene	0	200
Toluene	0	200
Ethylbenzene	0	200
Xylenes (Total)	0	200
Naphthalene	0	200
Duplicate Analysis (19-17576-29)	**RPD (%)**	**Limits (%)**
TRH C_{6-10}	0	200
TRH C_{6-10} minus BTEX (F1)	0	200
TRH $C_{>10-16}$	0	200
TRH $C_{>10-16}$ minus Naphthalene (F2)	0	200
TRH $C_{>16-34}$	32	200
TRH $C_{>34-40}$	29	200
Benzene	0	200
Toluene	0	200
Ethylbenzene	0	200
Xylenes (Total)	0	200
Naphthalene	0	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
TRH C_{6-10}	<2	2

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Quality Control Report

Job Number: 19-16504-A

Date: 30/10/2019

Environmental and Analytical Laboratory

Blank Analysis	Result (mg/kg)	Limit (mg/kg)
TRH C_{6-10} minus BTEX (F1)	<2	2
TRH $C_{>10-16}$	<20	20
TRH $C_{>10-16}$ minus Naphthalene (F2)	<20	20
TRH $C_{>16-34}$	<50	50
TRH $C_{>34-40}$	<50	50
Benzene	<0.1	0.1
Toluene	<0.1	0.1
Ethylbenzene	<0.1	0.1
Xylenes (Total)	<0.2	0.2
Naphthalene	<0.5	0.5
Laboratory Control Sample	**Recovery (%)**	**Limits (%)**
TRH C_{6-10}	81	70 - 140
TRH $C_{>10-16}$	102	70 - 140
TRH $C_{>16-34}$	101	70 - 140
TRH $C_{>34-40}$	104	70 - 140
Benzene	81	70 - 140
Toluene	83	70 - 140
Ethylbenzene	81	70 - 140
Xylenes (Total)	84	70 - 140
Naphthalene	74	70 - 140

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ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EP1910036**	Page	: 1 of 5
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	: 19WAU-0020 Port Hedland Spoilbank Marina: Sediment Sampling	Date Samples Received	: 02-Oct-2019
Order number	: ----	Date Analysis Commenced	: 04-Oct-2019
C-O-C number	: ----	Issue Date	: 14-Oct-2019
Sampler	: Claudio Deldeo		
Site	: ----		
Quote number	: EP/827/19 V3		
No. of samples received	: 42		
No. of samples analysed	: 42		

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
Diana Mesa	2IC Organic Chemist	Brisbane Organics, Stafford, QLD
Dianne Blane	Laboratory Coordinator (2IC)	Newcastle - Inorganics, Mayfield West, NSW
Vanessa Phung	Approved Asbestos Identifier	Melbourne Asbestos, Springvale, VIC

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: 2622396)									
EP1910036-010	C10	EG005-SD: Aluminium	7429-90-5	50	mg/kg	2770	2960	6.40	0% - 20%
		EG005-SD: Iron	7439-89-6	50	mg/kg	8890	10200	13.5	0% - 20%
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QC Lot: 2622395)									
EP1910036-010	C10	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 2626103)									
EP1909985-008	Anonymous	EA055: Moisture Content	----	0.1	%	53.7	54.2	0.892	0% - 20%
EP1910036-012	B12-1	EA055: Moisture Content	----	0.1	%	19.6	19.6	0.00	0% - 20%
EG020-SD: Total Metals in Sediments by ICPMS (QC Lot: 2622397)									
EP1910036-010	C10	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	0.2	<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: Arsenic	7440-38-2	1	mg/kg	8.06	12.3	41.6	0% - 50%
		EG020-SD: Chromium	7440-47-3	1	mg/kg	17.0	18.0	5.55	0% - 50%
		EG020-SD: Copper	7440-50-8	1	mg/kg	4.6	4.5	0.00	No Limit
		EG020-SD: Lead	7439-92-1	1	mg/kg	2.8	3.1	10.3	No Limit
		EG020-SD: Nickel	7440-02-0	1	mg/kg	7.5	7.8	3.82	No Limit
		EG020-SD: Zinc	7440-66-6	1	mg/kg	10.8	11.1	2.56	0% - 50%
		EG020-SD: Manganese	7439-96-5	10	mg/kg	126	168	28.8	0% - 50%
EP090: Organotin Compounds (QC Lot: 2623870)									
EM1916334-001	Anonymous	EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	0.9	0.7	31.2	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
EP1910036-010	C10	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

