ANNUAL MARINE SEDIMENT MONITORING REPORT 2012

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3	A Leonard	C. Aylott		23/09/2013	Draft Report
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1 SUMMARY

The Esperance Ports Sea and Land (EPSL) Operating Licence (5099/1974/13) requires marine sediment quality to be monitored annually within harbour waters during the month of November. The methodology is provided in the Comprehensive Sediment Monitoring and Reporting Plan (Oceanica, 2009a). Briefly, this requires EPSL to sample the top 10cm of sediment at 15 locations in the inner harbour and four outer harbour locations with lower contamination levels to assess for changes in sediment quality, particularly for lead and nickel, the principal contaminants of concern. The first time this survey was conducted according to the sampling design was in 2010 that established baseline information.

The number of sites exceeding the sediment quality criteria for lead and nickel reduced between 2010 and 2012. The only site in 2012 that became a new exceedance was site A10a likely to be due to spatial variability, A10a is atypical of the inner harbour whose levels appear to be declining due to the deposition of less contaminated sediments shown by the results of deeper sediment cores (0-100cm) taken at ten sites close to the berth pockets to secure maintenance dredging approvals at the Port. The recommended management action is to conduct the maintenance dredging and omit A10a in future surveys. The trigger for tributyltin was not exceeded as only one of three sites exceeded the ISQG-high criteria in 2012 which was also the case in 2008.

The overall results from the 2012 sediment sampling (all sites 0-10cm depth) were consistent with 2011 and 2010, with most contamination being limited to the three berth pockets. The concentrations of nickel and lead measured in sediments from the 15 inner harbour sites in 2012 were not significantly different from levels measured at these sites in 2011. The ten sites with the highest levels of lead and nickel in 2010 were compared to the results at these sites in 2012. The decreases in concentrations of nickel and lead between 2010 and 2012 were almost significant ($P<0.05$) with a P value of 0.057. Concentrations of lead and nickel in the inner harbour are likely to significantly decline from the 2010 baseline following maintenance dredging (scheduled for late 2013 or early 2014). The dredge material will be disposed of onshore. Recontamination of the inner harbour with lead and nickel from residues in stormwater drains will be avoided by stormwater drains being cleaned before the dredging works will be conducted.

Further recommendations to change the survey design were to move all sites where cores to the full 10cm were not possible. For sites situated over seagrass beds, visual cues maybe possible for relocation to sandy patches, for deeper rocky locations, the sounder display maybe used as a guide to avoid the hard rocky seabed that cannot be sampled.

2 INTRODUCTION

Historical bulk handling of lead carbonate and nickel concentrate operations at EPSL have led to lead and nickel contamination in the marine sediments within the berth pockets of Esperance Port. EPSL ceased handling and export of bulk lead carbonate in 2007, with all bulk handling of nickel exports ceasing in June 2012. EPSL now exports nickel in a fully containerised handling system. In 2009, upgrades to the nickel circuit were undertaken to reduce nickel emissions from bulk nickel ship loading.

Ministerial Statement 681 (2005) (which superseded Ministerial Statement 555, 2000) 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, the Department of Environment Regulation (DER) (formerly 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 EPSL 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.

Between 2007 and 2010 Oceanica undertook an extensive survey and investigation of the toxicity of surficial sediments. 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 organisms 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).

To ensure there are no further increases in contamination that may result in toxicity to marine life, DER require EPSL to annually monitor sediments (each November) and report levels of contaminants in marine sediments under the current Licence (5099/1974/13) issued to EPSL. Conditions 3(a), 3(b), 9(a), 9 (b) and 10 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. The ANZECC-ARMCANZ (2000) sediment quality criteria were adopted to form triggers for management actions (refer to Section 3 of the CSMRP, Oceanica, 2009a).

Following completion of maintenance dredging works to remove and dispose of these contaminated sediments, monitoring results are expected to show levels of contamination in the remaining sediments comply with relevant sediment quality criteria. If future monitoring demonstrates minimal recontamination, EPSL will review the required annual frequency for this monitoring.

3 OBJECTIVES AND SCOPE

The objective of the 2012 annual marine sediment monitoring was 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. If bioavailable metal concentrations exceed the ISQG-Low or ISQG-High values at a site where no previous exceedance has taken place;

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

    c. If 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 DER before 1 December 2013 as required by the EPSL operating licence (L5099/1974/12).

4 METHODOLOGY

4.1 Sampling Works

The 2012 annual marine sediment monitoring was conducted on the 13th and 14th November 2012. 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, A10 and A14 - A21). EPSL chose to split site A10 into 2 monitoring locations, site A10a and A10b located on the land side and the ocean side of a piling at Berth 1 respectively;

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 EPSL were appointed (consistent with AS/NZS 4122) to collect 300 sediment cores in November 2012. 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: Five cores within 1 m^2 quadrat to make one replicate sample.
Source: CSMRP (Oceanica 2009a)

Sample Site A10 was sampled twice (consistent with the 2011 annual marine sediment monitoring event), 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.

The polycarbonate corers used for the 2012 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. DER 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). Details of sampling sites are provided below in Table 1, while sample locations are shown on Figure 2.

Table 1: Details of Sampling Sites

Site Name	Latitude	Longitude	Site Location Description
Outer Harbour Sites			
A5	33.51.870	121.54.590	~ 350m NNE from tip of northern break wall
A6	33.51.730	121.54.327	~600m NNW from tip of northern break wall
A7	33.51.426	121.54.192	~1,100m from tip of northern break wall
A11	33.51.968	121.54.307	~ 200m WNW 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
A10a and 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	121.54.916	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			
A12	33.52.137	121.54.132	~ 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.			

Figure 2: Marine Sediment Sampling Sites at Esperance Ports Sea and Land

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 for the list of analytes required in Table 2 of the Licence and is outlined in Table 2 below. 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 Nickel	All three replicates	Particle size distribution	One replicate per site
Sites A5 to A13	Arsenic Cadmium Chromium Copper Zinc 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)
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 transported on ice at 4°C and couriered overnight to Perth in appropriate containers provided by each laboratory. MAFRL and NMI NATA accredited laboratories undertook analysis of sediment samples for analytes required by condition 9(a) 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, manganese, nickel, lead and zinc) and sulphur analysis;
- Duplicate (split replicate) samples from three sites (A13, A17 and A23) 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.

- Particle size distribution is required every three years and was not conducted in 2012. The next particle size analysis is due to be undertaken in 2013.

4.3 Quality Assurance/Quality Control

Field QA/QC was undertaken and three split replicate samples were collected and sent to NMI for 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 2012 for the 15 inner harbour sites and determine whether values are significantly different to those of 2010 and 2011 using a standard t-test (two tailed). The software package Statistica (Version 10, 2011) was used to conduct the t-tests. All data was Log10 transformed to normalise the data distribution that was inspected using a histogram. For comparison of the 2012 data to 2011 data, 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 2012 annual marine sediment monitoring event included 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 2011.

5.1 Field Sample Observations

During the 2012 monitoring event despite samples being collected for all sites, there were several sites where the total 10cm core of sediment was difficult to obtain. Sites A6 and A7 were located within seagrass beds, making it difficult for the divers to insert the core samplers through the dense seagrass and seagrass roots to obtain 10cm deep cores. Sites A5, A11, A20 and A23 were within a rocky limestone area, resulting in some of the samples at these sites containing a substantial amount of shell fragments. A summary of the sample descriptions for samples collected at each site are provided in Table 3. These sites will be relocated according to the recommendations in Section 8.2.

Table 3: Sample Field Observation Descriptions

Site Name	Sample Description
Outer Harbour Sites	
A5	Grey sand, odourless, shells and rocks present, limestone bottom
A6	White sand, odourless, seagrass present, heavy seagrass site
A7	White sand, odourless, seagrass present, heavy seagrass site
A11	Grey sand, odourless, limestone rocks & shell present
Inner Harbour Sites	
Berth pocket sites	
A8	Grey sand, slight H_2S odour, no foreign objects
A9	Grey sand, slight H_2S odour, no foreign objects
A10a & A10b	Dark grey/black sand, odourless, no foreign objects
A14	Grey sand, odourless, no foreign objects present
A15	Yellow/grey sand, odourless, no foreign objects present
A16	Dark grey sand, odourless, no foreign objects present
A17	Dark grey sand, slight H_2S odour, some shells present
A18	Light grey sand, odourless, no foreign objects present
A19	Grey sand, odourless, no foreign objects present
A20	Grey sand, slight H_2S odour, limestone rocks and shells present
A21	Grey sand, odourless, some shells present. Razorclam collected at this site
Channel and Turning Circle	
A12	White sand, odourless, limestone rocks present
A13	Sand, slight H_2S odour
A22	Grey sand, odourless, some shells present. Moved 5m off site due to rocky bottom and insufficient sediment present
A23	Grey sand, odourless, some rocks present, limestone bottom

5.2 Comparison of Results to Sediment Quality Guidelines

Median values for total and bioavailable levels of each metal were determined from the triplicate results for each site and compared to the results from 2011 sampling and the Australian and New Zealand Interim Sediment Quality Guidelines (ISQG) ISQG-Low and ISQG-High criteria (ANZECC-ARMCANZ, 2000) (refer to Tables 4 and 5). A full set of laboratory results are attached in Appendix B.

