SOUTHERN PORTS ESPERANCE

ANNUAL MARINE SEDIMENT MONITORING REPORT 2016/17

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1 SUMMARY

The Annual Sediment Report has been produced in accordance with the Southern Ports - Esperance (SPE) Operating Licence (L5099/1974/14) (herein the licence) and will present and discuss results from annual sampling of marine sediments at 19 sites in Esperance Harbour during the 2016-2017 licence year. The current version of the licence requires undertaking annual sediment monitoring between 1st June to 31st July each year with methodology in accordance with the Esperance Port Comprehensive Sediment Monitoring and Reporting Plan (Oceanica, 2009a). The first survey implementing the sampling design was conducted in 2010, and subsequent annual surveys have built on this baseline information.

In 2017, all bioavailable metal concentrations (including contaminants of concern nickel and lead) were below the ISQG-Low values for each sampling location. This is consistent with results from the previous sampling event in 2016 (refer to Table 7). Based on the results from the 19 sampling sites from Esperance Harbour, current levels of bioavailable metals in marine sediment do not present a significant risk of toxicity to marine biota and therefore immediate reporting contingencies have not been triggered. Results for total metals showed six of the 19 sites exceeded the ISQG-Low value for nickel, while all other results were below the ISQG-low value for the remaining metals (and sulphate). All of the six sites exceeding the nickel ISQG-Low value were located within the inner harbour.

However, results of sampling in the inner harbour (n=15) have indicated a three to five fold reduction in nickel and lead concentrations since 2010. Additionally, for the first time since the sampling regime began in 2010, no inner harbour sites exceeded the ISQG-High value for nickel or lead, indicating that the concentration of both metals in the inner harbour is declining. This is reinforced by the number of statistically significant results when comparing this year's nickel and lead sampling results to that of previous years. The nickel results from samples collected in 2017 from the inner harbour showed a significant reduction in nickel from those collected in 2014, 2011 and 2010. Lead results also showed a significant reduction when comparing 2017 results to that of 2014, 2012, 2011 and 2010.

The results for tributyltin (TBT) concentrations (standardised to 1% Total Organic Carbon (TOC) and dry weight) from the three berth pockets sampled were below the ISQG-High value (80 µg/kg). The number of sites exceeding the ISQG-High value since 2008 decreased from one to zero sites; and those exceeding the ISQG-Low value decreased from two sites to one. Based on these results, the management actions stated in the CSMRP (Oceanica, 2009a) were not triggered.

2 INTRODUCTION

The Southern Ports - Esperance (SPE) was required by licence L5099/1974/14 to sample the top 10cm of harbour sediments from 19 locations on an annual basis between 1 June and 31st July within the licence year from 1st October 2016 to 30th September 2017. The most recent dredging operations undertaken was maintenance dredging of the inner harbour (berth pockets and turning circle) and outer harbour (harbour channel) which was completed in August 2014. A brief history of harbour sediment contamination and monitoring is provided below as background information.

Historical bulk handling of lead carbonate and nickel concentrate operations at SPE have led to lead and nickel contamination in the marine sediments within the berth pockets. SPE ceased handling and export of bulk lead carbonate in 2007, with all bulk handling of nickel exports ceasing in June 2012. SPE now exports nickel in a fully containerised handling system.

Ministerial Statement 681 (2005) required marine sediment monitoring for tri-butyl tin (TBT) and nickel between 2002 and 2006. Following commencement of bulk lead exports, lead monitoring began in 2005. In March 2006 Condition M8.5 of the Ministerial Statement was closed and monitoring temporarily ceased. In 2007, DWER (formerly Department of Environment Regulation and Department of Environment Conservation) found high lead and nickel levels near a stormwater discharge pipe at Berth 1 (close to existing Site A10a shown in Figure 2). As a result of this, Oceanica were contracted by SPE to develop a Sampling Analysis Program (SAP) to assess the ecological risks of the lead and nickel contamination within the harbour waters at the Port (Oceanica 2009b).

Between 2007 and 2010 Oceanica undertook an extensive survey and investigation of the toxicity of surficial sediments (Oceanica, 2010). This included testing for total and bioavailable metals in marine sediments and early life stage testing of three different marine species and an acute mortality test using a burrowing crustacean (Amphipod) in whole sediments. The early life stage testing was selected since these stages represent the most sensitive stages of an organism's life cycle. The testing was conducted in elutriate waters of contaminated sediments and deformities in larval development of scallops and rock oysters and the changes in growth rates of algae were assessed. These studies by Oceanica found that despite the high levels of contamination, neither lead nor nickel within the sediments had significant toxicity to marine biota in any of these tests (Oceanica, 2010).

SPE annually monitors sediments and report levels of contaminants in marine sediments under the current DWER licence. Conditions 3.1.1, 3.8.3 and 5.2.1 specify the requirements and reference the Comprehensive Sediment Monitoring and Reporting Plan (CSMRP) (Oceanica, 2009a). Contaminants analysed include nickel and lead at all 19 sites, plus arsenic, cadmium, chromium, copper, zinc, manganese and sulphur at nine sites (Sites A5-A13). Organotins and Total Organic Carbon were analysed for sites in the berth pockets (Sites A8, A9 and A10). Particle size is required to be analysed once every three years and was undertaken in conjunction with the 2013/14 monitoring as well as the 2016/17 annual licence period. The next particle size analysis is scheduled to occur in 2019/2020. The ANZECC-ARMCANZ (2000) sediment quality criteria were adopted to form triggers for management actions (refer to Section 3 of the CSMRP, Oceanica, 2009a).

Maintenance dredging works were conducted at the Port in July and August 2014, however the removal and disposal of contaminated sediments in the Berth pockets was incomplete as a result of poor manoeuvrability of the dredge vessel which left high areas along the fender line of each berth. Maintenance dredging for removal of the remaining contaminated sediments at the berth pockets (land disposal) is targeted for completion in coming years.

3 OBJECTIVES

The objectives of the 2016/17 annual marine sediment monitoring were to:

1. Assess sediment quality of the inner harbour against the triggers for management action described in the CSMRP (Oceanica, 2009a). The triggers are as follows:

    a. Bioavailable metal concentrations exceed the ISQG-Low or ISQG-High values at a site where no previous exceedance has taken place;

    b. More than one out of three sites exceeds the Tributyltin ISQG-High values; and

    c. The mean nickel or mean lead concentration of the 15 inner harbour sites shows a statistically significant increase (from t-test results) since 2008 (revised to 2010 as 2008 monitoring was confounded by variable depth samples);

    If these triggers are exceeded, contingency management actions include investigation and conducting actions to reduce risk.

2. Submit the Annual Marine Sediment Monitoring Report to DWER before 19th December 2017 as required by the licence.

4 METHODOLOGY

4.1 Sampling Works

The 2016/17 annual marine sediment monitoring was conducted from the 24th to the 27th July 2017 (inclusive). Samples were collected from 19 monitoring locations (sample locations have been grouped as per the CSMRP (Oceanica, 2009a)):

1. 11 monitoring locations within and around the berth pockets (A8, A9, A10b and A14 - A21);

2. Five monitoring locations within the turning basin and channel (A11, A12, A13, A22 and A23); and

3. Three outer harbour monitoring locations (A5, A6 and A7).

Professional divers previously contracted by Oceanica and SPE were appointed (consistent with AS/NZS 4122) to collect 330 sediment cores (including QA/QC samples) in July 2017. Three replicate samples were taken within five metres of each other at the 19 sites. Each replicate consists of a homogenate of five 0-10cm cores taken from each corner and in the centre of a $1m^2$ quadrat (as shown on Figure 1). The locations of the 19 marine sediment sampling sites are provided on Figure 2.

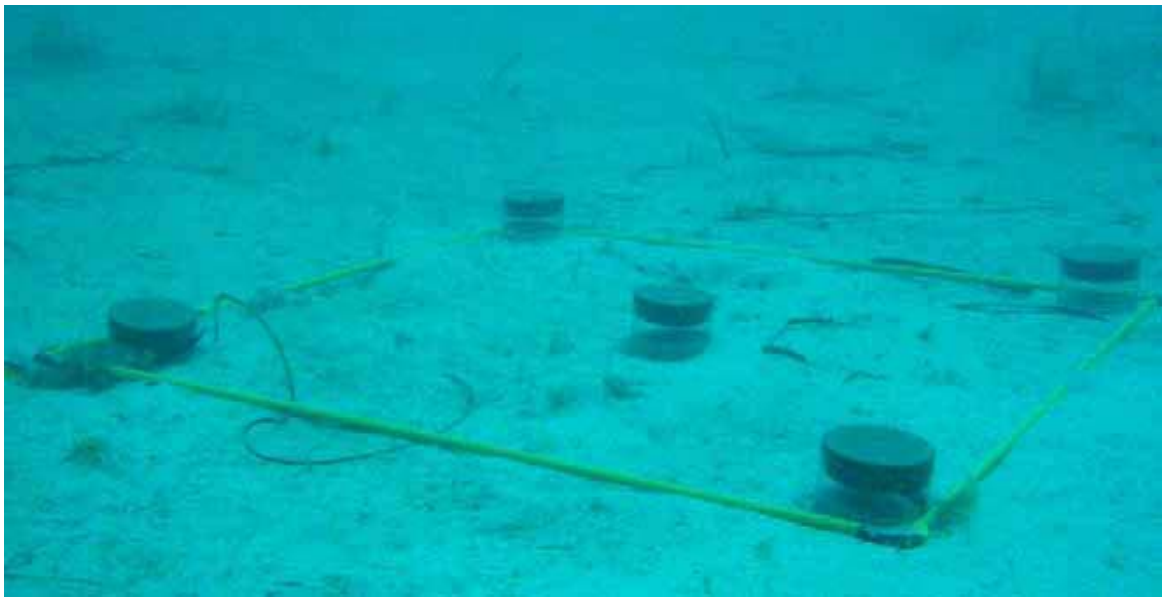

Figure 1: Replicate sample within $1m^2$ quadrat

Source: CSMRP (Oceanica 2009a)

In 2011 and 2012, sample Site A10 was sampled twice, with triplicate samples taken from the landward side (south side) of the metal sheet piling (A10a) and from the ocean side (northern side) of the metal sheet piling (A10b) located beneath Berth 1. Sample results at Site A10 between 2007 and 2008 indicated there may be a difference in results depending upon which side of the metal sheet piling the samples were taken. The 2011 results indicated the landward side retains historical sediments, as the sheet piling creates a barrier, while the ocean side undergoes regular flushing due to ocean currents and ships propeller wash. Samples were taken again in 2012 to provide further support for these differences observed in 2011. Subsequent surveys in 2013 and 2014 and 2016 omitted site A10a as it is not representative of the inner harbour with samples only being collected from the ocean side of the sheet piling only (A10b).

The polycarbonate corers used for the 2016 sediment sampling had an internal diameter ~100 mm in line with dimensions recommended in Section 2.2.4 of the CSMRP (Oceanica, 2009a). The corer dimensions recommended in CSMRP (Oceanica 2009a) are different to those specified in Australian Standard (AS 5667.12:1999 (Annex C)), which requires an internal diameter of 66mm and an outer diameter of 70mm. DWER have clarified that the dimensions of the polycarbonate corers used are acceptable as described in CSMRP (Oceanica, 2009a).

Further details regarding sampling methodology are provided in Section 2.2.4 of the CSMRP (Oceanica, 2009a). Four monitoring sites (A5, A7, A11 and A12) were relocated during the previous sampling campaign (2016) due to operational constraints including inclement weather and scouring of sediment of the harbour bed. Details of the 2017 sampling sites are provided below in Table 1, while sample locations are shown on Figure 2. During the 2017 sampling, A7 was moved again in order to find accessible sediment among seagrass meadows.