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 (%)*
EP090: Organotin Compounds (QC Lot: 2623870) - continued									
EP1910036-010	C10	EP090: Dibutyltin	1002-53-5	1	µgSn/kg	<1	<1	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: 2622396)								
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: 2622395)								
EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	2.154 mg/kg	112	80.0	120
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2622397)								
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	96.2	74.0	130
EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	4.6838 mg/kg	111	97.0	113
EG020-SD: Chromium	7440-47-3	1	mg/kg	<1.0	33.904 mg/kg	99.6	72.0	152
EG020-SD: Copper	7440-50-8	1	mg/kg	<1.0	33.782 mg/kg	91.6	76.0	116
EG020-SD: Lead	7439-92-1	1	mg/kg	<1.0	40.33169 mg/kg	111	74.0	124
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	96.2	81.0	135
EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	----	----	----	----
EG020-SD: Zinc	7440-66-6	1	mg/kg	<1.0	61.70999 mg/kg	108	81.0	143
EP090: Organotin Compounds (QCLot: 2623870)								
EP090: Monobutyltin	78763-54-9	1	µgSn/kg	<1	1.25 µgSn/kg	73.9	36.0	128
EP090: Dibutyltin	1002-53-5	1	µgSn/kg	<1	1.25 µgSn/kg	94.6	42.0	132
EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	1.25 µgSn/kg	105	52.0	139

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**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES (QCLot: 2622396)							
EP1910036-012	B12-1	EG005-SD: Aluminium	7429-90-5	50 mg/kg	# Not Determined	70.0	130
		EG005-SD: Iron	7439-89-6	50 mg/kg	# Not Determined	70.0	130
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QCLot: 2622395)							
EP1910036-012	B12-1	EG035T-LL: Mercury	7439-97-6	10 mg/kg	101	70.0	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*
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 2622397)							
EP1910036-012	B12-1	EG020-SD: Arsenic	7440-38-2	50 mg/kg	90.4	70.0	130
		EG020-SD: Cadmium	7440-43-9	50 mg/kg	100	70.0	130
		EG020-SD: Chromium	7440-47-3	50 mg/kg	81.6	70.0	130
		EG020-SD: Copper	7440-50-8	50 mg/kg	83.3	70.0	130
		EG020-SD: Lead	7439-92-1	50 mg/kg	99.2	70.0	130
		EG020-SD: Nickel	7440-02-0	50 mg/kg	80.6	70.0	130
		EG020-SD: Zinc	7440-66-6	50 mg/kg	87.8	70.0	130
EP090: Organotin Compounds (QCLot: 2623870)							
EM1916334-006	Anonymous	EP090: Monobutyltin	78763-54-9	1.25 µgSn/kg	# 0.775	20.0	130
		EP090: Dibutyltin	1002-53-5	1.25 µgSn/kg	# 11.4	20.0	130
		EP090: Tributyltin	56573-85-4	1.25 µgSn/kg	56.9	20.0	130