5.2.1 Outer Harbour Sites

Median analytical results for total metals (strong acid extraction) and bioavailable metals (dilute acid extraction) for the four outer harbour sites (A5, A6 A7 and A11) were below the ISQG-Low values for each analyte tested, consistent with the 2011 annual sediment monitoring results.

5.2.2 Inner Harbour Sites

In 2012, there were no new sites in the inner harbour that exceeded the ISQG-Low or High values for any metals where they had not done so in any previous monitoring years. This is with the following exception for bioavailable nickel (results provided in Table 5) at site A10a (landward side of piling at Berth 1) exceeding the ISQG-Low, no exceedance has previously been recorded at this site. This triggers the contingency action to inform DER via annual reporting, investigate and take appropriate management action.

The increased concentrations of nickel in sediments at site A10a in comparison to 2011 and 2010 is likely to be due to the patchy distribution of nickel landward of the sheet piling (indicated by high variability between triplicates) and not nickel spillage, since the last bulk nickel ship departed in October 2011 with bulk nickel handling completely ceasing in June 2012. Only a few meters away from A10a, site A10b seaward of the sheet piling had an eight-fold lower total nickel result and a two-fold higher bioavailable nickel result than the ocean side of the sheet piling. Furthermore, nickel concentrations in the inner harbour sites appear to be trending downwards (refer to Section 5.4). This downwards trend is almost certainly due to the deposition of less contaminated sediments shown by the results of deeper sediment cores (0-100cm) taken at ten sites close to the berth pockets to secure maintenance dredging approvals at the Port (EPSL, 2013). The recommended management action is to conduct the maintenance dredging and omit A10a in future surveys that is atypical of the inner harbour.

Despite there being no other exceedance of the contingency management triggers, trends in exceedance rates are described below.

Lead

Median concentrations for total lead (results provided in Table 4) were all below the ISQG-Low value for lead (50mg/kg) with the exception of Site A10:

- Site A10a (landward side of piling at Berth 1) reported a median concentration for total lead of 350 mg/kg (exceeding the ISQG-High value of 220 mg/kg), which was an increase from the 2011 concentration of 180 mg/kg which exceeded the ISQG-Low value of 50 mg/kg;

- Site A10b (ocean side of piling at Berth 1) reported a median concentration for total lead of 59 mg/kg (exceeding the ISQG-Low value of 50 mg/kg), which was generally consistent with the 2011 concentration of 58 mg/kg.

As for total lead, median concentrations for bioavailable lead (results provided in Table 5) were all below the ISQG-Low value for lead (50mg/kg) with the exception of Site A10:

- Site A10a (landward side of piling at Berth 1) reported a median concentration for bioavailable lead of 360 mg/kg (exceeding the ISQG-High value of 220 mg/kg), which was an increase from the 2011 concentration of 180 mg/kg which exceeded the ISQG-Low;

- Site A10b (ocean side of piling at Berth 1) reported a median concentration of 61 mg/kg (exceeding the ISQG-Low value of 50 mg/kg), which is a slight increase from the 2011 concentration of 50 mg/kg which was equivalent to the ISQG-Low.

The landward side of the sheet piling (Site A10a) had a five-fold higher total and bioavailable lead result than the ocean side of the sheet piling (Site A10b). These results support the suggestion that the landward side

of the piling is retaining historically contaminated sediments (as the sheet piling creates a barrier) and the ocean side is subjected to regular flushing due to ocean currents and ships propeller wash. Since site A10a is atypical of the inner harbour, monitoring will be discontinued at this location.

Nickel

Median concentrations for total nickel (results provided in Table 4) were compared to ISQG trigger values and previous surveys. Numbers of Inner harbour sites exceeding the ISQG-Low decreased from eight in 2011 to six in 2012 with nine inner harbour sites being below the ISQG-Low. Concentrations at sites A14 and A17 decreased from above the ISQG-Low value in 2011 to below the ISQG-Low value in 2012. Nickel concentrations decreased at seven of the eight sites between 2011 and 2012. In contrast to the above trend, concentrations of nickel at sites A10a and A10b increased between 2011 and 2012 and remain above the ISQG-High. All concentrations of bioavailable nickel were below the ISQG criteria, except for site A10a as described at the start of this section.

Copper

In 2012, median concentrations for total and bioavailable copper at all six inner harbour sites were below the ISQG-Low. In 2011, site A8 (170 mg/kg) exceeded the ISQG-Low (65 mg/kg) but decreased to 20 mg/kg in 2012, likely to be due to the patchy distribution of contaminants in sediments.

Manganese

In 2012, median concentrations for total and bioavailable manganese (results provided in Table 4 and Table 5) from the 6 inner harbour sites (Sites A8 to A13) were generally consistent with the 2011 results. There are no ISQG values for manganese (ANZECC-ARMCANZ, 2000), suggesting this metal has a low potential for toxicity. Median manganese results are similar between the inner harbour and outer harbour sites (Sites A5, A6 and A7).

Table 4: Total Metal (strong acid extraction) Median (n = 3) Results for 0-10cm Cores for 2012

	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	
	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Site	2011 results	2012 results	2011 Results	2012 Results	2011 Results	2012 Results	2011 Results	2012 Results	2011 Results	2012 Results	2011 Results	2012 Results	2011 Results	2012 Results	2011 Results	2012 Results	2011 Results	2012 Results
A5	2**	2	<0.1	<0.1	3.5	3.7	1.2	1.1	5.3	8.2	2	1.5	1**	3	830	700	2.7	3.2
A6	<2	*2	<0.1	<0.1	6	6	0.3	0.5	7	9.7	0.9	0.9	<1	3	1000	900	0.9	2.4
A7	3.5	3	<0.1	<0.1	3.7	3.6	0.2*	0.4	4.3	6.5	7	<0.7	<1	2	590	520	0.8	2.3
A8	2*	3	<0.1	0.1	8.4	8.1	**170**	20	8.9	9.7	**28**	**26**	11	10	2100	1600	66	28
A9	2*	*2	0.1	*0.1	8.8	7.7	30	15	7.3	7.1	**120**	**39**	35	17	1700	1300	40	14
A10a	4	10	<0.1	0.4	8.9	12	26	50	9.2	29	**380**	**1200**	**180**	**350**	2200	3900	35	56
A10b	2*	3	0.1**	0.2	7.9	7.9	11	9.8	7.3	8.6	**87**	**140**	**58**	**59**	1400	1500	36	23
A11	<2	2	<0.1	<0.1	4.6	4.3	0.8	1	4.5	6.1	2.9	2.6	2	3	730	830	1.7	2.4
A12	<2	2	<0.1	<0.1	5.1	6.1	2.3	1.2	6.4	8.6	6.9	3.8	3	4	960	1000	3.4	3.9
A13	3	3	0.1**	0.2	8.8	8.4	9.4	6.3	8.6	9.5	**26**	**22**	9	9	1900	1600	14	11
A14	-	-	-	-	-	-	-	-	-	-	**48**	14	18	8	-	-	-	-
A15	-	-	-	-	-	-	-	-	-	-	15	9	7	7	-	-	-	-
A16	-	-	-	-	-	-	-	-	-	-	**27**	**34**	10	19	-	-	-	-
A17	-	-	-	-	-	-	-	-	-	-	**22**	12	10	7	-	-	-	-
A18	-	-	-	-	-	-	-	-	-	-	12	2.1	6	4	-	-	-	-
A19	-	-	-	-	-	-	-	-	-	-	15	8.3	12	6	-	-	-	-
A20	-	-	-	-	-	-	-	-	-	-	**35**	17	13	8	-	-	-	-
A21	-	-	-	-	-	-	-	-	-	-	**27**	**33**	13	13	-	-	-	-
A22	-	-	-	-	-	-	-	-	-	-	2.3	*1	2	3	-	-	-	-
A23	-	-	-	-	-	-	-	-	-	-	**33**	**38**	12	13	-	-	-	-

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

Table 5: Bioavailable Metals (dilute acid extraction) Median (n = 3) Results for 0-10cm Cores for 2012