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Table 1: Details of Sampling Sites 2017

Site Name	Latitude	Longitude	Site Location Description
Outer Harbour Sites			
A5	*33.51.826*	*121.54.464*	A5 moved in 2015/16 to the NW edge of channel to access sediment. Previously ~ 350m NNE from tip of northern break wall
A6	33.51.719	121.54.197	~600m NNW from tip of northern break wall. Site moved 170m away due to seagrass coverage in 2017
A7	***33.51.262***	***121.54.305***	A7 moved in 2015/2016 due to heavy seagrass coverage. Previously ~1,100m from tip of northern break wall
Inner Harbour Sites			
Berth Pockets			
A8	33.52.179	121.54.193	Berth 3
A9	33.52.328	121.54.022	Berth 2
A10b	33.52.250	121.54.860	Berth 1
A14	33.52.303	121.54.967	Western end of Berth 2
A15	33.52.270	121.55.916	Eastern end of Berth 1
A16	33.52.233	121.53.835	Western end of Berth 1
A17	33.52.297	121.53.101	~100m W of the Tugboat wharf
A18	33.52.291	121.54.031	~80m N of Berth 2
A19	33.52.243	121.53.928	~80m N of eastern end of Berth 1
A20	33.52.218	121.53.839	~80m N of western end of Berth 1
A21	33.52.181	121.53.794	~150m NW of western end of Berth 1
Channel and Turning Circle			
A11	*33.51.912*	*121.54.280*	A11 moved due to high amount of shells in 2014 sample. Previously ~ 200m WNW from tip of northern break wall
A12	*33.52.089*	*121.54.056*	A12 moved in 2015/2016 NW due to scouring of berth pocket. Previously ~ 150m W of Berth 3
A13	33.52.024	121.54.927	~500m NW of Berth 3
A22	33.52.265	121.53.125	~120m NW of the Tugboat wharf
A23	33.52.079	121.54.245	~ 100m N of northern end of Berth 3

Note:
Approximate (~) site locations were determined from sample locations provided on Figure 2
Bold marks sites which were moved in 2017. Locations for these sites are provided on Figure 2

Figure 2: Marine Sediment Sampling Sites at Port of Esperance
Note: Site A6 was relocated 170m from 2016 location

4.2 Laboratory Analyses

In accordance with condition 9(b) of the Licence, all samples were submitted to National Association of Testing Authorities (NATA) accredited laboratories for analysis. The same laboratories have been used for all analytes since 2007. All sediment samples collected were analysed in accordance with Licence requirements with analytes shown in Table 2 below. Triennial sampling for particle size distribution was undertaken during 2016/17 in line with the Licence conditions. Laboratory Certificates of Analysis have been provided in Appendix B.

Table 2: Laboratory Analysis Required and Frequency of Analysis

Sampling Sites	Annual Analysis		Analysis Every 3 years	
	Analytes	**Replicates to be analysed**	**Analytes**	**Replicates to be analysed**
All 19 Sites	Lead and nickel	All three replicates	Particle size distribution	One replicate per site
Sites A5 to A13	Arsenic, cadmium Chromium, copper zinc, manganese sulphur	All three replicates	-	-
Sites A8, A9 and A10 (the three berth pocket sites)	Total Organic Carbon (TOC) Organotins (TBT, DBT, MBT)	One replicate per site	-	-

Note: Table sourced from CSMPR (Oceanica 2009a) and Licence L5099/1974-14
Note: Metals analysed were analysed for totals (strong acid extraction) and bioavailable (dilute acid extraction)

NATA accredited analytical laboratories Marine and Freshwater Research Laboratory (MAFRL) and National Measurement Institute (NMI) were commissioned for sediment sample analysis, consistent with the laboratories utilised by Oceanica. All samples were frozen prior to transport and transported on ice at 4°C and couriered overnight to Perth in appropriate containers provided by each laboratory. NATA accredited laboratories undertook analysis of sediment samples for analytes required by condition 3.8 of the Licence as follows:

- NMI was used to analyse TOC and organotins (TBT, DBT, MBT);
- MAFRL were used to analyse for a suite of metal (arsenic, cadmium, chromium, copper, lithium, manganese, nickel, lead and zinc) and sulphur analysis;
- Duplicate (split replicate) samples of all three replicates from three sites (A8, A14 and A16) were sent to NMI to provide quality assurance, to ensure reliable metal results

were obtained. This is based on AS 4482.1 - 2005 for soil sampling that suggests one split sample per batch of 20 samples be sent to a secondary laboratory; and

- Particle size distribution was analysed at CSIRO which is required every three years in accordance with the Licence.

4.3 Quality Assurance/Quality Control

Field QA/QC was undertaken and three split replicate samples were collected and sent to NMI for metals analysis. MAFRL and NMI undertook the required laboratory QA/QC. More detailed information regarding QA/QC methods are provided in Appendix C.

4.3.1 Statistical design and analyses

The required data analyses of laboratory results include:

1. Determine median triplicate concentrations at each site to assess compliance with sediment quality criteria (ANZECC-ARMCANZ, 2000);

2. Assess levels of organotins (TBT, DBT and MBT), normalised to 1% TOC content (as per National Assessment Guidelines for Dredging, (Commonwealth of Australia, 2009) in the sediments of the three berth pockets (Berths 1, 2, and 3) and compare to the number of sites exceeding the ANZECC-ARMCANZ (2000) guidelines in 2008.

3. Calculate the mean lead and nickel concentrations for each triplicate sample in 2017 for the 15 inner harbour sites and determine whether values are significantly different to those of 2016, 2014, 2013, 2012, 2011 and 2010 using a standard t-test (two tailed). The software package Statistica (Version 10, 2011) was used to conduct the t-tests. All data was Log_{10} transformed to normalise the data distribution that was inspected using a histogram. For comparison of the 2017 data to other years, the Levene's test for equal variances indicated the assumption of equal variances is valid. All data passed the Levene's test for equal variances with Levene's p value > 0.05.

5 RESULTS AND DISCUSSION

Results of the 2016/17 annual marine sediment monitoring event are presented and discussed herein, including field sampling and observations, laboratory analytical results and their assessment against the relevant guidelines and changes from the baseline established in 2010 and to the previous survey in 2016.

5.1 Field Sample Observations

Samples were collected from all 19 monitoring sites during the 2016/17 monitoring event, however there were several sites where the total 10cm core of sediment was difficult to obtain. As per 2016, sites A5, A7 and A12 were relocated due to the presence of rocky limestone and substantial shell fragments. During the 2017 sampling event, site A6 was also relocated approx. 170m away from the original coordinates due to dense seagrass and the inability to take a 10cm core sample. A summary of field observations for samples collected at each site are provided in Table 3.

Table 3: Sample Field Observations

Site Name	Sample Description 2017
Outer Harbour Sites	
A5	Pale grey sand, odourless, some small crabs. Sample taken at base of channel batter approx. 18m depth. Seagrass at top of batter.
A6	Light grey sand, odourless, shells present at surface. Site relocated 170m away from 2016 location due to seagrass meadow.
A7	Light grey sand, odourless, major shells and shell fragments. Only sandy area in site vicinity.
Inner Harbour Sites	
Berth pocket sites	
A8	Yellow to dark grey sand, slight H_2S odour. No foreign objects. Top 2-5cm clean yellow sand with some black discs on surface.
A9	Mid grey sand, organic odour, minor shells
A10b	Yellow, pale to dark grey sand, organic/slight H_2S odour, minor shells. Small bivalve in Repl. 3. One core very dark grey.
A14	Pale grey sand, slight organic odour. Clean yellow sand on top of grey sand, some black discs within sample cores buried by clean sediment.
A15	Pale to dark grey sand, slight organic odour. Some black discs on surface.
A16	Grey to dark grey, organic odour, minor shells and some black discs on surface.
A17	Grey to dark grey, organic odour, one crab present (Repl. 1), some black staining on surface.
A18	Light to mid grey sand, odourless, slight mottling at 8cm.
A19	Light grey sand, slight organic odour. White and brown worms seen in sediment at this site.
A20	Pale to dark grey sand, slight H_2S odour, minor shells, brittle star (Repl. 1). Pale grey/yellow sand on top of dark grey sand from 6cm onwards.
A21	Pale grey sand, slight organic odour, seagrass present. Seagrass rhizomes made it difficult to collect full 10cm sample.
Channel and Turning Circle	
A11	Pale grey sand, odourless, some worms. Top 1-2 cm pale grey sand, remainder of core slightly darker.
A12	Pale grey sand, odourless, some intact shells throughout sample core.
A13	Light to mid grey sand, organic/ H_2S odour, some seagrass at surface. Lighter grey sand at approx. 9cm.
A22	Pale grey sand, odourless, large proportion shells and rubble. Sample site at edge of slope.
A23	Pale to dark grey, yellow sand/silt. Organic odour. Hermit crab and minor seagrass fragments present. Top 2-6cm dark grey, fine/silt like.

5.2 Particle Size Distribution

Particle size results for the 2017 sediment cores were broadly consistent with those analysed in 2013 and 2010 (Table 4). In 2017, majority of the sites comprised fine and medium sands (60-500µm) with 16 of the 19 sites containing at least 90% within this size range. Sites A7, A8 and A22 contained the lowest proportion of fine and medium sands at 62, 79 and 58% of respectively. Sites A7 and A22 also contained the highest portion of coarse material (>500 µm) of all samples collected. Site A8 had the highest portion of silt (4-62µm) at 17%. This coincided with the previous 2013 results.

The fines fractions (clay and silts <62 µm) were less than 6.8% of overall particles, with exception of Site A8 with 20.9%. 11 of the 19 sites did not contain any clays and silts (0%). During the 2013 sampling events, it was found that sites with highest fraction of fines also triggered the ISQG-Low values for total nickel. This was also the case for 2017, with Site A8 recording a total nickel value of 29 mg/kg. However, site A10b recorded the highest total nickel value of 51 mg/kg and did not contain any fines material. The correlation between high nickel values and a high proportion of fine particles is therefore not as strong as previously reported in 2010. This is possible due to dissipation of fines during both maintenance dredging in 2014 and regular shipping activities (tug and vessel turbulence from propellers).

The highest fraction of coarse material (>500µm) was identified at site A7 and A22 with 37.9% and 41.9% respectively. This is consistent with the previous 2013 results and is largely due to the high proportion of shells and rubble in the area.

Table 4: Particle Size Distribution Results 2017

Site	Clay % (<4µm)	Silt % (4-62µm)	Fine sand % (62-250µm)	Medium sand % (250-500µm)	Coarse sand % (500-2000µm)	Gravel (>2000µm)
A5	0.00	0.00	63.58	34.62	1.20	0.60
A6	0.00	0.00	36.74	54.06	3.70	5.50
A7	0.00	0.00	35.08	27.02	22.40	15.50
A8	4.07	16.79	50.43	28.11	0.30	0.30
A9	0.00	0.00	43.24	54.96	1.70	0.10
A10b	1.72	3.88	50.59	43.11	0.50	0.20
A11	1.42	3.46	49.08	45.34	0.60	0.10
A12	0.00	0.00	55.32	41.58	1.90	1.20
A13	1.93	4.85	57.97	34.35	0.50	0.40
A14	0.00	0.00	37.23	55.67	6.80	0.30
A15	0.00	0.00	48.51	50.49	1.00	0.00
A16	1.26	2.55	42.88	50.51	2.40	0.40
A17	0.00	0.00	43.25	51.65	4.50	0.60
A18	0.00	0.00	38.70	56.30	4.80	0.20
A19	0.00	0.00	42.31	55.79	1.80	0.10
A20	1.09	0.69	50.61	46.91	0.70	0.00
A21	1.09	0.67	66.39	31.45	0.30	0.10
A22	0.00	0.00	19.15	38.95	23.20	18.70
A23	1.67	4.16	53.52	39.35	1.10	0.20
Note: Results from CSIRO report number R1714977. Size distribution analysis by laser diffraction and wet sieving.						

5.3 Comparison of Results to Sediment Quality Guidelines

Median values for total and bioavailable levels of each metal from the 2017 monitoring event were determined from the triplicate results for each site and compared to the results from 2016 sampling and the Australian and New Zealand Interim Sediment Quality Guidelines (ISQG) ISQG-Low and ISQG-High criteria (ANZECC-ARMCANZ, 2000) (refer to Tables 6 and 7). A full set of laboratory results are attached in Appendix B.

Analytical results have also been compared to the triggers and contingency actions outlined in Table 3.1 of the Comprehensive Sediment Monitoring and Reporting Plan (Oceanica, 2009) which have been provided below in Table 5.