Appendix G Chain of Custody Forms

Chain of Custody (CoC) Record

Project:	Port Hedland Spoilbank Marina: Sediment Sampling			**Laboratory:**	ARL																**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. LoR as required by NAGD 2009	
Client:	DoT	**Job No.:**	19WAU-0020	**Address:**	46-48 Banksia Road, WELSHPOOL, WA, 6106																	
Lab Quote No.:	O2M220819	**Turnaround Time:**	Quick	**Lab. Contact:**	Kim Rogers 8 6253 4444																	
O2M Project Manager	Claudio Del Deo	**Email Address:**	claudio.deldeo@o2marine.com.au		**Containers**				**Analyse = A; Hold = H**													
O2M Sample ID	**Laboratory Sample ID**	**Date**	**Time**	**Sample Matrix** S-Soil / SL-Sludge / W-Water / A-Air / B-Benthic Sieved	**Type** B-Bottle / J-Jar / V-Vial / G-Glass / P-Plastic Bag	**No. of Samples**	**Total Volume (mL)**	Metals (Al, Fe, Mg, Cr, Cu, Pb, Ni, Zn, Sb, As, Cd, Ag, Hg)	Moisture	TOC	TRH (BTEX)	NEPM TRH	NAGD PAH's	NAGD OCP, OPP Pesticides	Organotins (TBT, DBT, MBT)	PASS (Field pH)_	Cr Reducible Sulphur Suite	**Comments**				
C01		27.9.19	16:15	S	2J,1P	3	750	A	A	A	A	A	A	A	A	A	H	All Soil samples are marine sediment *				
C02 ###		27.9.19	16:35	S	2J,1P	3	750	A	A	A	A	A	A	A	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required *				
C03		27.9.19	17:25	S	2J,1P	3	750	A	A	A	A	A	A	A	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required				
C04		28.9.19	09:20	S	2J,1P	3	750	A	A	A	A	A	A	A	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required *				
C05		28.9.19	09:00	S	2J,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required				
C06		27.9.19	14:45	S	2J,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required				
C07		28.9.19	09:40	S	2J-1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required				
C08 ###		26.9.19	13:50	S	2J-1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required				
C09		26.9.19	14:34	S	2J,1P	3	750	A	A	A	A	A	A	A	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required *				
C10		27.9.19	15:40	S	2J,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required				
TRIP 1-0		27.9.19	—	S	2J	2	500	A	A	A	#	H	H	H	A	#	#	After analysis samples shall be hold by the lab in case additionhal analysis are required				
TRIP 1-1		27.9.19	—	S	2J	2	500	A	A	A	—	—	—	—	A	—	H	After analysis samples shall be hold by the lab in case additionhal analysis are required				

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

* Use Sample marked "VOL" for volatile analysis.

Chain of Custody (CoC) Record

Project:	Port Hedland Spoilbank Marina: Sediment Sampling		
Client:	DoT	**Job No.:**	19WAU-0020
Lab Quote No.:	O2M220819	**Turnaround Time:**	Quick
O2M Project Manager	Claudio Del Deo	**Email Address:**	claudio.deldeo@o2marine.com.au

Laboratory:	ARL
Address:	46-48 Banksia Road, WELSHPOOL, WA, 6106
Lab. Contact:	Kim Rogers 8 6253 4444

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.
LoR as required by NAGD 2009

O2M Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix (S-Soil / SL-Sludge / W-Water / A-Air / B-Benthic Sieved)	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 (Al, Fe, Mg, Cr, Cu, Pb, Ni, Zn, Sb, As, Cd, Ag, Hg)	Moisture	TOC	TRH (BTEX)	NEPM TRH	NAGD PAH's	NAGD OCP, OPP Pesticides	Organotins (TBT, DBT, MBT)	PASS (Field pH)_	Cr Reducible Suiphur Suite	Comments
B11		28.9.19	10:20	S	ZJ,1P	3	750	A	A	A	H	H	H	H	A	A	H	All Soil samples are marine sediment
B12.1		27.9.19	14:16	S	ZJ,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
B12.2		27.9.19	14:16	S	ZJ,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
B13		25.9.19	15:30	S	ZJ,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
B14		25.9.19	16:00	S	ZJ,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
B15		28.9.19	13:00	S	ZJ,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
B16-1		28.9.19	13:30	S	ZJ,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
B16-2		28.9.19	13:30	S	ZJ,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
B17		28.9.19	13:45	S	ZJ,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
B18		28.9.19	15:15	S	ZJ,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
B19		28.9.19	15:30	S	ZJ,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
B20		28.9.19	15:35	S	ZJ,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required

Sampled By:	C. DEL DEO	**Date/Time:**	29.9.19	**Relinquished By:**	
Received By Lab:		**Date/Time:**		**Courier:**	
Sample Cold (Yes/No):		**Sample Container Sealed (Yes/No):**			

Chain of Custody (CoC) Record

Project:	Port Hedland Spoilbank Marina: Sediment Sampling		
Client:	DoT	**Job No.:**	19WAU-0020
Lab Quote No.:	O2M220819	**Turnaround Time:**	Quick
O2M Project Manager	Claudio Del Deo	**Email Address:**	claudio.deldeo@o2marine.com.au

Laboratory:	ARL
Address:	46-48 Banksia Road, WELSHPOOL, WA, 6106
Lab. Contact:	Kim Rogers 8 6253 4444

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.
LoR as required by NAGD 2009