	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	
	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Site	2011 results	2012 results	2011 results	2012 results	2011 results	2012 results	2011 results	2012 results	2011 results	2012 results	2011 results	2012 results	2011 results	2012 results	2011 results	2012 results	2011 results	2012 results
A5	<2	2	<0.1	0.1**	2.4	2.5	0.4	0.6	2.8	2.9	<0.7	<0.7	<1	1*	610	650	1.1	1.2
A6	<2	2*	<0.1	<0.1	4.6	5.3	<0.2	0.3	4.8	5.6	<0.7	<0.7	<1	1**	730	880	0.6*	0.6
A7	3	3	<0.1	<0.1	2.8	2.7	<0.2	0.3	2.8	2.7	<0.7	<0.7	<1	<1	510	520	0.5*	0.5*
A8	<2	2	<0.1	0.1**	5.2	5.3	38	7.7	5.4	5.2	2.2	2.8	9	9	1000	1000	48	9.8
A9	<2	<2	0.1	0.1	7.3	6.6	6.2	7.1	5.8	4.6	5	3.1	33	19	1100	1000	13	5.7
A10a	<2	3	<0.1	0.2	6.6	6.2	5.7	8.6	5.8	6.2	20	**47**	**180**	**360**	1100	1000	45	33
A10b	<2	2*	<0.1	0.1	5.5	6	2.6	4.2	4.2	4.8	4.4	8.5	50	**61**	900	990	20	14
A11	<2	<2	<0.1	<0.1	2.5	3.4	0.4*	0.7*	2.8	4	<0.7	<0.7	2	2	510	730	1.1*	1.1
A12	<2	2**	<0.1	<0.1	3.2	4.7	0.6	0.7	4.4	5.9	0.7**	0.7*	2	3	620	900	1.5	1.4
A13	<2	2*	<0.1	0.1*	6.1	6.7	2.3	2.4	5.4	5.6	2.9	2.4	8	8	1200	1300	6.5	5.1
A14	-	-	-	-	-	-	-	-	-	-	4	1.9	15	9	-	-	-	-
A15	-	-	-	-	-	-	-	-	-	-	1.7	1.4	6	6	-	-	-	-
A16	-	-	-	-	-	-	-	-	-	-	2	3.5	7	20	-	-	-	-
A17	-	-	-	-	-	-	-	-	-	-	2.5	1.7	10	7	-	-	-	-
A18	-	-	-	-	-	-	-	-	-	-	0.8	0.7**	4	4	-	-	-	-
A19	-	-	-	-	-	-	-	-	-	-	1.1	0.7*	11	5	-	-	-	-
A20	-	-	-	-	-	-	-	-	-	-	2.2	1.5	11	7.5	-	-	-	-
A21	-	-	-	-	-	-	-	-	-	-	2.4	2.2	11	11	-	-	-	-
A22	-	-	-	-	-	-	-	-	-	-	<0.7	<0.7	1*	1**	-	-	-	-
A23	-	-	-	-	-	-	-	-	-	-	2.9	3.9	11	13	-	-	-	-

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

Organotins

Total Organic Carbon (TOC) and organotins were analysed for samples at sites A8, A9 and A10 (including A10a and A10b). TOC results remained generally consistent with the 2008 results. Analytical results are provided below in Table 6.

The 2012 analytical results for organotins led to all samples exceeding the ISGQ-Low, which is a similar result to 2008 when sites A8, A9 and A10 also exceeded the ISQG-Low. In contrast, there was only one exceedance in 2011, but organotins have a notoriously patchy spatial distribution due to their adherence to paint flakes. In 2012, one site exceeded the ISQG-High, this is also consistent with one exceedance in 2008. Since there was no increase in the number of sites exceeding the ISQG-High values from 2008, there is no exceedance of the relevant trigger for contingency action.

The results of deeper sediment cores taken at ten sites within the berth pockets as part of EPSL dredging approvals (EPSL, 2013) shows TBT contamination to a depth of 100cm. Contamination in the 50-100cm depth was higher than in the 0-50cm depth, with half the sites in the 50-100cm depth exceeding the ISQG-Low and two sites exceeding the ISQG-High.

Table 6: Organotins Results 2012 - Monobutyltin (MBT), Dibutyltin (DBT), Tributyltin (TBT) and % TOC Results for 10cm cores (n = 1)

`	Monobutyltin		Dibutyltin		Tributyltin		TOC		TOC	
	µg/kg		µg/kg		µg/kg		mg/kg		%	
Site	ISQG Low = NA		ISQG Low = NA		*ISQG Low = 9		ISQG Low = NA		NA	
	ISQG High = NA		ISQG High = NA		*ISQG High = 80		ISQG High = NA		NA	
	2008 results	2012 results	2008 results	2012 results	2008 results	2012 results	2008 results	2012 results	2008 results	2012 results
A8	<LOR	<LOR	20.2	10.8	**1181.8**	**51.3**	4400	3900	0.44	0.39
A9	<LOR	5.1	5.2	16.7	**14.1**	**183.3**	2700	1200	0.27	0.12
A10	<LOR	-	3.9	-	**10.4**	-	2600	-	0.26	-
A10a	-	3.3	-	13.3	**-**	**36.7**	-	3000	-	0.3
A10b	-	<LOR	-	5.9	-	**18.6**	-	2200	-	0.22

*ISQG low and high trigger values in ug/Sn/kg^2 (National Assessment Guidelines for Dredging, 2009 – as suggested in CSMRP, 2009).

Values normalised to 1% TOC content
ISQG-Low and High trigger values given in ug/Sn/kg^2 (National Assessment Guidelines for Dredging, 2009 guidelines suggested in CSMRP (Oceanica, 2009a)).
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 to dibutyltin (DBT) in sediments typically takes approximately one year, 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. EPSL only accepts vessels that are

IMO registered and compliant with the MARPOL convention. Therefore, a downward trend in levels of TBT should occur over the next few years. Following the maintenance dredging scheduled later in 2013, sediments contaminated with TBT will be removed and disposed to land, it is not expected that there will be any re-contamination.

5.3 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 RSD% above 50%, however, the results are still considered reliable, given that all sites (with the exception of A8) had all triplicate results below the ISQG-Low value. The high RSD % for Site A8 for copper should not have compromised the validity of the results. A high RSD % was also reported at Site A8 by Oceanica during the 2008 and 2011 monitoring events. The RPD results comparing primary environmental samples to split samples sent to NMI laboratory compliant with the 30 - 50% RPD range (AS4482.1, 2005) with the exception of arsenic at site A13. 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 2012 annual sediment monitoring.

5.4 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 2012 results, 2011 and 2010. As stated in the 2011 report, comparisons to results from 2007 and 2008 were confounded by the variable depths sampled in the earlier surveys. The 2012 results were compared to:

1. The means for all 15 inner harbour sites in 2011 and 2010 for both lead and nickel;

2. Although not required, it was also decided to test the ten sites exceeding ISQG-Low for nickel in 2010 as sites with highest concentrations demonstrated largest declines in concentrations of nickel. These analyses were not possible for total lead, as there were only two sites in 2010 that exceeded the ISQG-Low value for lead.

3. T-test analysis was undertaken including site A10b, site A10a was not included in t-test analysis as discussed in Section 5.2.2., A10a does not provide indicative results for an inner harbour site (given its proximity to a storm water drain outlet pipe). From 2013, only site A10b (seaward of sheet piling) will be sampled as this is more indicative of the inner harbour

T-test results showed that there was not a statistically significant increase in mean nickel or mean lead results from the 2012 to 2011 or 2010 monitoring events. For concentration of nickel in sediments, 11 of 15 sites decreased, while for lead 9 of 15 sites decreased. Results of the t-tests are presented in Tables 9, 10 and 11. The raw output from Statistica is provided in Appendix A.

Table 7: Average Values (n = 3) for Total Nickel for T-tests

Sampling Site	Ni 2011	Ni 2012
	mg/kg	mg/kg
A8	28	26.3
A9	107	34.7
A10b	86	160.0
A12	7	4.0
A13	27	21.7
A14	46	13.7
A15	16	9.2
A16	28	41.3
A17	24	11.7
A18	14	3.2
A19	15	8.9
A20	32	17
A21	33	29.7
A22	2	22.7
A23	33	36.3
Total mean	***33***	***29***

Table 8: Average Values (n = 3) for Total Lead for T-tests

Sampling Site	Pb 2011	Pb 2012
	mg/kg	mg/kg
A8	11	10.33
A9	39	20.33
A10b	59	65.67
A12	3	4.33
A13	9	8.67
A14	21	8.33
A15	7	7
A16	10	20.33
A17	11	6.67
A18	5	4
A19	12	6.67
A20	11	8
A21	14	12
A22	2	3
A23	12	13
Total Mean	***15***	***13.22***

5.4.1 T-test Inner Harbour Nickel Results

1. *Analyses between the 2012 data and 2011 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 and 2012, are provided below in Table 9. T-test results show that there was no significant difference (p=0.919 and 0.197) when comparing 2012 to 2011 and 2010.