Table 5: Triggers and Contingency Actions
(Source: Table 3.1 in CSMRP (Oceanica, 2009))

Trigger	Management action
Overall nickel and lead levels in inner harbour sediments	
The mean nickel or mean lead concentration of the 15 inner harbour sites shows a statistically significant increase[1] since 2008.	1. Investigate the source of contamination. 2. Address source of contamination via management as appropriate (improvement in bulk cargo handling practices, installation of stormwater traps/diversion).
Trace metals	
Bioavailable metal concentration exceeds the ISQG-Low, at a site where no previous exceedance has taken place.	1. DEC to be informed via annual reporting. 2. Investigate the source and extent of contamination in consultation with the DEC, as per the Contaminated Sites guidelines. 3. Address source of contamination via management as appropriate (improvement in bulk cargo handling practices, installation of stormwater traps/diversion).
Bioavailable metal concentration exceeds the ISQG-High, at a site where no previous exceedance has taken place.	1. DEC to be informed immediately, and via annual reporting. 2. Investigate the source and extent of contamination in consultation with the DEC, as per the Contaminated Sites guidelines. 3. Address source of contamination via management as appropriate (improvement in bulk cargo handling practices, installation of stormwater traps/diversion).
Tributyltin	
Increase in number of sites exceeding the ISQG-Low since 2008.	1. DEC to be informed via annual reporting. 2. Esperance Port to only accept IMO registered vessels that are compliant with MARPOL. 3. AQIS to conduct random checks on vessels. 4. Esperance Port Authority to do check on suspect vessels.
Increase in number of sites exceeding the ISQG-High since 2008	1. DEC to be informed via annual reporting. 2. Esperance Port to only accept IMO registered vessels that are compliant with MARPOL. 3. AQIS to conduct random checks on vessels. 4. Esperance Port Authority to do check on suspect vessels 5. Need for further action to be discussed in consultation with the DEC.

[1] Standard t-test (two tailed test), an effect size of 100%, alpha=0.05 (i.e. desired significance) and beta=0.2 (i.e. 1-statistical power).

5.3.1 Outer Harbour Sites

Median analytical results for total metals (strong acid extraction) and bioavailable metals (dilute acid extraction) for the three outer harbour sites (A5, A6 and A7) were below the ISQG-Low values for each analyte tested, with results consistent with the 2016 and 2014 annual sediment monitoring results.

5.3.2 Inner Harbour Sites

Concentrations of both lead and nickel in the 2017 samples have decreased three to five-fold below levels recorded in 2010. For total metals, the total number of sites with concentrations of total nickel above the ISQG-High declined from 1 sites in 2016 to no sites in 2017 (refer to Table 6). However, as a result, an increase was seen in the number of sites exceeding the ISQG-Low, with the number of sites increasing from 5 in 2016 to 6 sites in 2017.

Reductions in total nickel concentrations were seen at 13 out of 16 inner harbour sites with reductions up to four-fold in total nickel concentrations. The largest percentage reductions were seen at sites A12 (6mg/kg reduction to 1.5 mg/kg), A17 (26 mg/kg reduction to 8.2 mg/kg) and A15 (17mg/kg reduction to 6.8kg/mg) respectively. Increases in total nickel were observed at two out of 16 inner harbour sites with percentage increases up to two fold. Increases of approximately two-fold were seen at Site A21 (9.7mg/kg increase to 20mg/kg) and Site A23 (19mg/kg increase to 30mg/kg) respectively. These overall reductions in concentrations of nickel are likely to have occurred due to dispersion of contaminated sediments from turbulence caused by the propellers of tugs moving vessels in and out of the berth pocket.

Analytical results for bioavailable metal concentrations at the inner harbour monitoring sites (refer to Table 7), did not activate any of the triggers or management actions in Table 4. Total and bioavailable metals results did not record concentrations above the ISQG-Low or ISQG-High where this has not occurred at those sites in previous years.

For all metals, all median (n=3) bioavailable concentrations were below the ISQG-Low values for each sampling location in 2017, which is consistent with results from the 2016 sampling event (refer to Table 7). Therefore, total nickel in sediment is unlikely to be having a significant effect on marine biota and immediate reporting contingencies have not been triggered.

The reductions in bioavailable contaminants in the top 10cm of the sediment to below the relevant ISQG-Low values, suggests the inner harbour material maybe suitable for disposing on the Port's spoil ground, providing there is no practical alternative such as disposal on land. However, deeper sediment cores to the depth of any proposed dredging would be required to determine if the concentrations of contaminants in the proposed dredged material were below the relevant ISQG-Low values.

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Table 6: Total Metal (strong acid extraction) Median (n=3) results for 0-10cm cores for 2017

	Arsenic		Cadmium		Chromium		Copper		Lithium		Manganese		Nickel		Lead		Sulphur		Zinc	
Reporting Limit	*<2* ISQG Low = 20 ISQG High = 70 mg/kg		*<0.1* ISQG Low = 1.5 ISQG High = 10 mg/kg		*<0.2* ISQG Low = 80 ISQG High = 370 mg/kg		*<0.2* ISQG Low = 65 ISQG High = 270 mg/kg		*<1* ISQG Low = NA ISQG High = NA mg/kg		*<0.05* ISQG Low = NA ISQG High = NA mg/kg		*<0.7* ISQG Low = 21 ISQG High = 52 mg/kg		*<1* ISQG Low = 50 ISQG High = 220 mg/kg		*<10* ISQG Low = NA ISQG High = NA mg/kg		*<0.5* ISQG Low = 200 ISQG High = 410 mg/kg	
Site	2016 results	2017 Results	2016 results	2017 Results	2016 results	2017 Results	2016 results	2017 Results	2016 results	2017 Results	2016 results	2017 Results	2016 results	2017 Results	2016 results	2017 Results	2016 results	2017 Results	2016 results	2017 Results
Outer Harbour Sites																				
A5	3	2	*0.1	**0.1	6.6	6.5	1.5	1.1	n/a	1	8.4	9	3.7	2.9	1	1	1300	1300	2.4	2.1
A6	3	*2	<0.1	**0.1	6.8	6.8	0.4	0.4	n/a	1	9.2	9.2	0.9	<0.7	<1	<1	1200	1100	1	1.1
A7	*2	3	<0.1	<0.1	3.9	3.8	0.3	0.3	n/a	**1	5.5	5.1	<0.7	<0.7	<1	<1	910	1100	1.2	1
Inner Harbour Sites																				
A8	3	3	0.1	0.1	9	8.5	12	19	n/a	3	11	11	**30**	**29**	8	11	1200	2300	14	17
A9	*2	2	0.1	0.1	8.5	7.9	5.3	5.8	n/a	2	7.3	7.5	**34**	**30**	13	15	1600	1400	14	11
A10b	4	3	0.1	0.1	8.7	7.7	13	7.9	n/a	2	8.7	9.1	**68**	**51**	8	13	2000	1500	21	15
A11	3	3	0.1	**0.1	8.9	8.9	2.7	2.6	n/a	2	10	9.8	6.4	6.4	2	2	1700	1800	4.2	4.5
A12	*2	**2	<0.1	<0.1	6.1	5.9	1.1	0.5	n/a	2	7	6.8	6	1.5	3	<1	1000	1200	2.2	1
A13	3	3	0.1	*0.1	9.7	8.5	9.5	6.5	n/a	2	9.5	8.8	**30**	17	7	5	2100	2000	13	11
A14	-	-	-	-	-	-	-	-	-	-	-	-	12	9.4	5	3	-	-	-	-
A15	-	-	-	-	-	-	-	-	-	-	-	-	17	6.8	5	2	-	-	-	-
A16	-	-	-	-	-	-	-	-	-	-	-	-	**35**	**24**	10	7	-	-	-	-
A17	-	-	-	-	-	-	-	-	-	-	-	-	**26**	8.2	8	4	-	-	-	-
A18	-	-	-	-	-	-	-	-	-	-	-	-	9.6	7.7	5	4	-	-	-	-
A19	-	-	-	-	-	-	-	-	-	-	-	-	3.7	3.1	1	2	-	-	-	-
A20	-	-	-	-	-	-	-	-	-	-	-	-	19	12	6	5	-	-	-	-
A21	-	-	-	-	-	-	-	-	-	-	-	-	9.7	**20**	4	6	-	-	-	-
A22	-	-	-	-	-	-	-	-	-	-	-	-	3	2.4	2	1	-	-	-	-
A23	-	-	-	-	-	-	-	-	-	-	-	-	19	**30**	6	7	-	-	-	-

Bold indicates median values that exceed the ISQG-Low guideline

Grey highlight indicates median values that exceed the ISQG-High guideline

NA = not available.

A10a - landward side of sheet piling beneath Berth 1; A10b - ocean side of sheet piling beneath Berth 1

*Where 1 triplicate was <LOD, the value equal to the LOD was used

**Where 2 triplicates were <LOD, the value equal to the LOD was used

Where all triplicates were <LOD, median result was left as <LOD

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Table 7: Bioavailable Metals (dilute acid extraction) Median (n = 3) Results for 0-10cm Cores for 2017

	Arsenic		Cadmium		Chromium		Copper		Lithium		Manganese		Nickel		Lead		Sulphur		Zinc	
Reporting Limit	*<2* ISQG Low = 20 ISQG High = 70 mg/kg		*<0.1* ISQG Low = 1.5 ISQG High = 10 mg/kg		*<0.2* ISQG Low = 80 ISQG High = 370 mg/kg		*<0.2* ISQG Low = 65 ISQG High = 270 mg/kg		*<1* ISQG Low = NA ISQG High = NA mg/kg		*<0.05* ISQG Low = NA ISQG High = NA mg/kg		*<0.7* ISQG Low = 21 ISQG High = 52 mg/kg		*<1* ISQG Low = 50 ISQG High = 220 mg/kg		*<10* ISQG Low = NA ISQG High = NA mg/kg		*<0.5* ISQG Low = 200 ISQG High = 410 mg/kg	
Site	2016 results	2017 results	2016 results	2017 results	2016 results	2017 results	2016 results	2017 results	2016 results	2017 results	2016 results	2016 results	2016 results	2017 results	2016 results	2017 results	2016 results	2017 results	2016 results	2017 results
Outer Harbour Sites																				
A5	3	3	<0.1	**0.1	5.8	5.2	0.6	0.5	n/a	<1	6.2	5.5	<0.7	<0.7	1	*1	1200	1200	1.5	1.2
A6	2	<2	<0.1	<0.1	5.6	6.2	*0.2	*0.3	n/a	<1	5.7	6.8	<0.7	<0.7	<1	<1	1000	1100	**0.5	**0.5
A7	*2	*2	<0.1	**0.1	3.5	3.7	<0.2	*0.2	n/a	<1	4.1	4.1	<0.7	<0.7	<1	<1	790	880	**0.6	0.6
Inner Harbour Sites																				
A8	**2	**2	*0.1	*0.1	5.4	5.2	3.9	7	n/a	1	6.2	6.3	2	2.9	7	11	1300	1300	5.6	8.1
A9	<2	<2	*0.1	*0.1	6.8	6.3	1.6	1.5	n/a	*1	4.6	4.3	2.3	*1.2	10	16	1100	980	4.1	3.4
A10b	**2	<2	*0.1	**0.1	6.1	5.2	3.7	2.9	n/a	<1	4.9	4.5	4.8	4.5	8	13	1100	1100	7.5	8.4
A11	2	**2	*0.1	*0.1	6.8	7.1	1	1	n/a	1	7.4	7.8	0.9	0.9	2	2	1400	1600	1.7	1.9
A12	<2	<2	<0.1	<0.1	4.3	4.4	0.5	**0.2	n/a	<1	3.5	3.3	*0.8	<0.7	3	<1	740	900	1	<0.5
A13	**2	**2	0.1	0.1	6.5	6.8	2.7	2.3	n/a	1	5.8	6.7	2.7	2.2	6	4	1400	1700	6.3	5.9
A14	-	-	-	-	-	-	-	-			-	-	1.7	1.2	4	2	-	-	-	-
A15	-	-	-	-	-	-	-	-			-	-	1.7	0.9	5	2	-	-	-	-
A16	-	-	-	-	-	-	-	-			-	-	2.3	2.6	10	7	-	-	-	-
A17	-	-	-	-	-	-	-	-			-	-	2.1	1.7	8	3	-	-	-	-
A18	-	-	-	-	-	-	-	-			-	-	0.9	*1.1	3	3	-	-	-	-
A19	-	-	-	-	-	-	-	-			-	-	*0.7	**0.7	*1	*2	-	-	-	-
A20	-	-	-	-	-	-	-	-			-	-	1.4	1.3	6	3	-	-	-	-
A21	-	-	-	-	-	-	-	-			-	-	1.5	1.7	4	6	-	-	-	-
A22	-	-	-	-	-	-	-	-			-	-	<0.7	**0.7	<1	<1	-	-	-	-
A23	-	-	-	-	-	-	-	-			-	-	2.1	2.9	5	7	-	-	-	-

Bold indicates median values that exceed the ISQG-Low guideline

Grey highlight indicates median values that exceed the ISQG-High guideline

NA = not available.

A10a - landward side of sheet piling beneath Berth 1; A10b - ocean side of sheet piling beneath Berth 1

*Where 1 triplicate was <LOD, the value equal to the LOD was used

**Where 2 triplicates were <LOD, the value equal to the LOD was used

Where all triplicates were <LOD, median result was left as <LOD

The results for tributyltin (TBT) concentrations (standardised to 1% Total Organic Carbon (TOC) and dry weight) from the three berth pockets sampled were below the ISQG-High value (80 µg/kg) (refer to Table 8). TBT results from 2017 sampling provided in Table 8 have been compared to 2008 results to provide a comparison to triggers and contingency actions outlined in the CSMRP (Oceanica 2009), see Table 5. The 2017 results show a decrease in TBT from the previous year, with A9 (Berth 2 pocket) and A10b (Berth 1 pocket) now below the ISQG-Low value (9 µg/kg). TBT at A8 (Berth 3 pocket) increased from the previous year, however levels have decreased overall since 2014 when TBT at B8 was above the ISQG-high value (80 µg/kg).

The variation in TBT concentrations is likely to be due to a combination of sediment disturbance and the patchy spatial distribution due to the association of TBT with antifouling paint flakes (Negri & Marshall, 2009). The number of sites exceeding the ISQG-High value since 2008 decreased from one to zero sites; therefore the management actions stated in the CSMRP (Oceanica, 2009a) were not triggered. Should the management actions in the CSMRP be triggered, the below actions are required (Oceanica 2009a)

1. DWER (previously DER, DEC) to be informed via annual reporting;
2. SPE to only accept IMO registered vessels that are compliant with MARPOL;
3. AQIS to conduct random checks on vessels;
4. SPE to do checks on suspect vessels; and
5. Need for further action to be discussed with DWER.

Table 8: Organotins Results 2017 - standardized to 1 % TOC

Site	Monobutyltin µg/kg/1%TOC ISQG Low = NA ISQG High = NA		Dibutyltin µg/kg/1%TOC ISQG Low = NA ISQG High = NA		Tributyltin µg/kg/1%TOC *ISQG Low = 9 *ISQG High = 80		TOC** mg/kg ISQG Low = NA ISQG High = NA		TOC** % NA NA	
	2008 results	2017 results	2008 results	2017 results	2008 results	2017 results	2008 results	2017 results	2008 results	2017 results
A8	<LOR	<LOR	20.2	4.2	**1181.8**	**18.8**	4400	9600	0.44	0.96
A9	<LOR	<LOR	5.2	2.3	**14.1**	3.7	2700	2700	0.27	0.27
A10b	<LOR**	<LOR	3.9**	1.5	**10.4****	4.0	2600	3500	0.26	0.35

*ISQG low and high trigger values in ug/Sn/kg[2] (National Assessment Guidelines for Dredging, 2009 – as suggested in CSMRP, 2009).
** 2008 results were for site A10a but are now compared to A10b as this site (oceanside of sheet piling) provides more representative data
Bold - indicated median value that exceed the ISQG-Low guideline
Grey highlight - indicates median value that exceeds the ISQG-High guideline

The breakdown of TBT in sediments has a half-life of 360 to 775 days in surficial sediments (Dowson *et al*, 1996), however the rate of breakdown is dependent on sediment characteristics and temperatures. The MARPOL legislation on the use of TBT anti-fouling paint required commercial ships to cease application of TBT paints in September 2008. However, it is likely that ships arrived at the Port with historical undercoats of TBT applied to their hulls for several years after 2008. SPE only accepts vessels that are IMO registered and compliant with the MARPOL convention. These events explain the observed gradual decline in concentrations of TBT in sediments..

5.4 Quality Assurance/Quality Control Results

Details of the laboratory and field QA/QC results are provided in Appendix C. Some of the field QA/QC showed % Relative Standard Deviation above 50%, however the results are still considered reliable, given that all sites had all triplicate results below the ISQG-Low value for the relevant analyte. The Relative Percentage Difference (RPD) comparing primary environmental samples sent to MAFRL to split samples sent to NMI laboratory showed variable compliance with the ±30 - 50% RPD range (AS4482.1, 2005). Split samples in 2017 were collected using three replicate samples at three sampling locations (A8, A14 and A16). All of the bioavailable metal results were within the 50% RPD at all sites, with the exception of A8 for arsenic (120%) and sulphur (69%). The significant variability between MAFRL and NMI samples for arsenic is primarily due to the variation in each laboratory's limit of reporting (MAFRL <2 mg/kg and NMI <0.5mg/kg). Considering the variability between triplicate samples, RPDs outside the 30-50% RPD range should not affect the overall validity of the data for the purpose of the 2017 annual sediment monitoring.

5.5 Time Series Analysis

A t-test was conducted to detect any change in nickel and lead concentrations across the 15 inner harbour sites between the 2017 results and previous surveys in 2016, 2014, 2013, 2012, 2011 and 2010. As stated in the 2013 report, comparisons to results from 2007 and 2008 were confounded by the variable depths sampled in the earlier surveys.

Average values of nickel and lead concentrations for the 15 inner harbour sites between 2010 and 2017 are shown in Table 9 (total nickel) and Table 10 (total lead). Results of the t-tests are presented in Tables 11 and 12. Raw and log10 transformed data was assessed for normal distribution using a histogram in Statistica. Subsequently, Log10 transformed

was selected to conduct t-tests. A statistically significant difference was based on a p-value of less than 0.05 (<0.05). The raw output from Statistica is provided in Appendix A.

Table 9: Average Values (n = 3) for Total Nickel for T-tests

Sampling Site	Ni 2017 (mg/kg)	Ni 2016 (mg/kg)	Ni 2014 (mg/kg)	Ni 2013 (mg/kg)	Ni 2012 (mg/kg)	Ni 2011 (mg/kg)	Ni 2010 (mg/kg)
A8	32	28.7	60.00	20.67	26.3	28	32.0
A9	33	35.3	386.67	37.00	34.7	107	623.3
A10b	48	58.7	41.33	160.00	160.0	86	543.3
A12	1.5	6.1	3.07	4.73	4.0	7	3.1
A13	17.3	29.7	11.67	31.67	21.7	27	32.7
A14	8.2	12.0	40.33	29.00	13.7	46	58.0
A15	6.8	17.7	40.33	22.67	9.2	16	45.7
A16	24	31.7	37.67	36.00	41.3	28	112.7
A17	9.4	26.0	57.33	12.00	11.7	24	34.3
A18	6.4	11.8	32.33	6.30	3.2	14	10.3
A19	3.3	6.7	10.70	4.07	8.9	15	6.0
A20	11.4	19.3	29.33	16.00	17	32	38.3
A21	21	10.0	13.67	31.67	29.7	33	44.7
A22	2	2.5	8.10	1.37	22.7	2	2.6
A23	29.7	18.7	23.33	33.00	36.3	33	39.7
Mean	***16.93***	***20.98***	***53.06***	***29.74***	***29***	***33***	***108***

Note: Data in this table was not normally distributed. All data was Log10 transformed to provide a normally distributed data set prior to undertaking t-test

Table 10: Average Values (n = 3) for Total Lead for T-tests

Sampling Site	Pb 2017 (mg/kg)	Pb 2016 (mg/kg)	Pb 2014 (mg/kg)	Pb 2013 (mg/kg)	Pb 2012 (mg/kg)	Pb 2011 (mg/kg)	Pb 2010 (mg/kg)
A8	10.33	8.33	20.00	7.00	10.33	10.67	18.67
A9	15.67	12.00	14.33	17.00	20.33	39.33	210.00
A10b	12	9.00	26.00	47.00	65.67	58.67	326.67
A12	1	2.67	1.00	2.67	4.33	2.67	3.33
A13	5	6.67	4.33	7.67	8.67	8.67	10.00
A14	3.33	5.00	57.00	10.00	8.33	21.33	27.67
A15	2.33	5.33	20.67	7.00	7.00	7.33	21.33
A16	7.33	9.33	5.00	13.00	20.33	9.67	38.67
A17	4	8.33	20.33	5.67	6.67	11.00	16.33
A18	3.33	4.67	17.67	4.00	4.00	5.33	5.33
A19	2	1.33	4.33	2.00	6.67	11.67	3.00
A20	11.4	6.33	10.33	5.33	8.00	11.33	13.00
A21	21	4.33	6.67	11.67	12.00	14.33	18.33
A22	2	1.67	4.33	1.00	3.00	1.67	2.33
A23	29.7	5.67	8.33	11.00	13.00	12.00	15.00
Mean	***8.69***	***6.04***	***14.69***	***10.13***	***13.22***	***15.04***	***48.64***

Note: Data in this table was not normally distributed. All data was Log10 transformed to provide a normally distributed data set prior to undertaking t-test

5.5.1 T-test Inner Harbour Nickel Results

1. *Analyses of the 2017 data against the 2016, 2014, 2013, 2012, 2011 and 2010 data for all 15 inner harbour sites*

T-tests were conducted for average concentrations of nickel in the top 10cm of sediment for all 15 inner harbour sites in 2010, 2011, 2012, 2013, 2014, 2016 and 2017. T-test results comparing 2017 total nickel results against the previous year's results are provided below in Table 11. T-test results show that there was a statistically significant ($p<0.05$) decrease in total nickel concentrations when comparing 2017 data with 2014 ($p=0.024$), 2011 ($p=0.04$) and 2010 ($p=0.024$) data. There was no significant difference ($p>0.05$) when comparing 2017 to 2016, 2013 and 2012 data. The decline in nickel concentrations from 2010 to 2017 is representative of the cessation of bulk nickel export and indicates that contamination is decreasing in inner harbour sediments.

Table 11: T-Test Results for all Inner Harbour Sites for Total Nickel

	t value	p value	df
Nickel 2017 vs. 2016	-1.01446	0.319049	28
Nickel 2017 vs. 2014	-2.37962	**0.024382**	28
Nickel 2017 vs. 2013	-0.995705	0.327921	28
Nickel 2017 vs. 2012	-0.749953	0.459539	28
Nickel 2017 vs. 2011	-2.14882	**0.040440**	28
Nickel 2017 vs. 2010	-2.38507	**0.024085**	28

Note: All data was Log10 transformed to provide normal distribution of data
Bold red indicates p values <0.05, therefore statistically different

Although patterns in total nickel are indicative of exposure, exposures of nickel to marine biota are measured via bioavailable concentrations. All bioavailable concentrations were below ISQG-Low values in 2017 and so are unlikely to present significant risks of toxicity.

5.5.2 T-test Inner Harbour Lead Results

The results for the t-test conducted for lead data (Table 10) for all 15 inner harbour sites are provided below in Table 12. There was a significant difference ($p<0.05$) for total lead concentrations in the top 10cm of sediment sampled at 15 inner harbour sites when

comparing 2017 results to those of 2014, 2012, 2011 and 2010. There was no significant difference ($p>0.05$) for total lead when comparing 2017 results to 2016 and 2013 results.

Mean concentrations of total lead were three fold lower in 2017 than in 2010 (refer to Table 10). A decrease trend in mean total lead concentrations can be seen from 2011, with an increase in 2014, following a maintenance dredging event, and a slight increase in 2017 from 2016. The slight increase in 2017 still coincides with the overarching pattern of decreasing total lead concentrations in the 15 inner harbor site marine sediments. Although patterns in total lead are indicative of exposure, exposures of lead to marine biota are measured via bioavailable concentrations. All bioavailable concentrations were below ISQG-Low values and so are unlikely to present significant risks of toxicity.

Table 12: T-Test Results for all Inner Harbour Sites for Total Lead

	t value	p value	df
Lead 2017 vs. 2016	-0.550231	0.586524	28
Lead 2017 vs. 2014	-2.51951	**0.017737**	28
Lead 2017 vs. 2013	-1.43148	0.163362	28
Lead 2017 vs. 2012	-2.56618	**0.015922**	28
Lead 2017 vs. 2011	-2.75735	**0.010143**	28
Lead 2017 vs. 2010	-3.11977	**0.004168**	28

Note: All data was Log10 transformed prior to undertaking t-test to provide normal distribution of data
Bold red indicates p values <0.05, therefore statistically different

6 CONCLUSION

Bioavailable levels of contamination of metals (particularly nickel and lead) in the top 10cm of sediment in the inner and outer harbour sites were all below ISQG-Low values and therefore are unlikely to present a significant risk of toxicity to marine biota. Although one of the three sites sampled for TBT did exceed the ISQG-Low value.

Results from the 2017 monitoring were generally consistent with that of the previous year, and conform to the overall trend of declining lead and nickel concentrations in the inner harbour. Overall, the results of the 2017 survey did not exceed the relevant triggers for contingency actions (refer Table 5) and therefore no further action is required.

7 RISK MANAGEMENT AND RECOMMENDATIONS

7.1 Operational Actions taken to reduce emissions to inner harbour

1. Cleaning procedures on the multi-user Berth 2 have been upgraded and continue to be reviewed for additional improvements. These improvements aim to reduce the potential for nickel (containerised export), bulk sulphur and bulk fertiliser contaminated water from entering the harbour;

7.2 Further actions to be taken

1. Aim to complete maintenance dredging that removes the remaining contaminated sediments at the berth pockets (disposal to land) in the coming years. Timing of these works will be dependent on a number of factors including bathymetry surveys, availability of a suitable vessel and timing of other capital SPE projects;
2. Reduce potential for future nickel contamination of the marine sediments by continuing to receive nickel products within sealed containers for export or shiploading using a Rotating Container System (with controls on product conditioning and dust suppression) to reduce the potential for nickel entering the marine environment; and
3. Continue to monitor the quality of sample volume at each site and propose changes to monitoring locations as required to enable full sample collection and provide a representative sample.

8 REFERENCES

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9 APPENDICES

9.1 Appendix A - T-test Results from Statistica

T-Tests comparing Data for all 15 inner harbour sites

Note: For all tests, T-test for independent samples. Variables were treated as independent samples. All data was Log10 transformed to provide normally distributed data sets

Test 1: Levene's T-test for mean total Nickel results comparing 2017 and 2016 data for 15 inner harbour sites

Group 1 vs. Group 2	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Ni 2017 vs. Ni 2016	1.096044	1.231650	-1.01446	28	0.319049	15	15	0.399201	0.329643	1.466540	0.482935	0.945105	28	0.339292

Test 2: Levene's T-test for mean total Nickel results comparing 2017 and 2014 data for 15 inner harbour sites

Group 1 vs. Group 2	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Ni 2017 vs. Ni 2014	1.096044	1.472170	-2.37962	28	0.024382	15	15	0.399201	0.464102	1.351587	0.580501	0.011518	28	0.915298

Test 3: Levene's T-test for mean total Nickel results comparing 2017 and 2013 data for 15 inner harbour sites

Group 1 vs. Group 2	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Ni 2017 vs. Ni 2013	1.096044	1.253449	-0.995705	28	0.327921	15	15	0.399201	0.464216	1.352255	0.579883	0.173002	28	0.680629

Test 4: Levene's T-test for mean total Nickel results comparing 2017 and 2012 data for 15 inner harbour sites

Group 1 vs. Group 2	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Ni 2017 vs. Ni 2012	1.096044	1.215395	-0.749953	28	0.459539	15	15	0.399201	0.469620	1.383919	0.551283	0.069856	28	0.793483

Test 5: Levene's T-test for mean total nickel results comparing 2017 and 2011 data for 15 inner harbour sites

Group 1 vs. Group 2	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Ni 2017 vs. Ni 2011	1.096044	1.398505	-2.14882	28	0.040440	15	15	0.399201	0.371249	1.156252	0.789703	0.725222	28	0.401661

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Test 6: Levene's T-test for mean total nickel results comparing 2017 and 2010 data for 15 inner harbour sites

Group 1 vs. Group 2	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Ni 2017 vs. Ni 2010	1.096044	1.564238	-2.38507	28	0.024085	15	15	0.399201	0.647035	2.627080	0.081363	0.690368	28	0.413068

Test 7: Levene's T-test for mean total Lead results comparing 2017 and 2016 data for 15 inner harbour sites

Group 1 vs. Group 2	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Pb 2017 vs. Pb 2016	0.748497	0.799329	-0.550231	28	0.586524	15	15	0.286331	0.214554	1.781001	0.292062	1.327763	28	0.258947

Test 8: Levene's T-test for mean total Lead results comparing 2017 and 2014 data for 15 inner harbour sites

Group 1 vs. Group 2	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Pb 2017 vs. Pb 2014	0.748497	1.053850	-2.51951	28	0.017737	15	15	0.286331	0.371938	1.687351	0.339004	1.278157	28	0.267833

Test 9: Levene's T-test for mean total Lead results comparing 2017 and 2013 data for 15 inner harbour sites

Group 1 vs. Group 2	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Pb 2017 vs. Pb 2013	0.748497	0.911780	-1.43148	28	0.163362	15	15	0.286331	0.336423	1.380493	0.554311	0.074542	28	0.786839

Test 10: Levene's T-test for mean total Lead results comparing 2017 and 2012 data for 15 inner harbour sites

Group 1 vs. Group 2	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Pb 2017 vs. Pb 2012	0.748497	1.023289	-2.56618	28	0.015922	15	15	0.286331	0.300021	1.097912	0.863726	0.021535	28	0.884381

Test 11: Levene's T-test for mean total Lead results comparing 2017 and 2011 data for 15 inner harbour sites

Group 1 vs. Group 2	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Pb 2017 vs. Pb 2011	0.748497	1.066817	-2.75735	28	0.010143	15	15	0.286331	0.343401	1.438361	0.505260	0.001609	28	0.968285

Test 12: Levene's T-test for mean total Lead results comparing 2017 and 2010 data for 15 inner harbour sites

Group 1 vs. Group 2	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Pb 2017 vs. Pb 2010	0.748497	1.260267	-3.11977	28	0.004168	15	15	0.286331	0.567146	3.923321	0.015307	2.159498	28	0.152838

T-Tests comparing data for sites which exceeded ISQG-Low in 2010

Test 13: Levene's T-test for mean total Nickel results comparing 2017 and 2016 for 10 Inner Harbour Sites

	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Ni 2017 vs. Ni 2016	1.314915	1.410713	-0.951238	18	0.354083	10	10	0.252621	0.193922	1.697020	0.442889	1.008240	18	0.328633

Test 14: Levene's T-test for mean total Nickel results comparing 2017 and 2014 for 10 Inner Harbour Sites

	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Ni 2017 vs. Ni 2014	1.314915	1.591708	-1.88394	18	0.075831	10	10	0.252621	0.389930	2.382500	0.211998	0.286497	18	0.599025

Test 15: Levene's T-test for mean total Nickel results comparing 2017 and 2013 for 10 Inner Harbour Sites

	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Ni 2017 vs. Ni 2013	1.314915	1.465029	-1.12631	18	0.274827	10	10	0.252621	0.337367	1.783465	0.401750	0.023355	18	0.880237

Test 16: Levene's T-test for mean total Nickel results comparing 2017 and 2012 for 10 Inner Harbour Sites

	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Ni 2017 vs. Ni 2012	1.314915	1.450797	-1.03661	18	0.313644	10	10	0.252621	0.328652	1.692515	0.445160	0.097331	18	0.758641

Test 17: Levene's T-test for mean total Nickel results comparing 2017 and 2011 for 10 Inner Harbour Sites

	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Ni 2017 vs. Ni 2011	1.314915	1.550355	-2.12803	18	0.047408	10	10	0.252621	0.242052	1.089235	0.900769	0.230014	18	0.637289

Test 18: Levene's T-test for mean total Nickel results comparing 2017 and 2010 for 10 Inner Harbour Sites

	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene	p Levene
Ni 2017 vs. Ni 2010	1.314915	1.864161	-3.12855	18	0.005805	10	10	0.252621	0.494363	3.829588	0.058218	3.986165	18	0.061228

9.2 Appendix B – Laboratory Reports

REPORT OF ANALYSIS

Report No. RN1168954

Client	: CHEMCENTRE	**Job No.**	: CHEM06/170808
	CORNER MANNING ROAD AND SOUTH ENTRANCE	**Quote No.**	: QT-02029
	OF CURTIN UNIVERSITY	**Order No.**	:
	BENTLEY WA 6103	**Date Sampled**	:
		Date Received	: 8-AUG-2017
Attention	: ELENA MCCONVILLE-WOLFE	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: RICHARD COGHLAN	**Phone**	: (02) 94490161

Lab Reg No.	Sample Ref	Sample Description
N17/023237	A8	SOIL 17S0488/001 25/07/2017 10:30
N17/023238	A9	SOIL 17S0488/002 26/07/2017 10:45
N17/023239	A10b	SOIL 17S0488/003 24/07/2017 15:10

Lab Reg No.		N17/023237	N17/023238	N17/023239		
Sample Reference	**Units**	**A8**	**A9**	**A10b**		**Method**
Organotins						
Monobutyltin as Sn	ng/g	<0.5	<0.5	<0.5		NR_35
Dibutyltin as Sn	ng/g	4.0	0.63	0.52		NR_35
Tributyltin as Sn	ng/g	18	1.0	1.4		NR_35
Surrogate: Tripropyltin	%REC	94	91	94		NR_35
Dates						
Date extracted		15-AUG-2017	15-AUG-2017	15-AUG-2017		
Date analysed		16-AUG-2017	16-AUG-2017	16-AUG-2017		

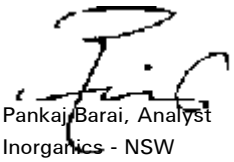
Luke Baker, Analyst
Organics - NSW
Accreditation No. 198

23-AUG-2017

Lab Reg No.		N17/023237	N17/023238	N17/023239		
Sample Reference	**Units**	**A8**	**A9**	**A10b**		**Method**
Trace Elements						
Total Solids	%	65.3	77.4	74.1		NT2_49

REPORT OF ANALYSIS

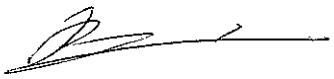
Lab Reg No.		N17/023237	N17/023238	N17/023239		
Sample Reference	Units	A8	A9	A10b		Method



Pankaj Barai, Analyst
Inorganics - NSW
Accreditation No. 198

23-AUG-2017

Lab Reg No.		N17/023237	N17/023238	N17/023239		
Sample Reference	Units	A8	A9	A10b		Method
Miscellaneous						
Carbon - Total Organic	mg/kg	9600	2700	3500		NW_S15



Wei Huang, Analyst
Inorganics - NSW
Accreditation No. 198

23-AUG-2017

All results are expressed on a dry weight basis.

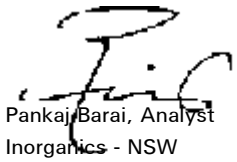
REPORT OF ANALYSIS

Report No. RN1168954

Client	: CHEMCENTRE	**Job No.**	: CHEM06/170808
	CORNER MANNING ROAD AND SOUTH ENTRANCE	**Quote No.**	: QT-02029
	OF CURTIN UNIVERSITY	**Order No.**	:
	BENTLEY WA 6103	**Date Sampled**	:
		Date Received	: 8-AUG-2017
Attention	: ELENA MCCONVILLE-WOLFE	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: RICHARD COGHLAN	**Phone**	: (02) 94490161

Lab Reg No.	Sample Ref	Sample Description
N17/023240	A8-1	SOIL 17S0488/004 25/07/2017 10:30
N17/023241	A8-2	SOIL 17S0488/005 25/07/2017 10:30
N17/023242	A8-3	SOIL 17S0488/006 25/07/2017 10:30

Lab Reg No.			N17/023240	N17/023241	N17/023242		
Sample Reference		Units	A8-1	A8-2	A8-3		Method
Trace Elements							
Arsenic - Bioavailable		mg/kg	<0.5	0.55	<0.5		NT2_49B
Cadmium - Bioavailable		mg/kg	<0.5	<0.5	<0.5		NT2_49B
Chromium - Bioavailable		mg/kg	5.9	5.5	5.6		NT2_49B
Copper - Bioavailable		mg/kg	5.8	5.5	3.6		NT2_49B
Total Solids		%	69.9	70.1	67.6		NT2_49
Lead - Bioavailable		mg/kg	12	13	8.3		NT2_49B
Manganese - Bioavailable		mg/kg	6.9	6.3	6.5		NT2_49B
Nickel - Bioavailable		mg/kg	3.0	2.8	2.1		NT2_49B
Sulphur - Bioavailable		mg/kg	2700	2680	2680		NT2_49B
Zinc - Bioavailable		mg/kg	13	8.9	8.4		NT2_49B



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Inorganics - NSW
Accreditation No. 198

23-AUG-2017

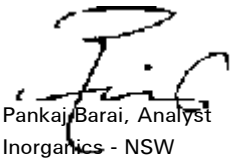
REPORT OF ANALYSIS

Report No. RN1168954

Client	: CHEMCENTRE	**Job No.**	: CHEM06/170808
	CORNER MANNING ROAD AND SOUTH ENTRANCE	**Quote No.**	: QT-02029
	OF CURTIN UNIVERSITY	**Order No.**	:
	BENTLEY WA 6103	**Date Sampled**	:
		Date Received	: 8-AUG-2017
Attention	: ELENA MCCONVILLE-WOLFE	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: RICHARD COGHLAN	**Phone**	: (02) 94490161

Lab Reg No.	Sample Ref	Sample Description
N17/023243	A14-1	SOIL 17S0488/007 24/07/2017 13:43
N17/023244	A14-2	SOIL 17S0488/008 24/07/2017 13:43
N17/023245	A14-3	SOIL 17S0488/009 24/07/2017 13:43
N17/023246	A16-1	SOIL 17S0488/010 24/07/2017 09:15

Lab Reg No.			N17/023243	N17/023244	N17/023245	N17/023246	
Sample Reference		Units	A14-1	A14-2	A14-3	A16-1	Method
Trace Elements							
Total Solids		%	74.4	75.4	75.0	78.3	NT2_49
Lead - Bioavailable		mg/kg	3.3	2.9	3.3	12	NT2_49B
Nickel - Bioavailable		mg/kg	1.4	1.2	1.3	2.1	NT2_49B



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23-AUG-2017

REPORT OF ANALYSIS

Report No. RN1168954

Client	: CHEMCENTRE	**Job No.**	: CHEM06/170808
	CORNER MANNING ROAD AND SOUTH ENTRANCE	**Quote No.**	: QT-02029
	OF CURTIN UNIVERSITY	**Order No.**	:
	BENTLEY WA 6103	**Date Sampled**	:
		Date Received	: 8-AUG-2017
Attention	: ELENA MCCONVILLE-WOLFE	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: RICHARD COGHLAN	**Phone**	: (02) 94490161

Lab Reg No.	Sample Ref	Sample Description
N17/023247	A16-2	SOIL 17S0488/011 24/07/2017 09:15
N17/023248	A16-3	SOIL 17S0488/012 24/07/2017 09:15

Lab Reg No.			N17/023247	N17/023248			
Sample Reference		Units	A16-2	A16-3			Method
Trace Elements							
Total Solids		%	73.2	72.5			NT2_49
Lead - Bioavailable		mg/kg	6.9	6.7			NT2_49B
Nickel - Bioavailable		mg/kg	2.8	2.1			NT2_49B

Pankaj Barai, Analyst
Inorganics - NSW
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23-AUG-2017

ACCREDITED FOR TECHNICAL COMPETENCE

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This report shall not be reproduced except in full.
Results relate only to the sample(s) tested.

This Report supersedes reports: *RN1168256*
RN1168327

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

Accreditation Number: 10603
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The results of the tests, calibrations and/or measurements included is this document are traceable to Australian/national standards.

Murdoch UNIVERSITY

SEDIMENT DATA

Contact: Caroline Aylott
Customer: Southern Ports Authority
Address: Crn Bower Avenue and The Esplanade, Esperance 6450

Date of Issue: 12/09/2017
Date Received: 01/08/2016
Our Reference: SPA17-3
Your Reference: EVV13-737

METHOD SAMPLE CODE	Sampling Date	ICP002 Total Ext As mg/kg	ICP002 Total Ext Cd mg/kg	ICP002 Total Ext Cr mg/kg	ICP002 Total Ext Cu mg/kg	ICP002 Total Ext Li mg/kg	ICP002 Total Ext Mn mg/kg	ICP002 Total Ext Ni mg/kg	ICP002 Total Ext Pb mg/kg	ICP002 Total Ext S mg/kg	ICP002 Total Ext Zn mg/kg
Reporting Limit		<2	<0.1	<0.2	<0.2	<1	<0.05	<0.7	<1	<10	<0.5
Analysis Date		15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017
File		17081501	17081501	17081501	17081501	17081501	17081501	17081501	17081501	17081501	17081501
A5-1	25/07/2017	2	<0.1	6.5	1.1	1	9.0	2.9	1	1300	2.1
A5-2	25/07/2017	3	0.1	6.7	1.4	2	9.6	3.1	1	1400	2.9
A5-3	25/07/2017	2	<0.1	6.4	1.0	1	8.0	1.8	1	1300	1.9
A6-1	26/07/2017	<2	0.1	6.6	0.4	1	9.2	<0.7	<1	1100	1.0
A6-2	26/07/2017	2	<0.1	7.1	0.4	1	9.9	<0.7	<1	1200	1.5
A6-3	26/07/2017	2	<0.1	6.8	0.4	1	9.1	<0.7	<1	1100	1.1
A7-1	27/07/2017	3	<0.1	3.8	0.7	<1	5.9	<0.7	<1	910	1.0
A7-2	27/07/2017	3	<0.1	3.8	0.3	1	5.1	<0.7	<1	1100	1.2
A7-3	27/07/2017	3	<0.1	3.8	0.3	<1	4.7	<0.7	<1	1100	1.0
A8-1	25/07/2017	5	0.2	11	33	4	14	47	14	3200	28
A8-2	25/07/2017	3	0.1	8.5	18	3	10	29	11	2300	17
A8-3	25/07/2017	3	0.1	7.8	19	2	11	20	6	1800	16
A9-1	26/07/2017	3	0.1	8.0	5.8	2	7.4	30	19	1500	11
A9-2	26/07/2017	2	0.1	7.6	9.7	2	7.5	49	23	1400	14
A9-3	26/07/2017	2	0.1	7.9	4.6	2	7.6	20	15	1400	7.2
A10b-1	24/07/2017	3	0.1	7.7	7.9	2	9.1	51	13	1500	13
A10b-2	24/07/2017	3	0.1	7.9	9.1	2	9.7	53	13	1600	15
A10b-3	24/07/2017	3	0.1	7.5	6.6	2	8.3	40	10	1500	22
A11-1	27/07/2017	3	<0.1	8.9	2.6	2	11	6.4	2	1800	4.9
A11-2	27/07/2017	3	<0.1	9.0	2.4	2	9.8	6.3	2	1800	3.9
A11-3	27/07/2017	3	0.1	8.3	3.1	2	9.3	7.7	2	1800	4.5

Signatory: Jamie Woodward
Date: 12/09/2017

All test items tested as received. 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

Accreditation Number: 10603
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The results of the tests, calibrations and/or
measurements included is this document are traceable
to Australian/national standards.

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SEDIMENT DATA

Contact: Caroline Aylott
Customer: Southern Ports Authority
Address: Crn Bower Avenue and The Esplanade, Esperance 6450

Date of Issue: 12/09/2017
Date Received: 01/08/2016
Our Reference: SPA17-3
Your Reference: EVV13-737

METHOD SAMPLE CODE	Sampling Date	ICP002 Total Ext As mg/kg	ICP002 Total Ext Cd mg/kg	ICP002 Total Ext Cr mg/kg	ICP002 Total Ext Cu mg/kg	ICP002 Total Ext Li mg/kg	ICP002 Total Ext Mn mg/kg	ICP002 Total Ext Ni mg/kg	ICP002 Total Ext Pb mg/kg	ICP002 Total Ext S mg/kg	ICP002 Total Ext Zn mg/kg
Reporting Limit		**<2**	**<0.1**	**<0.2**	**<0.2**	**<1**	**<0.05**	**<0.7**	**<1**	**<10**	**<0.5**
Analysis Date		**15/08/2017**	**15/08/2017**	**15/08/2017**	**15/08/2017**	**15/08/2017**	**15/08/2017**	**15/08/2017**	**15/08/2017**	**15/08/2017**	**15/08/2017**
File		**17081501**	**17081501**	**17081501**	**17081501**	**17081501**	**17081501**	**17081501**	**17081501**	**17081501**	**17081501**
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A12-3	27/07/2017	<2	<0.1	5.9	0.5	2	6.8	1.7	<1	1200	1.0
A13-1	26/07/2017	4	0.1	8.5	6.5	2	8.8	17	5	1900	10
A13-2	26/07/2017	3	<0.1	8.5	6.5	2	9.1	18	5	2000	11
A13-3	26/07/2017	3	0.1	8.6	7.3	2	8.8	17	5	2000	12
A14-1	24/07/2017							9.4	3		
A14-2	24/07/2017							5.3	3		
A14-3	24/07/2017							10	4		
A15-1	24/07/2017							6.8	2		
A15-2	24/07/2017							6.3	2		
A15-3	24/07/2017							7.3	3		
A16-1	24/07/2017							23	9		
A16-2	24/07/2017							24	6		
A16-3	24/07/2017							25	7		
A17-1	26/07/2017							6.9	3		
A17-2	26/07/2017							13	5		
A17-3	26/07/2017							8.2	4		
A18-1	26/07/2017							7.7	4		
A18-2	26/07/2017							2.8	2		
A18-3	26/07/2017							8.7	4		

Signatory: Jamie Woodward
Date: 12/09/2017

All test items tested as received. Spare test items will be held for two months unless otherwise requested.

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METHOD SAMPLE CODE	Sampling Date	ICP002 Total Ext As mg/kg	ICP002 Total Ext Cd mg/kg	ICP002 Total Ext Cr mg/kg	ICP002 Total Ext Cu mg/kg	ICP002 Total Ext Li mg/kg	ICP002 Total Ext Mn mg/kg	ICP002 Total Ext Ni mg/kg	ICP002 Total Ext Pb mg/kg	ICP002 Total Ext S mg/kg	ICP002 Total Ext Zn mg/kg
Reporting Limit		<2	<0.1	<0.2	<0.2	<1	<0.05	<0.7	<1	<10	<0.5
Analysis Date		15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017
File		17081501	17081501	17081501	17081501	17081501	17081501	17081501	17081501	17081501	17081501
A19-1	24/07/2017							3.1	2		
A19-2	24/07/2017							4.2	2		
A19-3	24/07/2017							2.6	2		
A20-1	25/07/2017							12	5		
A20-2	25/07/2017							14	5		
A20-3	25/07/2017							8.3	4		
A21-1	25/07/2017							20	6		
A21-2	25/07/2017							18	5		
A21-3	25/07/2017							25	7		
A22-1	25/07/2017							2.4	1		
A22-2	25/07/2017							1.5	1		
A22-3	25/07/2017							2.2	1		
A23-1	27/07/2017							33	10		
A23-2	27/07/2017							30	7		
A23-3	27/07/2017							26	7		

Note: Results expressed as dry weight basis

Signatory: Jamie Woodward
Date: 12/09/2017

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

Accreditation Number: 10603
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Murdoch UNIVERSITY

SEDIMENT DATA

Contact: Caroline Aylott
Customer: Southern Ports Authority
Address: Crn Bower Avenue and The Esplanade, Esperance 6450

Date of Issue: 12/09/2017
Date Received: 01/08/2016
Our Reference: SPA17-3
Your Reference: EVV13-737

METHOD SAMPLE CODE	Sampling Date	ICP002 Total Ext As mg/kg	ICP002 Total Ext Cd mg/kg	ICP002 Total Ext Cr mg/kg	ICP002 Total Ext Cu mg/kg	ICP002 Total Ext Li mg/kg	ICP002 Total Ext Mn mg/kg	ICP002 Total Ext Ni mg/kg	ICP002 Total Ext Pb mg/kg	ICP002 Total Ext S mg/kg	ICP002 Total Ext Zn mg/kg
Reporting Limit		<2	<0.1	<0.2	<0.2	<1	<0.05	<0.7	<1	<10	<0.5
Analysis Date		15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017	15/08/2017
File		17081501	17081501	17081501	17081501	17081501	17081501	17081501	17081501	17081501	17081501
QAQC Data	**Criteria**										
Duplicate 1	<20%	8.2%	<RL	2.1%	0.0%	2.6%	0.2%	19.0%	10.7%	0.4%	4.3%
Duplicate 2	<20%	17.5%	<RL	0.3%	6.7%	1.2%	1.4%	9.4%	<RL	1.3%	4.3%
Duplicate 3	<20%	4.4%	6.7%	1.7%	0.9%	0.1%	2.0%	5.5%	2.6%	0.6%	2.8%
Duplicate 4	<20%	2.5%	14.9%	0.9%	1.3%	0.2%	1.9%	0.4%	0.1%	1.2%	2.0%
Duplicate 5	<20%	14.3%	14.8%	6.5%	8.9%	4.5%	6.6%	8.7%	8.1%	4.2%	16.8%
Duplicate 6	<20%	0.9%	8.1%	1.4%	5.3%	5.5%	4.2%	3.5%	3.7%	0.7%	15.8%
Duplicate 7	<20%							5.0%	9.3%		
Duplicate 8	<20%							8.1%	3.5%		
Duplicate 9	<20%							5.4%	5.6%		
Duplicate 10	<20%							5.7%	8.6%		
Duplicate 11	<20%							19.6%	7.2%		
Duplicate 12	<20%							7.0%	5.0%		
SRM Recovery 1	80%-120%	100.6%	102.6%	100.9%	96.6%	93.4%	99.7%	101.6%	103.1%	94.9%	110.0%
SRM Recovery 2	80%-120%	96.0%	100.1%	94.7%	92.0%	82.3%	95.1%	96.8%	99.0%	90.8%	105.7%
SRM Recovery 3	80%-120%	96.0%	99.9%	98.2%	92.2%	90.8%	95.7%	98.1%	98.9%	92.5%	107.7%
SRM Recovery 4	80%-120%	90.7%	93.9%	88.9%	85.0%	80.3%	87.8%	89.7%	92.8%	86.6%	102.3%
SRM Recovery 5	80%-120%	99.1%	103.2%	95.1%	92.3%	80.8%	95.7%	97.9%	102.0%	93.7%	110.9%

Signatory: Jamie Woodward
Date: 12/09/2017

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SEDIMENT DATA

Contact: Caroline Aylott
Customer: Southern Ports Authority
Address: Crn Bower Avenue and The Esplanade, Esperance 6450

Date of Issue: 12/09/2017
Date Received: 01/08/2016
Our Reference: SPA17-3
Your Reference: EVV13-737

METHOD SAMPLE CODE	Sampling Date	ICP002 Total Ext As mg/kg	ICP002 Total Ext Cd mg/kg	ICP002 Total Ext Cr mg/kg	ICP002 Total Ext Cu mg/kg	ICP002 Total Ext Li mg/kg	ICP002 Total Ext Mn mg/kg	ICP002 Total Ext Ni mg/kg	ICP002 Total Ext Pb mg/kg	ICP002 Total Ext S mg/kg	ICP002 Total Ext Zn mg/kg
Reporting Limit		**<2**	**<0.1**	**<0.2**	**<0.2**	**<1**	**<0.05**	**<0.7**	**<1**	**<10**	**<0.5**
Analysis Date		**15/08/2017**	**15/08/2017**	**15/08/2017**	**15/08/2017**	**15/08/2017**	**15/08/2017**	**15/08/2017**	**15/08/2017**	**15/08/2017**	**15/08/2017**
File		**17081501**	**17081501**	**17081501**	**17081501**	**17081501**	**17081501**	**17081501**	**17081501**	**17081501**	**17081501**
QAQC Data	**Criteria**										
BLANK	<Reporting Limit	<2	<0.1	<0.2	<0.2	<1	<0.05	<0.7	<1	<10	<0.5
BLANK	<Reporting Limit	<2	<0.1	<0.2	<0.2	<1	<0.05	<0.7	<1	<10	<0.5
BLANK	<Reporting Limit	<2	<0.1	<0.2	<0.2	<1	<0.05	<0.7	<1	<10	<0.5
BLANK	<Reporting Limit	<2	<0.1	<0.2	<0.2	<1	<0.05	<0.7	<1	<10	<0.5
CRM Recovery 1	80%-120%	108.7%	103.4%	102.9%	95.6%	103.6%	98.6%	105.7%	106.7%	113.7%	103.7%
CRM Recovery 2	80%-120%	105.6%	100.9%	95.2%	93.9%	97.4%	92.7%	98.4%	102.5%	107.3%	100.7%

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Date: 12/09/2017

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Contact: Caroline Aylott
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Date of Issue: 12/09/2017
Date Received: 01/08/2016
Our Reference: SPA17-3
Your Reference: EVV13-737

METHOD SAMPLE CODE	Sampling Date	ICP002 Dilute Acid As mg/kg	ICP002 Dilute Acid Cd mg/kg	ICP002 Dilute Acid Cr mg/kg	ICP002 Dilute Acid Cu mg/kg	ICP002 Dilute Acid Li mg/kg	ICP002 Dilute Acid Mn mg/kg	ICP002 Dilute Acid Ni mg/kg	ICP002 Dilute Acid Pb mg/kg	ICP002 Dilute Acid S mg/kg	ICP002 Dilute Acid Zn mg/kg
Reporting Limit		**<2**	**<0.1**	**<0.2**	**<0.2**	**<1**	**<0.05**	**<0.7**	**<1**	**<10**	**<0.5**
Analysis Date		**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**
File		**17081601**	**17081601**	**17081601**	**17081601**	**17081601**	**17081601**	**17081601**	**17081601**	**17081601**	**17081601**
A5-1	25/07/2017	2	<0.1	5.2	0.5	<1	5.5	<0.7	1	1200	1.0
A5-2	25/07/2017	3	0.1	5.2	0.6	<1	5.5	<0.7	1	1200	1.3
A5-3	25/07/2017	3	<0.1	5.0	0.5	<1	5.3	<0.7	<1	1100	1.2
A6-1	26/07/2017	<2	<0.1	5.9	<0.2	<1	6.5	<0.7	<1	1100	<0.5
A6-2	26/07/2017	<2	<0.1	6.5	0.3	<1	6.8	<0.7	<1	1100	0.5
A6-3	26/07/2017	<2	<0.1	6.2	0.3	<1	6.9	<0.7	<1	1100	<0.5
A7-1	27/07/2017	3	<0.1	3.7	<0.2	<1	4.1	<0.7	<1	790	0.5
A7-2	27/07/2017	2	<0.1	3.5	0.2	<1	4.0	<0.7	<1	880	0.6
A7-3	27/07/2017	<2	0.1	3.8	0.2	<1	4.4	<0.7	<1	960	0.6
A8-1	25/07/2017	<2	0.1	5.4	11	1	7.2	3.8	14	1600	15
A8-2	25/07/2017	2	<0.1	5.2	7.0	1	6.3	2.9	11	1300	8.1
A8-3	25/07/2017	<2	0.1	5.1	6.8	1	5.9	2.1	6	1300	7.1
A9-1	26/07/2017	<2	0.1	6.3	1.5	1	4.3	1.2	16	980	3.4
A9-2	26/07/2017	<2	0.1	6.5	1.9	1	4.5	2.4	40	1100	5.9
A9-3	26/07/2017	<2	<0.1	3.1	0.7	<1	2.1	<0.7	8	490	1.7
A10b-1	24/07/2017	<2	0.1	5.2	2.9	<1	4.5	4.5	13	1100	8.4
A10b-2	24/07/2017	<2	<0.1	5.3	3.4	<1	4.7	5.5	13	1200	11
A10b-3	24/07/2017	<2	<0.1	5.1	2.4	<1	4.3	2.8	8	940	8.3
A11-1	27/07/2017	3	0.1	7.1	1.0	1	7.9	0.8	2	1600	1.9
A11-2	27/07/2017	<2	<0.1	7.3	1.0	1	7.8	0.9	2	1700	1.9
A11-3	27/07/2017	<2	0.1	6.5	1.2	1	7.2	0.9	3	1600	2.4

Signatory: Jamie Woodward
Date: 12/09/2017

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SEDIMENT DATA

Contact: Caroline Aylott
Customer: Southern Ports Authority
Address: Crn Bower Avenue and The Esplanade, Esperance 6450

Date of Issue: 12/09/2017
Date Received: 01/08/2016
Our Reference: SPA17-3
Your Reference: EVV13-737

METHOD SAMPLE CODE	Sampling Date	ICP002 Dilute Acid As mg/kg	ICP002 Dilute Acid Cd mg/kg	ICP002 Dilute Acid Cr mg/kg	ICP002 Dilute Acid Cu mg/kg	ICP002 Dilute Acid Li mg/kg	ICP002 Dilute Acid Mn mg/kg	ICP002 Dilute Acid Ni mg/kg	ICP002 Dilute Acid Pb mg/kg	ICP002 Dilute Acid S mg/kg	ICP002 Dilute Acid Zn mg/kg
Reporting Limit		<2	<0.1	<0.2	<0.2	<1	<0.05	<0.7	<1	<10	<0.5
Analysis Date		16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017
File		17081601	17081601	17081601	17081601	17081601	17081601	17081601	17081601	17081601	17081601
A12-1	27/07/2017	<2	<0.1	4.5	<0.2	<1	3.3	<0.7	<1	910	<0.5
A12-2	27/07/2017	<2	<0.1	4.4	0.2	<1	3.3	<0.7	<1	900	<0.5
A12-3	27/07/2017	<2	<0.1	4.1	<0.2	<1	3.2	<0.7	<1	880	<0.5
A13-1	26/07/2017	<2	0.1	7.0	2.3	1	6.9	2.2	4	1700	6.0
A13-2	26/07/2017	2	0.1	6.8	2.3	1	6.7	2.0	5	1800	5.4
A13-3	26/07/2017	<2	0.1	6.3	2.4	1	6.0	2.2	4	1600	5.9
A14-1	24/07/2017							1.2	2		
A14-2	24/07/2017							1.1	2		
A14-3	24/07/2017							1.6	4		
A15-1	24/07/2017							0.9	2		
A15-2	24/07/2017							0.7	2		
A15-3	24/07/2017							1.1	3		
A16-1	24/07/2017							2.6	9		
A16-2	24/07/2017							2.1	4		
A16-3	24/07/2017							2.6	7		
A17-1	26/07/2017							1.3	2		
A17-2	26/07/2017							2.2	5		
A17-3	26/07/2017							1.7	3		
A18-1	26/07/2017							1.1	3		
A18-2	26/07/2017							<0.7	2		
A18-3	26/07/2017							1.1	4		

Signatory: Jamie Woodward
Date: 12/09/2017

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Reporting Limit		<2	<0.1	<0.2	<0.2	<1	<0.05	<0.7	<1	<10	<0.5
Analysis Date		16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017
File		17081601	17081601	17081601	17081601	17081601	17081601	17081601	17081601	17081601	17081601
A19-1	24/07/2017							0.8	2		
A19-2	24/07/2017							<0.7	2		
A19-3	24/07/2017							<0.7	2		
A20-1	25/07/2017							1.3	4		
A20-2	25/07/2017							1.0	3		
A20-3	25/07/2017							1.3	3		
A21-1	25/07/2017							1.6	6		
A21-2	25/07/2017							1.7	5		
A21-3	25/07/2017							1.7	6		
A22-1	25/07/2017							0.7	<1		
A22-2	25/07/2017							<0.7	<1		
A22-3	25/07/2017							<0.7	<1		
A23-1	27/07/2017							2.9	10		
A23-2	27/07/2017							2.8	6		
A23-3	27/07/2017							2.3	7		

Note: Results expressed as dry weight basis

Signatory: Jamie Woodward
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METHOD SAMPLE CODE	Sampling Date	ICP002 Dilute Acid As mg/kg	ICP002 Dilute Acid Cd mg/kg	ICP002 Dilute Acid Cr mg/kg	ICP002 Dilute Acid Cu mg/kg	ICP002 Dilute Acid Li mg/kg	ICP002 Dilute Acid Mn mg/kg	ICP002 Dilute Acid Ni mg/kg	ICP002 Dilute Acid Pb mg/kg	ICP002 Dilute Acid S mg/kg	ICP002 Dilute Acid Zn mg/kg
Reporting Limit		**<2**	**<0.1**	**<0.2**	**<0.2**	**<1**	**<0.05**	**<0.7**	**<1**	**<10**	**<0.5**
Analysis Date		**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**
File		**17081601**	**17081601**	**17081601**	**17081601**	**17081601**	**17081601**	**17081601**	**17081601**	**17081601**	**17081601**
QAQC Data											
Duplicate 1	<20%	1.3%	13.0%	4.8%	15.2%	2.4%	1.9%	12.2%	< RL	2.5%	10.8%
Duplicate 2	<20%	10.2%	1.5%	2.3%	1.2%	4.6%	2.6%	0.6%	1.0%	0.7%	0.3%
Duplicate 3	<20%	< RL	< RL	12.9%	1.5%	13.6%	12.5%	4.0%	12.2%	8.6%	18.9%
Duplicate 4	<20%	< RL	< RL	3.8%	6.2%	5.4%	1.5%	9.2%	6.5%	5.9%	1.6%
Duplicate 5	<20%	< RL	3.9%	6.8%	19.7%	12.4%	10.3%	13.7%	10.9%	11.8%	16.3%
Duplicate 6	<20%							3.4%	2.1%		
Duplicate 7	<20%							2.3%	16.0%		
Duplicate 8	<20%							4.3%	0.4%		
Duplicate 9	<20%							4.5%	13.8%		
Duplicate 10	<20%							12.0%	9.9%		
Duplicate 11	<20%							9.6%	6.2%		
Duplicate 12	<20%							1.3%	5.9%		
SRM Recovery 1	80%-120%	94.7%	95.8%	94.9%	85.6%	89.4%	91.3%	94.4%	97.0%	114.3%	99.2%
SRM Recovery 2	80%-120%	95.2%	95.2%	93.1%	85.0%	88.0%	91.2%	95.6%	95.4%	113.9%	99.3%
SRM Recovery 3	80%-120%	97.7%	97.9%	102.8%	87.9%	100.4%	93.9%	98.5%	98.9%	117.8%	101.8%
SRM Recovery 4	80%-120%	96.8%	99.8%	101.2%	89.9%	93.0%	94.6%	100.3%	100.7%	119.1%	104.5%
SRM Recovery 5	80%-120%	95.3%	97.7%	95.8%	84.6%	89.0%	92.5%	96.7%	98.2%	116.0%	102.6%

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Date: 12/09/2017

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METHOD SAMPLE CODE	Sampling Date	ICP002 Dilute Acid As mg/kg	ICP002 Dilute Acid Cd mg/kg	ICP002 Dilute Acid Cr mg/kg	ICP002 Dilute Acid Cu mg/kg	ICP002 Dilute Acid Li mg/kg	ICP002 Dilute Acid Mn mg/kg	ICP002 Dilute Acid Ni mg/kg	ICP002 Dilute Acid Pb mg/kg	ICP002 Dilute Acid S mg/kg	ICP002 Dilute Acid Zn mg/kg
Reporting Limit		**<2**	**<0.1**	**<0.2**	**<0.2**	**<1**	**<0.05**	**<0.7**	**<1**	**<10**	**<0.5**
Analysis Date		**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**	**16/08/2017**
File		**17081601**	**17081601**	**17081601**	**17081601**	**17081601**	**17081601**	**17081601**	**17081601**	**17081601**	**17081601**
QAQC Data											
BLANK	<Reporting Limit	<2	<0.1	<0.2	<0.2	<1	<0.05	<0.7	<1	<10	<0.5
BLANK	<Reporting Limit	<2	<0.1	<0.2	<0.2	<1	<0.05	<0.7	<1	<10	<0.5
BLANK	<Reporting Limit	<2	<0.1	<0.2	<0.2	<1	<0.05	<0.7	<1	<10	<0.5
BLANK	<Reporting Limit	<2	<0.1	<0.2	<0.2	<1	<0.05	<0.7	<1	<10	<0.5
CRM Recovery 1	80%-120%	108.3%	104.7%	101.4%	95.9%	not certified	101.0%	101.9%	106.1%	104.9%	105.6%
CRM Recovery 2	80%-120%	104.2%	101.6%	89.5%	91.1%	not certified	93.8%	85.6%	103.8%	107.2%	103.8%

Signatory: Jamie Woodward
Date: 12/09/2017

All test items tested as received. Spare test items will be held for two months unless otherwise requested.

9.3 Appendix C – QA/QC Information and Results

Field QA/QC Methods

The following field quality assurance/quality control (QA/QC) steps were taken during sampling which included:

- Laboratory provided sample jars were used for sampling;
- White plastic sample spatulas and bucket were used for homogenisation of samples, to prevent contamination from trace metals which may be present in coloured plastic;
- The sample spatula and bucket were washed thoroughly with sea water after each replicate sample to minimise cross contamination between samples;
- All polycarbonate sample corers and lids were thoroughly washed with sea water after each sample site to avoid cross contamination between sample sites;
- Frozen samples were transported on ice to NATA accredited laboratories (NMI and MAFRL) in hard eskies;
- Split duplicate samples were collected from 3 monitoring sites (A8, A14 and A16) and sent to NMI, as a reference laboratory, to ensure results were reliably comparable to primary laboratory results for the same samples; and
- Relative Standard Deviation % (RSD) for each QA/QC sample site was calculated.

Laboratory QA/QC Methods

MAFRL and NMI carried out the required QA/QC as part of their digestions and analysis methods, which include blanks, duplicates, spikes and standard reference material. MAFRL and NMI QA/QC results have been provided in Appendix B. Reported results from MAFRL and NMI laboratories were all within the acceptable percentage recovery ranges.

QA/QC Results
Lab QA/QC

The relative standard deviations (RSD) of the triplicates for total metals were calculated for all sites using the following equation:

$$\text{Relative Standard Deviation (RSD \%)} = \frac{\text{(standard deviation of triplicate)} \times 100}{\text{(average of triplicate)}}$$

The acceptable RSD for triplicates is <50%. This calculation is based on the National Ocean Disposal Guidelines for Dredged Material (Environment Australia, 2002). Where concentrations for a triplicate metals were below the laboratory limit of detection (LOD), the LOD value was divided by two and the resulting value used in the RSD calculation on the triplicate results (Environment Australia, 2002).

RSD results for total metals and sulphur are provided in Table A9-1. Calculated RSDs were below 50% for all metals and sulphur results with the following exceptions:

- RSD results for copper at site A7 (53%);

The above mentioned RSDs greater than 50% account for 1 out of the total 101 calculated RSD's for total metals. The one site with RSD above 50% had all three triplicate samples below the ISQG-Low values.

Table A9-1 Total Metal Results Relative Standard Deviation (RSD %)

Reporting Limit	**Arsenic** *<2*	**Cadmium** *<0.1*	**Chromium** *<0.2*	**Copper** *<0.2*	**Manganese** *<0.05*	**Nickel** *<0.7*	**Lead** *<1*	**Sulphur** *<10*	**Zinc** *<0.5*
Site	RSD %	RSD %	RSD %	RSD %	RSD %	RSD %	RSD %	RSD %	RSD %
A5	25	**43	2	18	9	27	0	4	23
A6	*0	**43	4	0	5	<LOD	<LOD	5	22
A7	0	<LOD	0	**53**	12	<LOD	<LOD	11	11
A8	31	43	18	34	18	43	39	29	33
A9	25	0	3	40	1	45	45	4	32
A10b	0	0	3	16	8	15	14	4	28
A11	0	43	4	13	9	11	0	0	11
A12	**0	<LOD	4	11	5	13	<LOD	8	11
A13	17	35	1	7	2	3	0	3	9
A14	-	-	-	-	-	31	0	-	-
A15	-	-	-	-	-	7	25	-	-
A16	-	-	-	-	-	4	21	-	-
A17	-	-	-	-	-	34	25	-	-
A18	-	-	-	-	-	49	35	-	-
A19	-	-	-	-	-	25	0	-	-
A20	-	-	-	-	-	25	12	-	-
A21	-	-	-	-	-	17	17	-	-
A22	-	-	-	-	-	23	0	-	-
A23	-	-	-	-	-	12	22	-	-

Bold: RSD % above 50
<LOD: all triplicates for that site were <LOD
* one triplicate result <LOD (was given value of LOD/2)
** two triplicate results <LOD (were given values of LOD/2)
Based on Oceanica, 2008 and reference (Environment Australia, 2002)

Field QA/QC

Three split duplicate samples were collected at sampling sites A8, A14 and A16 and sent to the secondary laboratory (NMI) for analysis. The Relative Percentage Difference (RPD) was calculated, based on the Australian Standard (AS 4482.1, 2005). RPD results for bioavailable metals are provided below in Tables A9-2.

All bioavailable metals results were within the ±50% RPD range with the exception of arsenic and sulphur at samples collected from site A8. As results for both bioavailable arsenic and sulphur at A8 were well below the ISQG-Low concentrations for both analytes, these high RPD's should not affect the overall validity of the data for the purpose of the annual marine sediment monitoring. Variability between triplicate samples has been illustrated in section 5.3.2 and 5.4 due to the variable nature of sediment sampling, therefore it is determined that RPDs outside the ±50% RPD range should not affect the overall validity of the data for the purpose of the annual sediment monitoring.

Table A9-2: RPD results for bioavailable metals

	Arsenic	**Cadmium**	**Chromium**	**Copper**	**Manganese**	**Nickel**	**Lead**	**Sulphur**	**Zinc**
Reporting Limit	*<2*	*<0.1*	*<0.2*	*<0.2*	*<0.05*	*<0.7*	*<1*	*<10*	*<0.5*
	ISQG Low = 20	ISQG Low = 1.5	ISQG Low = 80	ISQG Low = 65	ISQG Low = NA	ISQG Low = 21	ISQG Low = 50	ISQG Low = NA	ISQG Low = 200
	ISQG High = 70	ISQG High = 10	ISQG High = 370	ISQG High = 270	ISQG High = NA	ISQG High = 52	ISQG High = 220	ISQG High = NA	ISQG High = 410
Site	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
A8 (MAFRL)	2	0.1	5.2	7	6.3	2.9	11	1300	8.1
A8 (NMI)	0.5	<LOR	5.6	5.5	6.5	2.8	12	2680	8.9
RPD	***120.00***	*<LOR*	*7.41*	*20.36*	*3.13*	*3.51*	*8.70*	***69.35***	*9.41*
A14 (MAFRL_	nt	nt	nt	nt	nt	1.2	2	nt	nt
A14 (NMI)	nt	nt	nt	nt	nt	1.3	3.3	nt	nt
RPD						8.00	49.06		
A16 (MAFRL)	nt	nt	nt	nt	nt	2.6	7	nt	nt
A16 (NMI)	nt	nt	nt	nt	nt	2.1	6.9	nt	nt
RPD						21.28	1.44		