O2M Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix (S-Soil / SL-Sludge / W-Water / A-Air / B-Benthic Sieved)	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 (Al, Fe,Mg,Cr, Cu,Pb,Ni,Zn,Sb,As,Cd,Ag,Hg)	Moisture	TOC	TRH (BTEX)	NEPM TRH	NAGD PAH's	NAGD OCP, OPP Pesticides	Organotins (TBT, DBT,MBT)	PASS (Field pH)_	Cr Reducible Sulphur Suite	Comments
B21		28-9-19	15:40	S	2J,1P	3	750	A	A	A	H	H	H	H	A	A	H	All Soil samples are marine sediment
B22-B		28-9-19	16:05	S	2J,1P	3	750	A	A	A	A	A	A	A	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
B23		28-9-19	15:45	S	2J,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
B24-B1		28-9-19	12:45	S	2J,1P	3	750	A	A	A	A	A	A	A	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required *
B24-B2		28-9-19	12:45	S	2J,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
TRIP 2-0		28-9-19	—	S	2J	2	500	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
TRIP 2-1		28-9-19	—	S	2J	2	500	A	A	A	H	H	H	H	A	—	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
B25		28-9-19	12:30	S	2J,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
S26		26-9-19	15:55	S	2J,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
S27		28-9-19	15:00	S	2J,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
S28		28-9-19	14:05	S	2J,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
S29B-1		26-9-19	15:01	S	2J,1P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required

Sampled By:	C. Del Deo	**Date/Time:**	29-9-19
Received By Lab:		**Date/Time:**	
Sample Cold (Yes/No):		**Sample Container Sealed (Yes/No):**	

Relinquished By:

Courier:

* Use Sample marked "VOL" for volatile analysis.

Chain of Custody (CoC) Record

Project:	Port Hedland Spoilbank Marina: Sediment Sampling		
Client:	DoT	**Job No.:**	19WAU-0020
Lab Quote No.:	O2M220819	**Turnaround Time:**	Quick
O2M Project Manager	Claudio Del Deo	**Email Address:**	claudio.deldeo@o2marine.com.au

Laboratory:	ARL
Address:	46-48 Banksia Road, WELSHPOOL, WA, 6106
Lab. Contact:	Kim Rogers 8 6253 4444

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O2M Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix (S-Soil / SL-Sludge / W-Water / A-Air / B-Benthic Sieved)	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 (Al, Fe, Mg, Cr, Cu, Pb, Ni, Zn, Sb, As, Cd, Ag, Hg)	Moisture	TOC	TRH (BTEX)	NEPM TRH	NAGD PAH's	NAGD OCP, OPP Pesticides	Organotins (TBT, DBT, MBT)	PASS (Field pH)_	Cr Reducible Sulphur Suite	Comments
S29-B2		26.9.19	15:01	S	J,P	3	750	A	A	A	H	H	H	H	A	A	H	All Soil samples are marine sediment
S30 B		26.9.19	16:00	S	J,P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
S31 B		26.9.19	14:00	S	J,P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
S32		28.9.19	14:10	S	J,P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
S33		28.9.19	14:20	S	J,P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
S34		28.9.19	8:30	S	J,P	3	750	A	A	A	A	A	A	A	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
S35		28.9.19	8:10	S	J,P	3	750	A	A	A	H	H	H	H	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
040		29.9.19	16:10	S	J,P	3	750	A	A	A	A	A	A	A	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
037		29.9.19	15:48	S	J,P	3	750	A	A	A	A	A	A	A	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
038		29.9.19	16:15	S	J,P	3	750	A	A	A	A	A	A	A	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
036		29.9.19	15:45	S	J,P	3	750	A	A	A	A	A	A	A	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
039		29.9.19	16:05	S	J,P	3	750	A	A	A	A	A	A	A	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required *

Sampled By:	C. Del Deo	**Date/Time:**	29.9.19
Received By Lab:		**Date/Time:**	
Sample Cold (Yes/No):		**Sample Container Sealed (Yes/No):**	

Relinquished By:

Courier:

* Use sample marked "VOL" for volatiles analysis.