Table 9: T-Test Results for all Inner Harbour Sites for Total Nickel

	t value	**Levene's p value**	**df**
Nickel 2012 vs. 2011^	0.92	0.919026	28
Nickel 2012 vs 2010*	1.74	0.197422	28

Note:
^ Data was Log10 transformed due to provide normal distribution of data
* Data was Log10 transformed due to unequal variances

Based on cessation of bulk nickel export and natural sedimentation processes, the overall concentrations of nickel are likely to decline further in the top 10cm in subsequent monitoring years, however increases in nickel concentrations in nickel contaminated areas may be seen at individual sites due to the patchy nature of sediment contamination. Once maintenance dredging has been completed, it is expected that the contamination will be removed and disposed to land. Subsequent monitoring of the top 10cm of sediments is expected to show a significant decline in concentrations of contaminants.

2. *Analyses between the 2012 data and 2010 data for inner harbour sites restricted to those sites with total nickel levels in 2010 exceeded the ISQG-Low value*

The results for the t-test conducted for nickel data for inner harbour sites which exceeded ISQG-Low values in 2010 are provided below in Table 10. T-test results show that there was no significant difference between nickel results when comparing 2012 vs. 2011 (p=0.518). However when comparing nickel data for 2012 vs. 2010 data, the difference is only marginally non-significant (p=0.057), indicating the reduction in concentrations of nickel has almost become significant (P<0.05) since 2010.

Table 10: T-Test Results for Inner Harbour Sites Exceeding ISQG-Low values in 2010 for Total Nickel

	t value	Levene's p value	df
Nickel 2012) vs. 2011^	0.44	0.517651	18
Nickel 2012 vs. 2010*	4.07	0.057405	20
Notes: * Data was Log10 transformed due to unequal variances ^ Data was Log10 transformed due to provide normal distribution of data			

5.4.2 T-test Inner Harbour Lead Results

The results for the t-test conducted for lead data (Table 11) for all 15 inner harbour sites are provided below in Table 14. T-test results show that there was no significant difference (p=0.924 and 0.288) for lead concentrations in the top 10cm of sediment sampled at 15 inner harbour sites when comparing 2012 to 2011 and 2010. The p-value for 2012 vs. 2010 data (p=0.288) was less than the value for 2012 vs. 2011 (p= 0.924), suggesting that the change in lead concentrations in sediments over the two year period may be of greater significance than over the one year period.

Table 11: T-Test Results for all Inner Harbour Sites for Total Lead between 2012 and 2011

	t value	Levene's p value	df
Lead 2012 vs. 2011^	0.009	0.923736	28
Lead 2012 vs 2010*	1.17	0.288409	28
Note: * Data was log10 transformed due to unequal variances ^ Data was Log10 transformed due to provide normal distribution of data			

Based on cessation of bulk lead export and natural sedimentation processes, the overall concentrations of lead are likely to decline further in subsequent monitoring years.

6 CONCLUSION

The results of the 2012 survey did not exceed the relevant triggers for contingency actions listed in the objectives of this report (refer to section 3) and no further contingency actions are required.

7 RISK MANAGEMENT AND RECOMMENDATIONS

7.1 Actions taken since 2011 Annual Sediment Monitoring

1. Bulk nickel handling ceased at Esperance Port in June 2012 and remains suspended indefinitely;

2. 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, sulphur and fertiliser contaminated water from entering the harbour.

7.2 Further actions to be taken

1. Reduce potential contamination of marine sediments from storm water drain inputs. EPSL received agreement from one of its long term lease holders in mid-2012 to help finance cleaning of the storm water infrastructure. Contractors engaged by EPSL began cleaning of the existing storm water infrastructure in early March 2013, however due to wet weather conditions generally experienced in Esperance during autumn and winter, the remainder of the cleaning has been proposed for spring (early December 2013). These cleaning works should remove any historical contamination and will allow the infrastructure to be surveyed and sub-catchments within the Port to be mapped to help manage contaminants in storm water.

2. Maintenance dredging works (preliminary timeframe first quarter of 2014) may remove contaminated sediments. Deeper sediment cores were sampled in August 2012, for dredging scheduled for 2013, subject to approvals. If dredging occurs in 2013, this would remove most of the nickel and lead contamination from the inner harbour.

3. Reduce potential future nickel contamination of the marine sediments by continuing to receive nickel products in bulker bags within sealed containers to reduce the potential for nickel entering the marine environment.

4. Only site A10b seaward of the sheet piling be sampled in future as this is more typical of the inner harbour;

5. All sites that were difficult to sample to 10cm depth will be moved and the new locations will be recorded. These movements include sites:

a. A6 and A7 which will be moved to the first visible area that does not have dense seagrass growth, or seaward until the depth increases above 10m.

b. Divers will attempt to sample sites A5, A11, A20 and A23 will be 'sampled' further to the North. The depth sounder will be utilised to show when the bottom becomes less dense. The divers will enter the water at this point to conduct sampling.

8 REFERENCES

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9 APPENDICES

9.1 Appendix A - T-test Results from Statistica

T-Tests comparing 2012 vs. 2011 data

Test 1: Levene's T-test for average Nickel results comparing 2012 and 2011 data for 15 inner harbour sites

T-Test for Log10 Ni 2012 vs 2011 with A10b														
	Mean	Mean	t-value	df	p	Valid N	Valid N	Std.Dev.	Std.Dev.	F-ratio	p	Levene	df	p
Ni 2011 Log10 (with A10b) vs. Ni 2012 Log10 (with A10b)	1.398505	1.215395	1.184661	28	0.246110	15	15	0.371249	0.469620	1.600160	0.389748	0.919026	28	0.345936

Note: T-test for independent samples. Variables were treated as independent samples

Test 2: Levene's T-test for average Lead results comparing 2012 and 2011 data from 15 inner harbour sites

T-Test for Log10 Pb 2012 vs 2011 with A10b for all inner harbour sites with A10b														
	Mean	Mean	t-value	df	p	Valid N	Valid N	Std.Dev.	Std.Dev.	F-ratio	p	Levene	df	p
Pb 2011 log10 A10b vs. Pb 2012 Log10 A10b	1.081684	1.023289	0.522336	28	0.605545	15	15	0.312192	0.300021	1.082781	0.883810	0.009331	28	0.923736

Note: T-test for independent samples. Variables were treated as independent samples

Test 3: Levene's T-test for average nickel results comparing 2012 to 2011 data for inner harbour sites which >ISQG-Low values in 2010

T-Test for Log10 Ni 2012 vs 2011 with A10b for sites >ISQG-Low values in 2010														
	Mean	Mean	t-value	df	p	Valid N	Valid N	Std.Dev.	Std.Dev.	F-ratio	p	Levene	df	p
Ni 2011 Log10 (A10b) vs. Ni 2012 Log10 A10b	1.550355	1.450797	0.771320	18	0.450525	10	10	0.242052	0.328652	1.843547	0.375706	0.435516	18	0.517651

T-Tests comparing 2012 vs. 2010 results

Test 4: Levene's T-test for average nickel results comparing 2012 to 2010 data for all inner harbour sites

	Mean	Mean	t-value	df	p	Valid N	Valid N	Std.Dev.	Std.Dev.	F-ratio	p	Levene	df	p
Ni 2012 Log10 vs. Ni 2010 Log10	1.398505	1.564238	-0.860458	28	0.396845	15	15	0.371249	0.647035	3.037567	0.046197	1.743231	28	0.197422

Test 5: Levene's T-test for average lead results comparing 2012 to 2010 data for all inner harbour sites

t-test for Log10 Pb 2012 vs Ni 2010 all inner harbour sites (with A10b)														
	Mean	Mean	t-value	df	p	Valid N	Valid N	Std.Dev.	Std.Dev.	F-ratio	p	Levene	df	p
Pb 2012 Log10 vs. Pb 2010 Log10	1.113739	1.260267	-0.817277	28	0.420670	15	15	0.400631	0.567146	2.004011	0.205794	1.171094	28	0.288409

Test 6: Levene's T-test for average nickel results comparing 2012 to 2010 data for inner harbour sites >ISQG-Low in 2010

t-test for Log 10 Ni 2012 vs Ni 2010 inner harbour sites exceeding ISQG-Low in 2010 (with A10b)														
	Mean	Mean	t-value	df	p	Valid N	Valid N	Std.Dev.	Std.Dev.	F-ratio	p	Levene	df	p
Ni 2012 with A10b vs. Ni 2010	1.561430	1.855288	-1.85886	20	0.077826	11	11	0.232550	0.469916	4.083274	0.036523	4.065231	20	0.057405

9.2 Appendix B – Laboratory Reports

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Accreditation Number: 10603
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Murdoch UNIVERSITY

SEDIMENT DATA

Contact: Natasha Norrish
Customer: Esperance Ports Sea and Land
Address: PO Box 35 , Esperance WA 645

Date of Issue: 1/02/2013
Date Received: 16/11/2012
Our Reference: EPSL12-1
Your Reference: ENV08-951