Chain of Custody (CoC) Record

Project:	Port Hedland Spoilbank Marina: Sediment Sampling		
Client:	DoT	**Job No.:**	19WAU-0020
Lab Quote No.:	O2M220819	**Turnaround Time:**	Quick
O2M Project Manager	Claudio Del Deo	**Email Address:**	claudio.deldeo@o2marine.com.au

Laboratory:	ARL
Address:	46-48 Banksia Road, WELSHPOOL, WA, 6106
Lab. Contact:	Kim Rogers 8 6253 4444

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Email laboratory analysis results to O2M Project Manager.
LoR as required by NAGD 2009

O2M Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix (S-Soil / SL-Sludge / W-Water / A-Air / B-Benthic Sieved)	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 (Al, Fe,Mg,Cr, Cu,Pb,Ni,Zn,Sb,As,Cd,Ag,Hg)	Moisture	TOC	TRH (BTEX)	NEPM TRH	NAGD PAH's	NAGD OCP, OPP Pesticides	Organotins (TBT, DBT,MBT)	PASS (Field pH)_	Cr Reducible Sulphur Suite	Comments
TRIP 3-0		23.9.19	—	S	ZJ	2	500	A	A	A	—				A	—	H	All Soil samples are marine sediment
TRIP 3-1		28.9.19	—	S	ZJ	2	500	A	A	A	—				A	—	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
TRIP 4-0		28.9.19	—	S	ZJ	2	500	A	A	A	—				A	—	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
TRIP 4-1		28.9.19	—	S	ZJ	2	500	A	A	A	—				A	—	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
RINS 2		28.9.19	18:00	W	4B	4	1675	A	A	A	A	A	A	A	A	—	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
RINS 1		29.9.19	17:00	W	1B	1	1000	A	A	A	—				A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
RINS 3		26.9.19	18:10	W	3B	3	1000	A	A	A	A	A	A	A	A	A	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
																	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
																	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
																	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
																	H	After analysis samples shall be hold by the lab in case additionhal analysis are required
																	H	After analysis samples shall be hold by the lab in case additionhal analysis are required

Sampled By:	C DEL DEO	**Date/Time:**	29.9.19
Received By Lab:		**Date/Time:**	
Sample Cold (Yes/No):		**Sample Container Sealed (Yes/No):**	

Relinquished By:	
Courier:	

Project:	Port Hedland Spoilbank Marina: Sediment Sampling		
Client:	DoT	**Job No.:**	19WAU-0020
Lab Quote No.:	EP/827/19 V3	**Turnaround Time:**	5 days
O2M Project Manager	Claudio Del Deo	**Email Address:**	claudio.deldeo@o2marine.com.au

Laboratory:	ALS
Address:	26 Rigali Way, Wangara
Lab. Contact:	

Please Note:
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All LoR must comply with NAGD 2009

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: Particle Sizing + Soil Particle Density (EA150H/EA 152)	Total Metals: Sb, As. Cd, Cr, Cu, Pb, Mn, Ni, Ag & Zn (EG020-SD)	Total Al & Fe (EG005-SD)	Mercury (EG035-SD)	Organotins: TBT, DBT & MBT (EP090 (solids))	Asbestos (EA200N)	Comments
C01		27/9/19	16:15	S	3P	3	1500	A	—	—	—	—	—	After analysis please hold on samples in case additional analysis will be required
C02		" "	16:35	S	2P	2	1000	A	—	—	—	—	—	After analysis please hold on samples in case additional analysis will be required
C 3		27/9/19	17:25	S	3P	3	1500	A	—	—	—	—	—	After analysis please hold on samples in case additional analysis will be required
C 4		28/9/19	9:20	S	4P	4	2000	A	—	—	—	—	—	After analysis please hold on samples in case additional analysis will be required
C 5		28/9/19	9:00	S	4P	4	2000	A	—	—	—	—	—	After analysis please hold on samples in case additional analysis will be required
C 6		27/9/19	14:45	S	3P	3	1500	A	—	—	—	—	—	After analysis please hold on samples in case additional analysis will be required
C 7		28/9/19	9:40	S	4P	4	2000	A	—	—	—	—	—	After analysis please hold on samples in case additional analysis will be required
C8		26/9/19	13:50	S	2P	2	1000	A	—	—	—	—	—	After analysis please hold on samples in case additional analysis will be required
C9		26/9/19	14:34	S	2P	2	1000	A	—	—	—	—	—	After analysis please hold on samples in case additional analysis will be required
C10		27/9/19	15:40	S	2J, 2P	4	1500	A	A	A	A	A	—	After analysis please hold on samples in case additional analysis will be required
B11		28/9/19	10:20	S	3P	3	1500	A	—	—	—	—	—	After analysis please hold on samples in case additional analysis will be required