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 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**	**<0.05**	**<0.7**	**<1**	**<10**	**<0.5**
File						**12121701-13012401**				
A5 Repl. 1	14/11/2012	2	<0.1	3.7	1.2	8.2	1.5	2	670	3.5
A5 Repl. 2	14/11/2012	2	<0.1	3.4	0.9	6.9	1.5	3	700	3.0
A5 Repl. 3	14/11/2012	3	<0.1	3.7	1.1	9.0	1.6	3	720	3.2
A6 Repl. 1	13/11/2012	2	<0.1	6.0	0.5	9.7	0.7	3	890	1.7
A6 Repl. 2	13/11/2012	<2	<0.1	6.2	0.5	11	1.1	2	900	2.4
A6 Repl. 3	13/11/2012	2	<0.1	5.9	0.6	9.0	0.9	3	920	3.3
A7 Repl. 1	13/11/2012	3	<0.1	3.6	0.4	6.5	<0.7	2	520	2.4
A7 Repl. 2	13/11/2012	3	<0.1	3.6	0.5	7.6	<0.7	2	590	2.3
A7 Repl. 3	13/11/2012	3	<0.1	3.4	0.4	6.4	<0.7	2	510	1.4
A8 Repl. 1	13/11/2012	3	0.1	7.7	20	9.0	24	9	1600	28
A8 Repl. 2	13/11/2012	3	0.2	8.1	110	9.8	26	10	1700	56
A8 Repl. 3	13/11/2012	3	0.1	8.2	14	9.7	29	12	1600	15
A9 Repl. 1	14/11/2012	<2	<0.1	7.5	7.0	7.1	25	14	1100	15
A9 Repl. 2	14/11/2012	2	0.1	7.9	26	8.3	39	30	1300	14
A9 Repl. 3	14/11/2012	2	0.1	7.7	15	7.1	40	17	1300	13
A10a Repl. 1	13/11/2012	15	0.5	12	85	29	1800	280	5700	68
A10a Repl. 2	13/11/2012	10	0.3	11	50	29	1200	350	3900	45
A10a Repl. 3	13/11/2012	10	0.4	12	37	30	780	410	3000	56
A10b Repl. 1	13/11/2012	4	0.2	8.3	14	9.8	220	85	1800	24
A10b Repl. 2	13/11/2012	3	0.2	7.9	9.8	8.6	140	59	1500	17
A10b Repl. 3	13/11/2012	2	0.1	7.4	8.7	8.1	120	53	1400	23

Signatory:

Date: 1/02/2013

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

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SEDIMENT DATA

Contact: Natasha Norrish
Customer: Esperance Ports Sea and Land
Address: PO Box 35 , Esperance WA 645

Date of Issue: 1/02/2013
Date Received: 16/11/2012
Our Reference: EPSL12-1
Your Reference: ENV08-951

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 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**	**<0.05**	**<0.7**	**<1**	**<10**	**<0.5**
File						**12121701-13012401**				
A11 Repl. 1	13/11/2012	2	<0.1	4.8	1.4	6.1	3.5	4	910	2.4
A11 Repl. 2	14/11/2012	2	<0.1	4.3	1.0	6.3	2.0	3	830	2.4
A11 Repl. 3	14/11/2012	2	<0.1	4.3	1.0	6.0	2.6	3	800	2.8
A12 Repl. 1	14/11/2012	2	<0.1	6.2	1.2	11	3.8	5	1000	3.9
A12 Repl. 2	13/11/2012	2	<0.1	5.7	1.1	8.4	3.3	4	1000	4.4
A12 Repl. 3	13/11/2012	2	<0.1	6.1	2.0	8.6	5.0	4	1100	3.9
A13 Repl. 1	13/11/2012	4	0.1	8.4	6.3	9.7	20	9	1600	11
A13 Repl. 2	14/11/2012	3	0.2	7.9	8.3	8.7	23	9	1600	13
A13 Repl. 3	14/11/2012	3	0.2	8.6	6.3	9.5	22	8	1800	10
A14 Repl. 1	14/11/2012	<2	0.1	8.1	3.7	8.9	14	9	1300	12
A14 Repl. 2	14/11/2012	<2	0.1	7.8	3.3	7.0	13	8	1200	6.5
A14 Repl. 3	14/11/2012	2	0.1	7.5	3.0	6.7	14	8	1100	7.3
A15 Repl. 1	14/11/2012	2	0.1	8.1	2.1	7.0	9.0	7	1200	6.0
A15 Repl. 2	14/11/2012	<2	0.1	8.0	2.7	7.6	8.9	7	1100	8.5
A15 Repl. 3	14/11/2012	3	0.1	7.8	3.0	7.1	9.6	7	1200	6.4
A16 Repl. 1	14/11/2012	3	0.1	7.0	4.9	9.4	34	17	1100	14
A16 Repl. 2	14/11/2012	2	0.1	7.6	7.5	9.7	57	25	1400	20
A16 Repl. 3	13/11/2012	2	0.1	6.9	5.2	10	33	19	1100	42
A17 Repl. 1	13/11/2012	<2	0.1	6.2	2.8	7.8	10	6	950	5.6
A17 Repl. 2	13/11/2012	<2	<0.1	6.9	3.4	7.7	12	7	1100	6.3
A17 Repl. 3	14/11/2012	<2	<0.1	6.3	5.1	7.1	13	7	1000	5.6

Signatory:

Date: 1/02/2013

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Marine and Freshwater
Research Laboratory
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Murdoch UNIVERSITY

SEDIMENT DATA

Contact: Natasha Norrish
Customer: Esperance Ports Sea and Land
Address: PO Box 35 , Esperance WA 645

Date of Issue: 1/02/2013
Date Received: 16/11/2012
Our Reference: EPSL12-1
Your Reference: ENV08-951

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 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	<0.05	<0.7	<1	<10	<0.5
File					12121701-13012401					
A18 Repl. 1	14/11/2012	<2	<0.1	6.8	1.4	6.0	5.9	5	1000	5.4
A18 Repl. 2	14/11/2012	<2	<0.1	6.6	0.5	6.5	2.1	4	910	2.7
A18 Repl. 3	14/11/2012	2	<0.1	7.2	0.4	6.2	1.6	3	1100	3.7
A19 Repl. 1	14/11/2012	2	<0.1	7.3	1.6	6.1	5.4	6	1200	3.4
A19 Repl. 2	14/11/2012	2	<0.1	7.4	3.1	6.3	13	8	1200	5.8
A19 Repl. 3	14/11/2012	3	<0.1	7.4	2.3	6.6	8.3	6	1100	4.3
A20 Repl. 1	14/11/2012	3	<0.1	5.0	3.5	6.1	14	7	820	7.4
A20 Repl. 2	14/11/2012	4	0.1	6.6	5.4	6.9	20	9	1100	11
A21 Repl. 1	14/11/2012	3	0.2	8.4	4.8	9.9	22	10	1500	9.6
A21 Repl. 2	14/11/2012	3	0.2	8.8	7.7	10	33	13	1800	13
A21 Repl. 3	14/11/2012	4	0.2	8.7	6.5	10	34	13	1700	11
A22 Repl. 1	14/11/2012	<2	0.1	3.6	1.0	11	1.0	3	760	8.1
A22 Repl. 2	14/11/2012	<2	<0.1	5.5	0.4	11	1.4	3	840	1.8
A22 Repl. 3	14/11/2012	<2	<0.1	4.4	0.3	8.9	<0.7	3	880	1.3
A23 Repl. 1	13/11/2012	3	0.1	8.6	9.2	9.5	38	13	1700	13
A23 Repl. 2	13/11/2012	4	0.2	9.1	8.8	10	38	14	1900	14
A23 Repl. 3	13/11/2012	3	0.2	8.2	7.4	9.5	33	12	1600	12

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Reporting Limit		**<2**	**<0.1**	**<0.2**	**<0.2**	**<0.05**	**<0.7**	**<1**	**<10**	**<0.5**
File						**12121701-13012401**				
QA/QC DATA	**Criteria**									
Duplicate 1	<20% difference	Low Conc	Low Conc	4%	1%	3%	Low Conc	13%	4%	11%
Duplicate 2	<20% difference	Low Conc	Low Conc	2%	1%	3%	4%	4%	1%	0%
Duplicate 3	<20% difference	Low Conc	Low Conc	5%	0%	7%	5%	2%	4%	14%
Duplicate 4	<20% difference	Low Conc	Low Conc	5%	7%	0%	3%	8%	4%	4%
Duplicate 5	<20% difference	Low Conc	Low Conc	7%	4%	6%	5%	8%	8%	18%
Duplicate 6	<20% difference	Low Conc	Low Conc	1%	1%	2%	1%	2%	3%	5%
Duplicate 7	<20% difference	Low Conc	Low Conc	8%	5%	7%	8%	7%	7%	8%
Duplicate 8	<20% difference	Low Conc	Low Conc	3%	4%	3%	12%	1%	3%	0%
Duplicate 9	<20% difference	Low Conc	Low Conc	2%	2%	1%	2%	3%	0%	13%
SRM RECOVERY 1	80%-120%	104%	102%	98%	100%	94%	94%	91%	101%	92%
SRM RECOVERY 2	80%-120%	100%	103%	99%	101%	95%	99%	94%	101%	94%
SRM RECOVERY 3	80%-120%	101%	100%	96%	99%	93%	95%	93%	101%	90%
SRM RECOVERY 4	80%-120%	99%	103%	95%	95%	93%	95%	96%	100%	95%
CRM RECOVERY 1	80%-120%	107%	101%	97%	102%	94%	97%	84%	100%	99%
CRM RECOVERY 2	80%-120%	97%	99%	96%	100%	93%	96%	81%	99%	96%
BLANK 1	<Reporting Limit	<2	<0.1	<0.2	<0.2	<0.05	<0.7	<1	<10	<0.5
BLANK 2	<Reporting Limit	<2	<0.1	<0.2	<0.2	<0.05	<0.7	<1	<10	<0.5

Signatory:

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Reporting Limit		**<2**	**<0.1**	**<0.2**	**<0.2**	**<0.05**	**<0.7**	**<1**	**<10**	**<0.5**
File						**13010702-13011501**				
A5 Repl. 1	14/11/2012	2	<0.1	2.5	0.6	3.0	<0.7	<1	620	1.2
A5 Repl. 2	14/11/2012	2	<0.1	2.4	0.5	2.6	<0.7	1	640	1.0
A5 Repl. 3	14/11/2012	3	0.1	2.5	0.6	2.9	<0.7	1	650	1.2
A6 Repl. 1	13/11/2012	<2	<0.1	5.5	0.2	5.6	<0.7	<1	910	0.6
A6 Repl. 2	13/11/2012	2	<0.1	5.3	0.3	5.8	<0.7	<1	880	0.6
A6 Repl. 3	13/11/2012	2	<0.1	5.2	0.3	5.5	<0.7	1	880	0.9
A7 Repl. 1	13/11/2012	3	<0.1	2.7	0.3	2.6	<0.7	<1	520	0.6
A7 Repl. 2	13/11/2012	3	<0.1	2.7	0.3	2.8	<0.7	<1	520	0.5
A7 Repl. 3	13/11/2012	3	<0.1	2.7	0.3	2.7	<0.7	<1	510	<0.5
A8 Repl. 1	13/11/2012	2	0.2	5.2	7.7	5.1	2.8	9	1000	8.6
A8 Repl. 2	13/11/2012	2	<0.1	5.3	26	5.2	2.4	9	970	15
A8 Repl. 3	13/11/2012	2	<0.1	5.6	6.0	5.4	3.2	11	1000	9.8
A9 Repl. 1	14/11/2012	<2	0.1	6.6	6.0	4.6	2.7	10	1000	5.1
A9 Repl. 2	14/11/2012	<2	0.1	6.5	11	4.5	3.1	20	990	6.9
A9 Repl. 3	14/11/2012	<2	0.1	6.7	7.1	4.6	3.1	19	1000	5.7
A10a Repl. 1	13/11/2012	4	0.2	7.0	13	8.1	69	310	1200	34
A10a Repl. 2	13/11/2012	3	0.1	6.2	8.6	6.2	47	360	1000	33
A10a Repl. 3	13/11/2012	3	0.2	6.2	7.2	6.2	38	380	980	32
A10b Repl. 1	13/11/2012	2	0.1	6.2	4.4	5.0	12	72	1000	18
A10b Repl. 2	13/11/2012	2	0.1	6.0	4.2	4.8	8.5	61	990	14
A10b Repl. 3	13/11/2012	<2	0.1	5.7	2.8	4.5	6.9	51	930	11

Signatory:

Date: 1/02/2013

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Murdoch UNIVERSITY

SEDIMENT DATA

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Customer: Esperance Ports Sea and Land
Address: PO Box 35 , Esperance WA 645

Date of Issue: 1/02/2013
Date Received: 16/11/2012
Our Reference: EPSL12-1
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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 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**	**<0.05**	**<0.7**	**<1**	**<10**	**<0.5**
File						**13010702-13011501**				
A11 Repl. 1	14/11/2012	<2	<0.1	3.6	0.7	4.0	<0.7	2	730	1.2
A11 Repl. 2	14/11/2012	<2	<0.1	3.1	0.7	3.9	<0.7	2	610	1.1
A11 Repl. 3	14/11/2012	<2	<0.1	3.4	0.7	4.1	<0.7	2	730	1.1
A12 Repl. 1	13/11/2012	<2	<0.1	5.2	0.5	6.2	0.7	3	900	1.4
A12 Repl. 2	13/11/2012	<2	<0.1	4.3	0.7	5.4	<0.7	2	840	1.4
A12 Repl. 3	13/11/2012	2	<0.1	4.7	1.0	5.9	0.7	3	920	1.8
A13 Repl. 1	14/11/2012	2	0.1	6.7	2.4	5.6	2.4	8	1200	5.1
A13 Repl. 2	14/11/2012	<2	<0.1	6.3	2.4	5.4	2.7	8	1300	5.1
A13 Repl. 3	14/11/2012	2	0.2	7.4	2.3	7.3	2.1	7	1600	4.3
A14 Repl. 1	14/11/2012	<2	<0.1	6.7	2.0	4.6	1.9	10	1100	4.1
A14 Repl. 2	14/11/2012	<2	<0.1	6.2	1.8	4.3	1.5	9	930	3.7
A14 Repl. 3	14/11/2012	<2	<0.1	6.6	1.6	4.6	1.9	8	1000	4.0
A15 Repl. 1	14/11/2012	<2	<0.1	6.7	1.2	4.5	1.1	6	1000	3.2
A15 Repl. 2	14/11/2012	<2	<0.1	6.5	1.3	4.3	1.4	5	990	4.3
A15 Repl. 3	14/11/2012	<2	<0.1	6.8	1.3	4.6	1.4	6	1100	4.0
A16 Repl. 1	13/11/2012	<2	0.1	5.4	1.7	4.2	3.5	17	840	11
A16 Repl. 2	13/11/2012	<2	<0.1	5.9	2.4	4.6	4.2	28	960	12
A16 Repl. 3	13/11/2012	<2	<0.1	5.7	2.0	4.5	3.0	20	920	18
A17 Repl. 1	14/11/2012	<2	<0.1	4.9	1.3	4.0	1.6	7	800	2.9
A17 Repl. 2	14/11/2012	<2	<0.1	5.2	1.4	4.3	1.7	6	880	3.2
A17 Repl. 3	14/11/2012	<2	<0.1	5.2	1.8	4.2	1.9	7	880	3.0

Signatory:

Date: 1/02/2013

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Date Received: 16/11/2012
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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 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**	**<0.05**	**<0.7**	**<1**	**<10**	**<0.5**
File						**13010702-13011501**				
A18 Repl. 1	14/11/2012	<2	<0.1	6.3	0.6	4.3	0.9	4	980	1.7
A18 Repl. 2	14/11/2012	<2	<0.1	5.8	0.4	3.8	<0.7	9	850	0.8
A18 Repl. 3	14/11/2012	<2	<0.1	6.6	0.3	4.4	<0.7	1	990	0.6
A19 Repl. 1	14/11/2012	<2	<0.1	6.3	0.9	4.3	<0.7	5	1000	3.1
A19 Repl. 2	14/11/2012	<2	<0.1	6.2	1.3	4.3	1.2	5	970	2.8
A19 Repl. 3	14/11/2012	<2	<0.1	6.1	1.1	4.2	0.7	4	960	2.0
A20 Repl. 1	14/11/2012	<2	<0.1	4.7	1.6	3.6	1.3	7	820	4.3
A20 Repl. 2	14/11/2012	<2	<0.1	5.3	2.0	4.4	1.7	8	930	5.0
A21 Repl. 1	14/11/2012	<2	0.1	7.0	1.3	7.2	1.6	8	1300	2.9
A21 Repl. 2	14/11/2012	2	0.1	7.4	2.0	7.5	2.2	11	1400	4.5
A21 Repl. 3	14/11/2012	2	0.1	7.5	1.7	8.0	2.2	12	1400	4.0
A22 Repl. 1	13/11/2012	<2	<0.1	1.8	0.3	1.6	<0.7	1	480	0.6
A22 Repl. 2	13/11/2012	<2	<0.1	4.6	0.2	3.6	<0.7	<1	700	0.5
A22 Repl. 3	13/11/2012	<2	<0.1	2.8	0.2	2.2	<0.7	<1	620	<0.5
A23 Repl. 1	13/11/2012	2	0.1	6.2	3.7	6.7	4.0	13	1300	6.0
A23 Repl. 2	13/11/2012	2	0.1	6.2	3.9	6.8	3.9	13	1300	6.5
A23 Repl. 3	13/11/2012	2	0.1	6.2	3.5	6.7	3.9	12	1300	5.9

Signatory:

Date: 1/02/2013

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Reporting Limit		**<2**	**<0.1**	**<0.2**	**<0.2**	**<0.05**	**<0.7**	**<1**	**<10**	**<0.5**
File						**13010702-13011501**				
QA/QC DATA	**Criteria**									
Duplicate 1	<20% difference	Low Conc	Low Conc	0%	Low Conc	2%	Low Conc	Low Conc	2%	Low Conc
Duplicate 2	<20% difference	Low Conc	Low Conc	20%	20%	0%	19%	6%	1%	2%
Duplicate 3	<20% difference	Low Conc	Low Conc	3%	2%	5%	4%	6%	3%	1%
Duplicate 4	<20% difference	Low Conc	Low Conc	3%	6%	2%	9%	4%	2%	6%
Duplicate 5	<20% difference	Low Conc	Low Conc	0%	14%	6%	4%	10%	2%	10%
Duplicate 6	<20% difference	Low Conc	Low Conc	4%	Low Conc	1%	Low Conc	Low Conc	2%	Low Conc
Duplicate 7	<20% difference	Low Conc	Low Conc	1%	1%	5%	9%	12%	1%	6%
Duplicate 8	<20% difference	Low Conc	Low Conc	2%	Low Conc	3%	Low Conc	Low Conc	4%	Low Conc
Duplicate 9	<20% difference	Low Conc	Low Conc	0%	1%	2%	0%	4%	0%	5%
SRM RECOVERY 1	80%-120%	100%	94%	100%	99%	99%	100%	99%	98%	102%
SRM RECOVERY 2	80%-120%	103%	97%	103%	104%	103%	100%	102%	100%	103%
SRM RECOVERY 3	80%-120%	100%	92%	99%	104%	101%	96%	98%	100%	98%
SRM RECOVERY 4	80%-120%	100%	90%	98%	106%	100%	95%	98%	98%	99%
CRM RECOVERY 1	80%-120%	108%	109%	101%	106%	100%	110%	104%	108%	100%
CRM RECOVERY 2	80%-120%	111%	102%	97%	108%	97%	102%	99%	105%	92%
BLANK 1	<Reporting Limit	<2	<0.1	<0.2	<0.2	<0.05	<0.7	<1	<10	<0.5
BLANK 2	<Reporting Limit	<2	<0.1	<0.2	<0.2	<0.05	<0.7	<1	<10	<0.5

Signatory:

Date: 1/02/2013

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Australian Government

National Measurement Institute

REPORT OF ANALYSIS

Report No. RN945934

Client	: ESPERANCE PORTS SEA & LAND	Job No.	: ESPE03/121121
	PO BOX 35	Quote No.	: QT-01898
	ESPERANCE WA 6450	Order No.	: 122687
		Date Sampled	:
		Date Received	: 21-NOV-2012
Attention	: NATASHA NORRISH	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W12/018338/1	A17	MARINE SEDIMENT REPLICATE 1 DILUTE ACID 14/11/2012
W12/018339/1	A17	MARINE SEDIMENT REPLICATE 2 DILUTE ACID 14/11/2012
W12/018340/1	A17	MARINE SEDIMENT REPLICATE 3 DILUTE ACID 14/11/2012
W12/018341/1	A23	MARINE SEDIMENT REPLICATE 1 DILUTE ACID 13/11/2012

Lab Reg No.		W12/018338/1	W12/018339/1	W12/018340/1	W12/018341/1	
Sample Reference	Units	A17	A17	A17	A23	Method
Trace Elements						
Lead	mg/kg	4.9	4.8	5	11	NT2_49
Nickel	mg/kg	1.4	1.3	1.5	3.1	NT2_49

W12/018338/1
- W12/018343/1
Method used for Bioavailable Metals: Samples were extracted with 1M HCl then analysed by ICP-MS/AES.
This method is not NATA accredited.

Nasir Shikdar, Analyst
Inorganics - NSW

Ling Shuang Lu, Analyst
Inorganics - NSW

30-NOV-2012

REPORT OF ANALYSIS

Report No. RN945934

Client	: ESPERANCE PORTS SEA & LAND	Job No.	: ESPE03/121121
	PO BOX 35	Quote No.	: QT-01898
	ESPERANCE WA 6450	Order No.	: 122687
		Date Sampled	:
		Date Received	: 21-NOV-2012
Attention	: NATASHA NORRISH	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W12/018342/1	A23	MARINE SEDIMENT REPLICATE 2 DILUTE ACID 13/11/2012
W12/018343/1	A23	MARINE SEDIMENT REPLICATE 3 DILUTE ACID 13/11/2012

Lab Reg No.		W12/018342/1	W12/018343/1			
Sample Reference	Units	A23	A23			Method
Trace Elements						
Lead	mg/kg	9.8	11			NT2_49
Nickel	mg/kg	2.7	2.9			NT2_49

Nasir Shikdar, Analyst
Inorganics - NSW

Ling Shuang Lu, Analyst
Inorganics - NSW

30-NOV-2012

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REPORT OF ANALYSIS

Report No. RN945933

Client	: ESPERANCE PORTS SEA & LAND	Job No.	: ESPE03/121121
	PO BOX 35	Quote No.	: QT-01898
	ESPERANCE WA 6450	Order No.	: 122687
		Date Sampled	:
		Date Received	: 21-NOV-2012
Attention	: NATASHA NORRISH	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W12/018335/1	A13	MARINE SEDIMENT REPLICATE 1 DILUTE ACID 14/11/2012
W12/018336/1	A13	MARINE SEDIMENT REPLICATE 2 DILUTE ACID 14/11/2012
W12/018337/1	A13	MARINE SEDIMENT REPLICATE 3 DILUTE ACID 14/11/2012

Lab Reg No.		W12/018335/1	W12/018336/1	W12/018337/1		
Sample Reference	Units	A13	A13	A13		Method
Trace Elements						
Arsenic	mg/kg	< 0.5	0.66	< 0.5		NT2_49
Cadmium	mg/kg	< 0.5	< 0.5	< 0.5		NT2_49
Chromium	mg/kg	6.5	6	6.7		NT2_49
Copper	mg/kg	2	1.9	2.1		NT2_49
Lead	mg/kg	7.8	6.2	6.6		NT2_49
Manganese	mg/kg	5.3	5.2	6.7		NT2_49
Nickel	mg/kg	2.3	2	1.9		NT2_49
Zinc	mg/kg	5.6	5.4	4.8		NT2_49
Sulphur	mg/kg	1170	1270	1550		NT2_49

W12/018335/1
- W12/0183337/1
Method used for Bioavailable Metals: Samples were extracted with 1M HCl then analysed by ICP-MS/AES.
This method is not NATA accredited.

Nasir Shikdar, Analyst
Inorganics - NSW

Ling Shuang Lu, Analyst
Inorganics - NSW

30-NOV-2012

REPORT OF ANALYSIS

Results relate only to the sample(s) tested.
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105 Delhi Road, North Ryde NSW 2113 Tel: +61 2 9449 0111 Fax: +61 2 9449 1653 www.measurement.gov.au

REPORT OF ANALYSIS

Report No. RN945907

Client	: ESPERANCE PORTS SEA & LAND	Job No.	: ESPE03/121121
	PO BOX 35	Quote No.	: QT-01898
	ESPERANCE WA 6450	Order No.	: 122687
		Date Sampled	:
		Date Received	: 21-NOV-2012
Attention	: NATASHA NORRISH	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W12/018335	A13	MARINE SEDIMENT REPLICATE 1 STRONG ACID 14/11/2012
W12/018336	A13	MARINE SEDIMENT REPLICATE 2 STRONG ACID 14/11/2012
W12/018337	A13	MARINE SEDIMENT REPLICATE 3 STRONG ACID 14/11/2012

Lab Reg No.		W12/018335	W12/018336	W12/018337		
Sample Reference	Units	A13	A13	A13		Method
Trace Elements						
Arsenic	mg/kg	1.8	2.6	1.7		NT2_49
Cadmium	mg/kg	< 0.5	< 0.5	< 0.5		NT2_49
Chromium	mg/kg	9.5	9.6	9.7		NT2_49
Copper	mg/kg	8.5	12	6.9		NT2_49
Lead	mg/kg	7.8	8.3	6.3		NT2_49
Manganese	mg/kg	8	8.7	9.4		NT2_49
Nickel	mg/kg	35	33	25		NT2_49
Zinc	mg/kg	13	20	11		NT2_49
Total Solids	%	73.5	70.2	69.9		NT2_49
Sulphur	mg/kg	1620	1770	1910		NT2_49

Nasir Shikdar, Analyst
Inorganics - NSW
Accreditation No. 198

29-NOV-2012

All results are expressed on a dry weight basis.

REPORT OF ANALYSIS

This Report supersedes reports: RN945348

REPORT OF ANALYSIS

Report No. RN945904

Client	: ESPERANCE PORTS SEA & LAND	Job No.	: ESPE03/121121
	PO BOX 35	Quote No.	: QT-01898
	ESPERANCE WA 6450	Order No.	: 122687
		Date Sampled	:
		Date Received	: 21-NOV-2012
Attention	: NATASHA NORRISH	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W12/018331	A8	MARINE SEDIMENT 13/11/2012
W12/018332	A9	MARINE SEDIMENT 14/11/2012
W12/018333	A10A	MARINE SEDIMENT 13/11/2012
W12/018334	A10B	MARINE SEDIMENT 13/11/2012

Lab Reg No.		W12/018331	W12/018332	W12/018333	W12/018334	
Sample Reference	Units	A8	A9	A10A	A10B	Method
Organotins						
Monobutyltin as Sn	ng/g	< 0.5	0.61	1.0	< 0.5	NR_35
Dibutyltin as Sn	ng/g	4.2	2.0	4.0	1.3	NR_35
Tributyltin as Sn	ng/g	20	22	11	4.1	NR_35
Surrogate: Tripropyltin	%REC	99	76	66	95	NR_35
Dates						
Date extracted		28-NOV-2012	28-NOV-2012	28-NOV-2012	28-NOV-2012	
Date analysed		28-NOV-2012	28-NOV-2012	28-NOV-2012	28-NOV-2012	

Luke Baker, Analyst
Organics - NSW
Accreditation No. 198

29-NOV-2012

Lab Reg No.		W12/018331	W12/018332	W12/018333	W12/018334	
Sample Reference	Units	A8	A9	A10A	A10B	Method
Trace Elements						
Total Solids	%	68	76.4	74.2	72.8	NT2_49

REPORT OF ANALYSIS

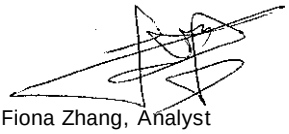
Report No. RN945904

Lab Reg No.		W12/018331	W12/018332	W12/018333	W12/018334	
Sample Reference	Units	A8	A9	A10A	A10B	Method

Nasir Shikdar, Analyst
Inorganics - NSW
Accreditation No. 198

29-NOV-2012

Lab Reg No.		W12/018331	W12/018332	W12/018333	W12/018334	
Sample Reference	Units	A8	A9	A10A	A10B	Method
Miscellaneous						
Carbon - Total Organic	mg/kg	3900	1200	3000	2200	NW_S15



Fiona Zhang, Analyst
Inorganics - NSW
Accreditation No. 198

29-NOV-2012

All results are expressed on a dry weight basis.

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This Report supersedes reports: RN945348 RN945697 RN945849

REPORT OF ANALYSIS

Report No. RN945376

Client	: ESPERANCE PORTS SEA & LAND	Job No.	: ESPE03/121120
	PO BOX 35	Quote No.	: QT-01898
	ESPERANCE WA 6450	Order No.	: 122687
		Date Sampled	:
		Date Received	: 20-NOV-2012
Attention	: NATASHA NORRISH	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W12/018330	.	MOLLUSC RAZORFISH (PINNA BICOLOR) (FROM SITE A21)

Lab Reg No.		W12/018330				
Sample Reference	Units	.				Method
Trace Elements						
Arsenic	mg/kg	5.8				NT2_46
Cadmium	mg/kg	1.2				NT2_46
Chromium	mg/kg	0.07				NT2_46
Copper	mg/kg	0.64				NT2_46
Lead	mg/kg	0.07				NT2_46
Manganese	mg/kg	0.35				NT2_46
Nickel	mg/kg	0.45				NT2_46
Sulphur	mg/kg	3570				NT2_46
Zinc	mg/kg	600				NT2_46

W12/018330
Results are reported on the sample(s) as received.

Lisa Liu, Analyst
Inorganics - NSW
Accreditation No. 198

27-NOV-2012

REPORT OF ANALYSIS

This Report supersedes reports: RN945264

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;
- Samples were transported on ice to NATA accredited laboratories (NMI and MAFRL) in hard eskies;
- Split duplicate samples were collected from 3 monitoring sites (A13, A17 and A23) and sent to NMI, as a reference laboratory, to ensure reliable results were obtained; and
- Relative Standard Deviation % (RSD) for each sample site was calculated.

The following three QA/QC split replicate samples were collected in the field and sent to secondary laboratory NMI for analysis:

- Split replicate sample was collected from A13 and analysed for a suite of metals;
- Split replicate sample was collected from A17 and analysed for lead and nickel; and
- Split replicate sample was collected from A23 and analysed for lead and nickel.

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 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. This is calculated by the following equation:

Relative Standard Deviation (RSD %) = (standard deviation of triplicate) x 100

(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).

RSD results for total metals and sulphur are provided in Table 7. Calculated RSDs were below 50% for all metals and sulphur results with the following exceptions:

- Site A8 recorded an RSD of 112% for copper;
- Site A9 recorded an RSD of 60% for copper;
- Site A18 recorded an RSD of 73% for nickel;
- Site A22 recorded an RSD of 58% for nickel; and
- Site A8 recorded an RSD of 63% for zinc.

The above mentioned RSDs greater than 50% account for 5 out of the total 110 calculated RSD's.

Copper results from Site A8 indicate the variability of the copper levels found in the sediment (which is most likely due to flakes of copper from ships hulls, as they use copper-based antifouling rather than organotins in the paint.

The other four sites with RSD above 50% all had three triplicates below the ISQG-Low values whose lower values mean that laboratory measurement will be more imprecise.

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

	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*
Site									
A5	25	<LOD	5	14	13	4	22	4	8
A6	35*	<LOD	3	11	10	22	22	2	33
A7	0	<LOD	3	13	10	<LOD	0	8	27
A8	0	43	3	**112**	5	10	15	4	**63**
A9	35*	35*	3	**60**	9	24	42	9	7
A10a	25	25	5	43	2	41	19	33	20
A10b	33	35	6	26	10	33	26	13	18
A11	0	<LOD	6	20	2	28	17	7	9
A12	0	<LOD	4	34	16	22	13	6	7
A13	17	35	4	17	6	7	7	7	13
A14	-	-	-	-	-	4	7	-	-
A15	-	-	-	-	-	4	0	-	-
A16	-	-	-	-	-	33	20	-	-
A17	-	-	-	-	-	13	9	-	-
A18	-	-	-	-	-	**73**	25	-	-
A19	-	-	-	-	-	43	17	-	-
A20	-	-	-	-	-	25	18	-	-
A21	-	-	-	-	-	22	14	-	-
A22	-	-	-	-	-	**58***	0	-	-
A23	-	-	-	-	-	8	8	-	-

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)

Each site that was sampled for organotins and TOC were single samples, and as a result, field QA/QC is not applicable.

Field QA/QC

Three split duplicate samples were collected at sampling sites A13, A17 and A23 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 total and bioavailable metals are provided below in Tables 8 and 9 respectively. Total results were within the 30 - 50% RPD range with the exception of arsenic at A13. However, values were an order of magnitude below the ISQG-Low and this result is not significant. AS4482.1 (2005) states that the variability of samples should be considered when evaluating RPD results. High variability between triplicate samples has been illustrated in section 5.3.1 due to the variable nature of sediment sampling, therefore it is determined that RPDs outside the 30-50% 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 total 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
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Site									
A13 (MAFRL)	3	0.2	8.4	6.3	9.5	22	9	1600	11
A13 (NMI)	1.8	<0.05	9.6	8.5	8.7	33	7.8	1770	13
RPD	50	n/a	**13.33**	29.73	**8.79**	40	**14.29**	**10.09**	**16.67**
A17 (MAFRL)	nt	nt	nt	nt	nt	12	7	nt	nt
A17 (NMI)	nt	nt	nt	nt	nt	13	4.9	nt	nt
RPD	n/a	n/a	n/a	n/a	n/a	8	35.29	n/a	n/a
A23 (MAFRL)	nt	nt	nt	nt	nt	38	13	nt	nt
A23 (NMI)	nt	nt	nt	nt	nt	44	14	nt	nt
RPD	n/a	n/a	n/a	n/a	n/a	14.63	7.41	n/a	n/a
Total results were within 50% RPD for all metals at all sites									

Table A9-3: 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
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Site									
A13 (MAFRL)	2	0.1	6.7	2.4	5.6	2.4	8	1300	5.1
A13 (NMI)	0.5	<0.05	6.5	2	5.3	2	6.6	1270	5.4
RPD	120.0	n/a	3.0	18.2	5.5	18.2	19.2	2.3	5.7
A17 (MAFRL)	nt	nt	nt	nt	nt	1.7	7	nt	nt
A17 (NMI)	nt	nt	nt	nt	nt	1.4	4.9	nt	nt
RPD	n/a	n/a	n/a	n/a	n/a	19.4	35.3	n/a	n/a
A23 (MAFRL)	nt	nt	nt	nt	nt	3.9	13	nt	nt
A23 (NMI)	nt	nt	nt	nt	nt	2.9	11	nt	nt
RPD	n/a	n/a	n/a	n/a	n/a	29.4	16.7	n/a	n/a
Bioavailable results were within 50% RPD for all metals at all sites with the exception of Site A13 for lead (120 RPD).									