Sampled By:	C Del Deo	**Date/Time:**	29.9.19
Received By Lab:		**Date/Time:**	
Sample Cold (Yes/No):	C°	**Sample Container Sealed (Yes/No):**	
Relinquished By:			
Courier:			

Project:	Port Hedland Spoilbank Marina: Sediment Sampling		
Client:	DoT	**Job No.:**	19WAU-0020
Lab Quote No.:	EP/827/19 V3	**Turnaround Time:**	5 days
O2M Project Manager	Claudio Del Deo	**Email Address:**	claudio.deldeo@o2marine.com.au

Laboratory:	ALS
Address:	26 Rigali Way, Wangara
Lab. Contact:	

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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: Particle Sizing + Soil Particle Density (EA150H/EA 152)	Total Metals: Sb, As, Cd, Cr, Cu, Pb, Mn, Ni, Ag & Zn (EG020-SD)	Total Al & Fe (EG005-SD)	Mercury (EG035-SD)	Organotins: TBT, DBT & MBT (EP090 (solids))	Asbestos (EA200N)	Comments
B12-1		27/9/19	14:16	S	2J,2P	4	1500	A	A	A	A	A	—	After analysis please hold on samples in case additional analysis will be required
B12-2		27/9/19	14:16	S	2P	2	1000	A	—					After analysis please hold on samples in case additional analysis will be required
B13		25/9/19	15:30	S	2P	2	1000	A	—					After analysis please hold on samples in case additional analysis will be required
B14		25/9/19	16:00	S	2P	2	1000	A	—					After analysis please hold on samples in case additional analysis will be required
B15		28/9/19	13:00	S	3P	3	1500	A	—					After analysis please hold on samples in case additional analysis will be required
B16-1		28/9/19	13:30	S	3P	3	1500	A	—					After analysis please hold on samples in case additional analysis will be required
B16-2		28/9/19	13:30	S	3P	3	1500	A	—					After analysis please hold on samples in case additional analysis will be required
B17		28/9/19	13:45	S	2J,2P	4	1500	A	A	A	A	A	—	After analysis please hold on samples in case additional analysis will be required
B18		28/9/19	15:15	S	4P	4	2000	A	—					After analysis please hold on samples in case additional analysis will be required
B19		28/9/19	15:30	S	4P	4	2000	A	—					After analysis please hold on samples in case additional analysis will be required
B20		28/9/19	15:35	S	4P	4	2000	A	—					After analysis please hold on samples in case additional analysis will be required

Sampled By:	C Del Deo	**Date/Time:**	29.9.19
Received By Lab:		**Date/Time:**	
Sample Cold (Yes/No):	C°	**Sample Container Sealed (Yes/No):**	
Relinquished By:		**Courier:**	

Project:	Port Hedland Spoilbank Marina: Sediment Sampling			**Laboratory:**	ALS											**Please Note:** Please sign copy on receipt of samples and email signed copy of CoC record to O2M Project Manager. All LoR must comply with NAGD 2009 Email laboratory analysis results to O2M Project Manager.	
Client:	DoT	**Job No.:**	19WAU-0020	**Address:**	26 Rigali Way, Wangara												
Lab Quote No.:	EP/827/19 V3	**Turnaround Time:**	5 days	**Lab. Contact:**													
O2M Project Manager	Claudio Del Deo	**Email Address:**	claudio.deldeo@o2marine.com.au		**Containers**				**Analyse = A; Hold = H**								
O2M Sample ID	**Laboratory Sample ID**	**Date**	**Time**	**Sample Matrix** S-Soil / SL-Sludge / W-Water / A-Air	**Type** B-Bottle / J-Jar / V-Vial / G-Glass / P-Plastic Bag	**No. of Samples**	**Total Volume (mL)**	Particle Sizing + Soil Particle Density (EA150H/EA 152)	Total Metals: Sb, As. Cd, Cr, Cu, Pb, Mn, Ni, Ag & Zn (EG020-SD)	Total Al & Fe (EG005-SD)	Mercury (EG035-SD)	Organotins: TBT, DBT & MBT (EP090 (solids))	Asbestos (EA200N)	**Comments**				
B21		28-9-19	15:40	S	4P	4	2000	A	—					After analysis please hold on samples in case additional analysis will be required				
B22-B		28-9-19	16:05	S	2P	2	1000	A	—					After analysis please hold on samples in case additional analysis will be required				
B23		28-9-19	15:45	S	4P	4	2000	A	—					After analysis please hold on samples in case additional analysis will be required				
B24-B1		28-9-19	12:45	S	2P	2	1000	A	—					After analysis please hold on samples in case additional analysis will be required				
B24-B2		28-9-19	12:45	S	4P	4	2000	A	—					After analysis please hold on samples in case additional analysis will be required				
B25		28-9-19	12:30	S	3P	3	1500	A	—					After analysis please hold on samples in case additional analysis will be required				
S26		26-9-19	16:00	S	2J,2P	4	1500	A	A	A	A	A	—	After analysis please hold on samples in case additional analysis will be required				
S27		28-9-19	15:00	S	4P	4	2000	A	—					After analysis please hold on samples in case additional analysis will be required				
S28		28-9-19	14:05	S	2P	2	1000	A	—					After analysis please hold on samples in case additional analysis will be required				
S29-B2		26-9-19	15:01	S	2P	2	1000	A	—					After analysis please hold on samples in case additional analysis will be required				
S30-B		26-9-19	16 07	S	2J	2	500	—	A	A	A	A	—	After analysis please hold on samples in case additional analysis will be required				

Sampled By:	C. Del Deo	**Date/Time:**	29-9-19	**Relinquished By:**	
Received By Lab:		**Date/Time:**		**Courier:**	
Sample Cold (Yes/No):		**Sample Container Sealed (Yes/No):**			

Project:	Port Hedland Spoilbank Marina: Sediment Sampling		
Client:	DoT	**Job No.:**	19WAU-0020
Lab Quote No.:	EP/827/19 V3	**Turnaround Time:**	5 days
O2M Project Manager	Claudio Del Deo	**Email Address:**	claudio.deldeo@o2marine.com.au

Laboratory:	ALS
Address:	26 Rigali Way, Wangara
Lab. Contact:	

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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: Particle Sizing + Soil Particle Density (EA150H/EA 152)	Total Metals: Sb, As. Cd, Cr, Cu, Pb, Mn, Ni, Ag & Zn (EG020-SD)	Total Al & Fe (EG005-SD)	Mercury (EG035-SD)	Organotins: TBT, DBT & MBT (EP090 (solids))	Asbestos (EA200N)	Comments
S32		28-9-19	14:00	S	4P	4	2000	A	—	—	—	—	—	After analysis please hold on samples in case additional analysis will be required
S33		28-9-19	14:10	S	2P	2	1000	A	—	—	—	—	—	After analysis please hold on samples in case additional analysis will be required
S34		28-9-19	8:30	S	4P	4	2000	A	—	—	—	—	—	After analysis please hold on samples in case additional analysis will be required
S35		28-9-19	8:10	S	4P	4	2000	A	—	—	—	—	—	After analysis please hold on samples in case additional analysis will be required
036		28-9-19	16:40	S	1P	1	250	—	—	—	—	—	A	After analysis please hold on samples in case additional analysis will be required
037		28-9-19	16:35	S	1P	1	250	—	—	—	—	—	A	After analysis please hold on samples in case additional analysis will be required
038		28-9-19	16:30	S	1P	1	250	—	—	—	—	—	A	After analysis please hold on samples in case additional analysis will be required
039		28-9-19	16:50	S	1P	1	250	—	—	—	—	—	A	After analysis please hold on samples in case additional analysis will be required
040		28-9-19	16:45	S	1P	1	250	—	—	—	—	—	A	After analysis please hold on samples in case additional analysis will be required
														After analysis please hold on samples in case additional analysis will be required
														After analysis please hold on samples in case additional analysis will be required
														After analysis please hold on samples in case additional analysis will be required

Sampled By:	C. Del Deo	**Date/Time:**	29-9-19
Received By Lab:		**Date/Time:**	
Sample Cold (Yes/No):		**Sample Container Sealed (Yes/No):**	

Relinquished By:
Courier: