ANNUAL MARINE SEDIMENT MONITORING REPORT 2011

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1	N. Norrish	A Leonard		13/11/2012	
2	N. Norrish	A Leonard		19/11/2012	
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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 in November of each year. The details of these requirements are provided in the Comprehensive Sediment Monitoring and Reporting Plan (Oceanica, 2009a). Briefly, this requires EPSL to resample the top 10cm of sediment at 15 locations in the inner harbour and four locations with lower contamination levels to assess for changes in sediment quality, particularly for lead and nickel, the principal contaminants of concern.

The overall results from the 2011 sediment sampling (all sites 0-10cm depth) were consistent with previous studies, with most contamination being limited to the three berth pockets. No statistical comparisons were made between 2011 and the earlier 2007 and 2008 surveys since, because as discussed in the 2010 Marine Sediment Report (EPSL, 2011), these comparisons are confounded by the variable depths sampled in the earlier surveys. Between 2010 and 2011, concentrations of both lead and nickel had declined at all ten sites that had levels of these contaminants exceeding the relevant sediment quality criteria (ISQG-Low values, ANZECC-ARMCANZ, 2000). Although, these declines were marginally not significant at the 95% level of confidence due to high variability, it is expected that the differences will be significant in next year's survey as bulk nickel handling has been indefinitely suspended and bulk lead handling ceased in 2007. The remaining nickel is likely to be dissipated by natural processes. Concentrations of contaminants will decline further should EPSL proceed with planned maintenance dredging and cleaning of existing stormwater infrastructure and demolition of the nickel handling circuit.

2. INTRODUCTION

Bulk handling operations by Esperance Ports Sea and Land (EPSL) of lead carbonate and nickel concentrate have caused lead and nickel contamination in the marine sediments within the berth pockets of Esperance Port. EPSL has not exported bulk lead carbonate since 2007. Bulk nickel exports continued until October 2011. In 2009, measures were taken to reduce potential nickel contamination from bulk nickel ship loading. These measures included upgrading the nickel circuit including:

- fully enclosing the conveyor system that loads the bulk nickel from the nickel storage shed into the ship;
- installation of a telescopic chute on the ship loader that extends into the ships hold; and
- a container tipper system for bulk inloading to the storage shed.

The last bulk nickel concentrate export was completed on 5th October 2011. Between October 2011 and June 2012, nickel was brought into the Port in containers, tipped via the nickel tipper and conveyed to the nickel shed, where it was bagged and exported in bulker bags. Since June 2012, bulk nickel inloading and exporting has ceased indefinitely. All nickel products are now delivered to the Port in sealed containers or bulker bags. Lead ceased being exported through the Port in 2007, and the last of the remaining lead was double bagged and sealed in containers and removed from the Port in mid 2009. EPSL no longer handles any lead product.

Marine sediment monitoring for TBT and nickel was required by Ministerial Statement 555 (2000) and its superseding legislation Ministerial Statement 681 (2005). EPSL conducted marine sediment sampling between 2002 and 2006, with nickel analysis commencing in 2002 and lead monitoring commencing in 2005, after bulk lead exports commenced at the Port. In March 2006 Condition M8.5 was closed and monitoring temporarily ceased. In 2007, the Department of Environment and Conservation (DEC) found high lead and nickel levels near a discharge pipe at Berth 1 (close to existing Site A10). As a result of this, Oceanica were contracted by EPSL to develop a Sampling and Analysis Program (SAP) to assess the ecological risks of the lead and nickel contamination within the Esperance Harbour.

An extensive survey and investigation of the toxicity of surficial sediments by Oceanica consultants was commissioned by the Port between 2007 and 2010. These tests included total and bioavailable metals 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 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 lead to toxicity, EPSL were required by DEC to monitor and report levels of contaminants in marine sediments under the current Licence (5099/1974/13) conditions 4(a), 4(b), 14(a), 14(b) and 15. The methods required to meet the Licence criteria are specified in 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. Particle size analyses are conducted once every three years and is next due November 2013. The ANZECC-ARMCANZ (2000) sediment quality criteria were adopted to form triggers for management actions (refer to Section 3 of the CSMRP, Oceanica, 2009a).

These monitoring requirements will be reviewed should EPSL secure government approval for maintenance dredging works to remove and dispose of these contaminated sediments, or repeated sampling shows stable or declining levels of contamination.

EPSL conducted sediment sampling, based on the methods in the CSMRP (Oceanica, 2009a), by contracting local divers, for the annual survey in 2010. The overall results from the 2010 sediment sampling (all sites 0-10cm depth) were consistent with previous studies, with most contamination being limited to the berth pockets and bioavailable levels of metals did not increase since previous studies. However, direct comparison between previous years sampling (2007 and 2008) could not be carried out as only the surficial layer (0-2cm) was sampled.

In 2011, EPSL contracted the same local divers to conduct the 2011 annual sediment sampling and used the same laboratories for the chemical analyses. All sites were sampled to a depth of 0-10cm, allowing for direct comparison with the 2010 results.

3. OBJECTIVES

1. As required in Table 3.1 of the CSMRP (Oceanica, 2009a), assess median values of samples to assess compliance with sediment quality criteria (refer to the Interim Sediment Quality Guidelines (ISQG) in ANZECC-ARMCANZ, 2000)) for the 2007, 2008 and 2010 results and undertake any required contingency actions;

2. As required in Section 2.2.8. Time Series Analysis of the CSMRP (2009a) for any given annual survey:

    a. Calculate the mean lead and nickel value for the 15 inner harbour sites using the average value for each site (calculated from the three replicates for each sites); and
    b. Determine whether these values are significantly different to those of previous annual surveys using a standard t-test (two tailed).

3. 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 ANZECC-ARMCANZ (2000) guidelines.

The above objectives were amended by not conducting t-tests between the 2011 data and 2007 or 2008, due to the majority of the earlier samples only having results for the top 0-2cm of the core, which provides confounded comparisons between these years (refer to 2010 report for a full discussion of these limitations). Therefore, the only valid comparisons were between the data from 2010 and 2011.

4. METHODS

4.1. Sampling Works

Professional divers previously contracted by Oceanica and EPSL were appointed (consistent with AS/NZS 4122) to collect 300 sediment cores in November 2011. The 2011 samples were collected at the same nineteen sites sampled in 2008. Three replicate samples were taken within 5 metres of each other at the nineteen 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. 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 landward side is thought to accumulate sediments, as the sheet piling creates a barrier, and the ocean side was thought to undergo regular flushing due to ocean currents and ships propeller wash. Samples were taken on either side of the sheet piling to determine whether this is the case.

The sample sites grouped by Oceanica comprise three outer harbour sites (A5, A6 and A7), 11 sites within the berth pockets (A8, A8, A10 and A14 to A21), and five sites in the turning basin and channel (A11, A12, A13, A22 and A23) (Figure 1). For further details of the sampling methods refer to Section 2.2.4 of the CSMRP (Oceanica, 2009a).

The corers used for sampling are a different dimension to the Australian Standard. DEC clarified that the dimensions of the polycarbonate cores (internal diameter ~100 mm) should be used as described in Section 2.2.4 of the CSMRP (Oceanica, 2009a), and not as specified in the Australian Standard (AS 5667.12:1999 (Annex C)) which requires an internal diameter of 66mm and an outer diameter of 70mm, with lengths from 1 to 3m (for further details refer to the CSMRP (Oceanica, 2009a)).

In contrast to previous studies, the sample processing of cores from annual sampling in 2010 and 2011 were composite surface sediments from 0 to 10cm from the five different cores. In previous studies (Oceanica, 2007, 2008; 2009b; 2010) the homogenates of the five cores consisted of only the surficial layer (0-2cm). Analysis of the 2-5cm and 6-10cm layers was only conducted if high levels of lead or nickel were found in the surficial layer.

Figure 1. Marine Sediment Sampling Sites at Esperance Ports Sea and Land

4.2 Sample Site Descriptions

There were several sites in 2011 where the total 10cm of sediment were difficult to obtain. Sites A6 and A7 were within seagrass beds. The divers found it difficult to insert the cores through the dense seagrass and seagrass roots to obtain adequate 10cm sediment samples. Sites A5, A11 and A23 were within a rocky limestone area. Some of the samples at these sites had a substantial amount of shell fragments in the samples.

Within the berth pockets, Site A8 comprised dark grey sand, with some sulphur odour and had a small amount of seaweed. At Site A8, replicate 2 only had 4 sub-samples taken, due to one area in the quadrat where the corer could not be inserted. The other two berth pockets, A9 and A10 were comprised of dark grey sand with some black sand and fine material.

Site A21 was comprised of medium grey sands and had a strong sulphur odour. Sites A14, A17, A18 and A19 were comprised mainly of grey coloured sand with some darker grey to black sand within the sample. Sites A15 and A13 were of medium grey sand with some darker grey sand at the bottom of the sample. This indicates the effect of the propeller wash from the ship and tug movements.

These sites were difficult to sample in both 2010 and 2011, may be considered for relocation for the 2013 sediment sampling.

4.3 Laboratory Analyses

Certificates of analysis are attached in Appendix B.
All 19 sites were tested according to condition 14(b) and Table 2 of the EPSL Operating Licence. In summary, all 19 sites were tested for nickel and lead. Nine sites (A5 to A13) were also tested for arsenic, cadmium, chromium, copper, manganese, zinc and sulphur. Strong acid extraction method was used to obtain results of the total metal fraction in the sediments. Dilute acid extraction method was used to measure the bioavailable metal fraction in the sediments. In addition, Sites A8, A9, A10 (both sub-sites A10a and A10b) were tested for Organotins (Tributyltin (TBT), Dibutyltin (DBT), Monobutyltin (MBT) and Total Organic Carbon (TOC)).

The same laboratories used in this survey were used in the previous surveys conducted by Oceanica consultants, which were the Marine and Freshwater Research Laboratory (MAFRL) and National Measurement Institute (NMI). Both laboratories are National Association of Testing Authority (NATA) accredited. All samples were stored at 4^{o}C in an esky and couriered overnight to Perth in appropriate containers provided by each laboratory. The following laboratories were used for the analytes required by condition 14(a) of the EPSL Licence:

- NMI was used to analyse TOC and organotins (TBT, DBT, MBT);
- MAFRL were used for metal (As, Cd, Cu, Mn, Ni, Pb, Zn) and sulphur analyses;
- Duplicate (split) samples from three sites 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 different laboratory.
- Particle size distribution was not analysed in 2011. This analysis is required every three years. The next particle size analysis will be carried out in 2013.

4.4 Quality Assurance/Quality Control

Field QA/QC

Quality assurance steps were taken during sampling which included:

- New, clean sample jars were ordered from the laboratories and used for sampling.
- The sample spatula and bucket were white plastic, to prevent contamination from metal or coloured sampling equipment.
- The sample spatula and bucket in which the sub-samples were mixed were washed thoroughly with fresh sea water after each replicate sample to avoid cross contamination between samples.
- All sample corers and lids were thoroughly washed with fresh sea water after each sample site to avoid cross contamination between sample sites.
- Samples were sent to NATA accredited laboratories, National Measurement Institute (NMI) and Marine and Freshwater Research Laboratory (MAFRL).
- At three of the sample sites, duplicate (split) samples were taken and sent to NMI, as a reference laboratory, to ensure reliable results were obtained.
- Relative Standard Deviation % (RSD) for each sample site was calculated.

Laboratory QA/QC

MAFRL carried out the required QA/QC as part of their digestions and analysis methods, which include blanks, duplicates, spikes and standard reference material.

5. RESULTS

5.1 Comparison of Results to Guidelines

Median values for both total and bioavailable levels of each contaminant were determined from the triplicate results for each site (shown in Tables 1 and 2), and compared to the ISQG-Low and ISQG-High criteria (ANZECC-ARMCANZ, 2000). A full set of laboratory results are attached in Appendix B.

The 2011 data was directly compared to 2010 as all sites were sampled for 0-10cm cores. The manganese results could not be compared to the 2010 samples because the requirement to analyse for manganese was only included in the EPSL Licence in July 2011. .

5.1.1 Outer Harbour Sites

The 2011 data (refer to Tables 1 and 2) of the outer harbour sites (A5, A6 and A7) had concentrations of total and bioavailable arsenic, cadmium, chromium, nickel, lead and zinc below the ISQG-Low values. This is consistent with the previous annual survey data in 2010; the 0-10cm cores were below the ISQG values. Manganese and sulphur do not have ISQG values since their toxicity has not caused sufficient concern to develop criteria.

5.1.2. Inner Harbour Sites

The inner harbour sites had exceedances of the ISQG values for lead, nickel and copper.

Lead

The total lead results for 2011 (refer to Table 1) when compared to the 2010 annual survey (refer to EPSL, 2011) show:

- The number of sites exceeding the ISQG values reduced from two sites to one site (A10);

- This one site (A10a and A10b) exceeded the ISQG-Low value (50 mg/kg) on both sides of the sheet piling;
- The landward side of the sheet piling (Site A10a) had a three fold higher total lead result (180 mg/kg) than the ocean side of the sheet piling (Site A10b) (58 mg/kg) due to the retention of historical nickel contamination from under the berth.
- Site A9 showed concentrations of total lead decreased from exceeding the ISQG-Low value in 2010 (210 mg/kg) to having values of total lead below the ISQG-Low value in 2011 (35 mg/kg).

The bioavailable lead results for 2011 show (refer to Table 2):

- Only sediments landward of the sheet piling at Site A10a, exceeded the ISQG-Low value;
- 100% of the lead was bioavailable, returning the same concentration of 180 mg/kg as for total lead;
- The ocean side of the sheet piling (A10b) was also nearly 100% bioavailable but did not exceed the ISQG-Low value.
- The bioavailable lead at Site A9 was nearly 100% bioavailable but levels had decreased since 2010 and were below the ISQG-Low value in 2011.

Nickel

The total nickel results for 2011 (refer to Table 1) when compared to the 2010 annual survey (refer to EPSL, 2011) show:

- An overall reduction in nickel levels:
- Two sites (A14 - 53 mg/kg and A16 - 130 mg/kg) went from exceeding the ISQG-High value (52 mg/kg) in 2010 to only exceeding the ISQG-Low value (21 mg/kg) in 2011 (A14, 48 mg/kg; A16, 27 mg/kg);
- Two sites, Site A9 and A10, still exceeded the ISQG-High value in 2011 but had two to five fold lower concentrations than in 2010;
- Both sides of the metal sheet piling at Site A10 exceeded the ISQG-High value. Consistent with the pattern observed for lead, the landward side of the sheet piling (Site A10a) was found to have a four-fold higher nickel result (380 mg/kg) than the ocean side of the sheet piling (Site A10b) which had a total nickel result of 87 mg/kg;.
- Seven sites exceeded the ISQG-Low value in 2010 and these had reduced to six sites in 2011. This was due to total nickel at Site A15 being reduced from 46 mg/kg to

15 mg/kg. Most other sites also showed reduction in nickel but not enough to fall below the ISQG-Low value.

There were no sites in 2011 that exceeded the ISQG-Low or High value for bioavailable nickel after one site (A9) marginally exceeded the ISQG-Low value for bioavailable nickel in 2010. Unlike lead, which is highly bioavailable, nickel is only approximately 7% bioavailable.

Copper

The 2011 results for total copper exceeded the ISQG-Low value at Site A8 (located at Berth 3). While in 2010 Site A9 (located at Berth 2) exceeded the ISQG-High value, the copper result decreased in 2011 to below the ISQG-Low value. The bioavailable level of copper at Site A8 did not exceed the ISQG-Low value, so no further action is required as a contingency action (Oceanica, 2009a). The copper result from Berth 3 is most likely from anti-fouling on the ships that berth at the Port. Copper is currently used in anti-fouling paint as a replacement to organotins. EPSL does not handle any copper products and the copper content of ores currently handled is less than 0.2% based on triplicate analyses.

Manganese

Manganese was added to the EPSL Licence during a licence amendment in July 2011. The inclusion of manganese to the Licence was from a suggestion by a community member that was based on one study that found manganese in razorfish (*Pinna bicolor*), a bi-valve mollusc, near Esperance, although the research paper, location of the study or information on whether razorfish bio-regulate manganese was not supplied to EPSL. As a result of this study, DEC required manganese analysis in marine sediments as part of EPSL's Licence. There are no ISQG values for manganese (ANZECC-ARMCANZ, 2000), suggesting this metal's toxicity is of low concern. The median total manganese results for all sites ranged between 4.3 mg/kg and 9.2 mg/kg, with an average of 6.9 mg/kg (Table 1). Bioavailable median manganese results for all sites ranged between 2.8 mg/kg and 5.8 mg/kg, with an average of 4.4 mg/kg (Table 2).

Median manganese results are similar between the inner harbour (Sites A8 to A13) and outer harbour sites (Sites A5, A6 and A7). At the outer harbour sites manganese concentrations ranged from 2.8 mg/kg to 4.8 mg/kg, with an average median result of 3.5 mg/kg. The inner harbour sites show median results ranging between 2.8 mg/kg to 5.4 mg/kg, with an average median result of 4.8 mg/kg. If the Port was a significant source of manganese, significantly

higher concentrations would be expected at the inner harbour sites which is not the case. Significantly higher concentrations were observed for both nickel and lead within about 50 metres from the berth compared to distances exceeding 50m. The Port handles two fertiliser products and bulk iron ore that contain less than 1% manganese. Therefore, toxicological and measured exposures of manganese in sediment show there is no basis to the suggestion that manganese emissions from the Port present a potential risk to the marine environment.

Table 1. Total Metal (strong acid extraction) median (n = 3) results for 0-10cm cores for 2011

Site	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 High = 70 mg/kg	ISQG Low = 1.5 ISQG High = 10 mg/kg	ISQG Low = 80 ISQG High = 370 mg/kg	ISQG Low = 65 ISQG High = 270 mg/kg	ISQG Low = NA ISQG High = NA mg/kg	ISQG Low = 21 ISQG High = 52 mg/kg	ISQG Low = 50 ISQG High = 220 mg/kg	ISQG Low = NA ISQG High = NA mg/kg	ISQG Low = 200 ISQG High = 410 mg/kg
A5	2**	<0.1	3.5	1.2	5.3	2	1**	830	2.7
A6	<2	<0.1	6	0.3	7	0.9	<1	1000	0.9
A7	3.5	<0.1	3.7	0.2*	4.3	7	<1	590	0.8
A8	2*	<0.1	8.4	**170**	8.9	**28**	11	2100	66
A9	2*	0.1	8.8	30	7.3	**120**	35	1700	40
A10a	4	<0.1	8.9	26	9.2	**380**	**180**	2200	35
A10b	2*	0.1**	7.9	11	7.3	**87**	**58**	1400	36
A11	<2	<0.1	4.6	0.8	4.5	2.9	2	730	1.7
A12	<2	<0.1	5.1	2.3	6.4	6.9	3	960	3.4
A13	3	0.1**	8.8	9.4	8.6	**26**	9	1900	14
A14	-	-	-	-		**48**	18	-	-
A15	-	-	-	-		15	7	-	-
A16	-	-	-	-		**27**	10	-	-
A17	-	-	-	-		**22**	10	-	-
A18	-	-	-	-		12	6	-	-
A19	-	-	-	-		15	12	-	-
A20	-	-	-	-		**35**	13	-	-
A21	-	-	-	-		**27**	13	-	-
A22	-	-	-	-		2.3	2	-	-
A23	-	-	-	-		**33**	12	-	-

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 2. Bioavailable Metals (dilute acid extraction) median (n = 3) results for 0-10cm cores for 2011

Reporting Limit	**Arsenic** *<2* ISQG Low = 20 ISQG High = 70 mg/kg	**Cadmium** *<0.1* ISQG Low = 1.5 ISQG High = 10 mg/kg	**Chromium** *<0.2* ISQG Low = 80 ISQG High = 370 mg/kg	**Copper** *<0.2* ISQG Low = 65 ISQG High = 270 mg/kg	**Manganese** *<0.05* ISQG Low = NA ISQG High = NA mg/kg	**Nickel** *<0.7* ISQG Low = 21 ISQG High = 52 mg/kg	**Lead** *<1* ISQG Low = 50 ISQG High = 220 mg/kg	**Sulphur** *<10* ISQG Low = NA ISQG High = NA mg/kg	**Zinc** *<0.5* ISQG Low = 200 ISQG High = 410 mg/kg
Site									
A5	<2	<0.1	2.4	0.4	2.8	<0.7	<1	610	1.1
A6	<2	<0.1	4.6	<0.2	4.8	<0.7	<1	730	0.6*
A7	3	<0.1	2.8	<0.2	2.8	<0.7	<1	510	0.5*
A8	<2	<0.1	5.2	38	5.4	2.2	9	1000	48
A9	<2	0.1	7.3	6.2	5.8	5	33	1100	13
A10a	<2	<0.1	6.6	5.7	5.8	20	**180**	1100	45
A10b	<2	<0.1	5.5	2.6	4.2	4.4	50	900	20
A11	<2	<0.1	2.5	0.4*	2.8	<0.7	2	510	1.1*
A12	<2	<0.1	3.2	0.6	4.4	0.7**	2	620	1.5
A13	<2	<0.1	6.1	2.3	5.4	2.9	8	1200	6.5
A14	-	-	-	-	-	4	15	-	-
A15	-	-	-	-	-	1.7	6	-	-
A16	-	-	-	-	-	2	7	-	-
A17	-	-	-	-	-	2.5	10	-	-
A18	-	-	-	-	-	0.8	4	-	-
A19	-	-	-	-	-	1.1	11	-	-
A20	-	-	-	-	-	2.2	11	-	-
A21	-	-	-	-	-	2.4	11	-	-
A22	-	-	-	-	-	<0.7	1*	-	-
A23	-	-	-	-	-	2.9	11	-	-

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

5.2 Quality Assurance/Quality Control

All sites were sampled in triplicate. Five core samples, within a $1m^2$ quadrat, were taken to comprise one triplicate. Three triplicates were obtained within five meters of each other from each of the nineteen sample sites. All triplicates were analysed using a NATA accredited laboratory.

The relative standard deviation (RSD) of the triplicates for total metals was calculated for all sites. This is calculated by:

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

The acceptable RSD for triplicates is 50%. This calculation is based on the National Ocean Disposal Guidelines for Dredged Material (Environment Australia, 2002).

Metals and Sulphur

There were four out of the total 110 RSD's above 50% (Table 3) all due to variations between the triplicates. Only one site (A8 for copper) had two of the three triplicate results above the ISQG-Low value, but below the ISQG-High value. A similar result was found for the same site in the 2008 RSD %, where it was suggested that one large result did not change the outcome of the results (Oceanica, 2009b).

One site (A8) indicates the randomness 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 three sites with RSD above 50% had all three triplicates below the ISQG-Low values.

Organotins and TOC

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

Laboratory QA/QC

Three duplicate (split) samples (Sites A6, A9 and A11) were taken and sent to a second laboratory for cross checking. The Relative Percent Difference (RPD) was calculated, based on the Australian Standard (AS 4482.1, 2005). Total results were within the 35 - 50% RPD for all metals at all sites with the exception of Site A6 for nickel (where there was a 127% difference). Bioavailable results were within 35 - 50% RPD for all metals at all sites with the exception of Site A11 for lead (58% difference).

QA/QC Conclusion

Some of the field QA/QC showed RSD% above 50%, however, the results are still considered reliable, given that all but one site had all triplicates below the ISQG-Low value. The high RSD % for Site A8 for copper did not alter the overall results and this was a similar outcome for the sample results in 2008 (Oceanica, 2009b). While split samples sent to a second laboratory (NMI) for cross checking, indicate results were within acceptable 35 - 50% RPD range are therefore acceptable, with the exception of nickel at Site A6 and lead at Site A11.

Table 3. Total Metal Results Relative Standard Deviation (RSD %)

	Arsenic	Cadmium	Chromium	Copper	Manganese	Nickel	Lead	Sulphur	Zinc
Reporting Limit (mg/kg)	*<2*	*<0.1*	*<0.2*	*<0.2*	*<0.05*	*<0.7*	*<1*	*<10*	*<0.5*
Site									
A5	<LOD	<LOD	11	0	14	<LOD	<LOD	3	5
A6	<LOD	<LOD	4	<LOD	5	<LOD	<LOD	5	42*
A7	0	<LOD	4	<LOD	4	<LOD	<LOD	4	**53***
A8	<LOD	<LOD	1	**98**	4	10	18	7	**73**
A9	<LOD	0	4	**64**	13	18	10	7	23
A10a	<LOD	<LOD	9	14	6	17	12	13	41
A10b	<LOD	<LOD	3	5	1	10	3	5	14
A11	<LOD	<LOD	23	**62***	44	<LOD	50	31	**92***
A12	<LOD	<LOD	2	24	19	43**	25	12	43
A13	<LOD	<LOD	1	3	2	12	13	5	10
A14	-	-	-	-	-	10	7	-	-
A15	-	-	-	-	-	10	9	-	-
A16	-	-	-	-	-	28	40	-	-
A17	-	-	-	-	-	8	29	-	-
A18	-	-	-	-	-	24	25	-	-
A19	-	-	-	-	-	17	11	-	-
A20	-	-	-	-	-	31	26	-	-
A21	-	-	-	-	-	29	26	-	-
A22	-	-	-	-	-	<LOD	35*	-	-
A23	-	-	-	-	-	13	5	-	-

Bold: RSD % above 50
<LOD: all triplicates for the site were <LOD
* one triplicate result <LOD (was given value of LOD/2)
** two triplicate results <LOD (given value of LOD/2)

5.3 Time Series Analysis

The CSMRP (Oceanica, 2009a) requires that a t-test be used to determine if there have been temporal changes in the average nickel and lead levels across the 15 inner harbour sites between the 2011 results and the previous year's results. As stated in the objectives for this report, comparisons to results from 2007 and 2008 were not conducted as they would be confounded by the variable depths sampled in the earlier surveys. As a result, comparisons and test of significance were conducted for:

1. Analyses between the 2011 data and 2010 data for all 15 inner harbour sites, in which all sites had 0-10 cm sample cores for both years, were conducted for both lead and nickel. Furthermore, the comparisons were repeated;

2. With the group restricted to those sites whose total nickel levels in 2010 exceeded the ISQG-Low value for nickel (over 21 mg/kg) (refer to Table 6) since the raw data in Table 4 show sites with highest levels of contamination having the largest declines between 2010 and 2011. This was also true for lead in Table 5, but 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. With Site A10a (landward side of the metal sheet piling) and without Site A10b (ocean side of the metal sheet piling) and vice versa for both lead and nickel comparisons.

The software package Statistica (Version 10, 2011) was used to conduct the t-tests. The raw data sets for the data with the Site A10b included were log10 transformed to improve variance equality before the t-test was carried out. Following this transformation, all data passed the Levene's test for equal variances. Tables 7, 8 and 9 show the t-test results. The raw output from Statistica is provided in Appendix A.

Table 4. Average Values (n = 3) for Total Nickel for T-tests

Site	Ni 2011	Ni 2010
	mg/kg	mg/kg
A8	28	32
A9	107	623
A10	-	543
A10(a)*	400	-
A10b**	86	-
A12	7	3
A13	27	33
A14	46	58
A15	16	46
A16	28	113
A17	24	34
A18	14	10
A19	15	6
A20	32	38
A21	33	45
A22	2	3
A23	33	40
Total mean		*108*
Total Mean (with A10a)	*54*	-
Total mean (with A10b)	33	-

*A10a, sample site located landward side of metal sheet piling beneath Berth 1
**A10b, sample site located ocean side of metal sheet piling beneath Berth 1

Table 5. Average Values (n = 3) for Total Lead for T-tests

Site	Pb 2011 mg/kg	Pb 2010 mg/kg
A8	11	19
A9	39	210
A10	-	327
A10(a)*	180	-
A10b**	59	-
A12	3	3
A13	9	10
A14	21	28
A15	7	21
A16	10	39
A17	11	16
A18	5	5
A19	12	3
A20	11	13
A21	14	18
A22	2	2
A23	12	15
Total mean		*49*
Total Mean (with A10a)	*23*	-
Total Mean (with A10b)	*15*	-

*A10a, sample site located landward side of metal sheet piling beneath Berth 1
**A10b, sample site located ocean side of metal sheet piling beneath Berth 1

Table 6. Average values (n=3) for Total Nickel at sites exceeding ISQG-Low value in 2010.

Site	Ni 2011	Ni 2010
	mg/kg	mg/kg
A8	28	32
A9	107	623
A10	-	543
A10(a)*	400	-
A10b**	86	-
A13	27	33
A14	46	58
A15	16	46
A16	28	113
A17	24	34
A20	32	38
A21	33	45
A23	33	40
Total mean		*146*
Total Mean (with A10a)	*54*	-
Total mean (with A10b)	33	-

*A10a, sample site located landward side of metal sheet piling beneath Berth 1
**A10b, sample site located ocean side of metal sheet piling beneath Berth 1

5.3.1 T-tests: 2011 and 2010 Inner Harbour Results

Nickel

1. *Analyses between the 2011 data and 2010 data for all 15 inner harbour sites*

There was no significant decline in nickel concentration in the top 10cm of sediment sampled at the 15 sites located in the inner harbour of Esperance Port between November 2011 and November 2010 (refer to Table 7).

Table 7. T-test results for inner harbour total nickel between 2011 and 2010

	t value	p value	df
Nickel 2011 (with A10a) vs. 2010	-0.96	0.35	28
Nickel 2011 (with A10b) vs. 2010*	-0.80	0.43	28

* Data was log10 Transformed due to unequal variances.

2. *Analyses between the 2011 data and 2010 data for inner harbour sites restricted to those sites with total nickel levels in 2010 exceeded the ISQG-Low value*

The decline in concentrations of nickel at sites exceeding the ISQG-Low value in 2010 was not significant, although when Site A10b (seaward of the sheet piling) is used instead of A10a, landward of the sheet piling), the difference is significant at the 90% level of confidence (refer to Table 8). Based on cessation of bulk nickel export and natural dissipation processes, concentrations of nickel are likely to decline further and these declines in nickel will become more significant in subsequent surveys.

Table 8. T-test results for sites exceeding the ISQG-Low values in 2010 compared to 2011

	t value	p value	df
Nickel 2011 (with A10a) vs. 2010	-1.02	0.32	20
Nickel 2011 (with A10b) vs. 2010*	-1.87	0.08	20

Lead

The t-test results for total lead in inner harbour sites (n= 15) between 2011 and 2010 indicates that there have been no significant ($p<0.05$) temporal changes in lead (refer to Table 9).

Table 9. T-test results for inner harbour total lead between 2011 and 2010

	t value	p value	df
Lead 2011 (with A10a) vs. 2010	-0.96	0.34	28
Lead 2011 (with A10b) vs. 2010*	-1.33	0.19	28

* Data was log10 Transformed due to unequal variances.

5.4 Organotins

One site (A8 located at Berth 3) exceeded the ISQG-High value for TBT (Table 10). This site also exceeded the ISQG-High value in 2010 (EPSL, 2011). Berth 1 (A10a, landward side of the sheet piling where sediments accumulate) was slightly above the ISQG-Low value for TBT, while the nearby Site A10b (located on the ocean side of the sheet piling beneath Berth 1) was below the ISQG-Low value. Berth 2 (Site A9) was below the ISQG-Low value. The breakdown of TBT to dibutyltin (DBT) in sediments typically takes about a year but is dependent on sediment characteristics and temperatures. Trends in TBT are

notoriously difficult to capture in a representative sample due to the patchy distribution of TBT on paint flakes.

Table 10. Organotins - Monobutyltin (MBT), Dibutyltin (DBT), Tributyltin (TBT) and % TOC results for 10cm cores (n = 1) 2011 results

Site	Monobutyltin µg/kg ISQG Low = NA ISQG High = NA	Dibutyltin µg/kg ISQG Low = NA ISQG High = NA	Tributyltin µg/kg *ISQG Low = 9 *ISQG High = 80	TOC % NA NA
A8	10.6	90.6	**1226.4**	0.53
A9	<0.5	2.8	6.2	0.29
A10a	<0.5	3.6	**9.7**	0.33
A10b	<0.5	1.6	3.9	0.49

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 ratio of TBT result to the breakdown products DBT and MBT at Site A8 indicate the TBT has continued to reduce since 2010, although this site still exceeds the ISQG-High value. The ratio of the TBT result to the breakdown products, DBT and MBT at this site indicate the contamination was recent, which was the same conclusion as last year. There was no increase in the sites exceeding the ISQG-Low or High values; therefore there is no need to implement the contingency plan set out in Section 3 of the CSRMP (Oceanica, 2009a). The MARPOL legislation on the use of TBT anti-fouling paint requires commercial ships to cease application of TBT paints after 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.

Contingency Actions

A number of contingency actions were set out in the CSMRP (Oceanica, 2009a) to address any sites that exceed the sediment criteria. The triggers for the actions include:

1. If the mean nickel or mean lead concentration of the 15 inner harbour sites shows a statistically significant increase since 2008.

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

3. If there is an increase in the number of sites exceeding the ISQG-Low or High values since 2008.

In 2011, there were no sites that exceeded the ISQG-Low or High values for any metals or organotins where they had not done so previously. Therefore, no management actions were required based on these results.

As mentioned previously in this report, statistical analysis between the 2011 mean nickel and lead results and the 2007 and 2008 results were not conducted due to the varying core depths. Comparison of the 2010 and 2011 sample results provides a much more realistic indication of temporal changes in levels of nickel and lead and the observed reductions in levels of nickel and lead do not trigger management actions.

6. CONCLUSION

6.1 Metals

The annual sediment sampling results for 2011 indicate:

- None of the 15 inner harbour sites exceeded the ISQG-High values for lead, in contrast to 2010 when one site (A10) exceeded. Reduced levels of lead at Site A10 in 2011 led to this site being the only site exceeding the ISQG-Low value. In 2010, two sites exceeded the ISQG-Low value.
- A reduction from four to two of the 15 inner harbour sites exceeding the ISQG-High value for nickel. The number of sites exceeding the ISQG-Low value for nickel increased from seven to eight due to the reduction in levels of nickel at two sites previously exceeding the ISQG-High value and one site previously exceeding the ISQG-Low value is now below this value. No sites exceeded the ISQG values for bioavailable nickel.
- All inner and outer harbour sites for total and bioavailable As, Cd, Cr and Zn were below the ISQG values. Mn and S do not have any ISQG values.
- One inner harbour site (A8) at the Berth 3 pocket exceeded the ISQG-Low value for total copper.
- There were no statistically significant changes in the mean total nickel and lead results for the 15 inner harbour sites between 2010 and 2011 or between sites grouped according to those exceeding the ISQG-Low value for nickel in 2010. However, it is expected that cessation of bulk nickel handling and natural dissipation processes will cause the levels of nickel in the sediments to drop further and differences between 2010 and next years samples, in 2012, may show a significant reduction.

6.2 Organotins

Berth 3 (Site A8) results exceed the ISQG-High value for TBT indicating the levels present a significant risk to the marine environment, as was the case in 2010. The sediment results for 2011 indicate that the TBT result from Berth 1 (Site A10) has decreased since 2010 but exceeded the ISQG-Low value and presents a potential for harm to the marine environment. The TBT contamination may be recent and not historical based on the ratio of TBT to the breakdown products DBT and MBT being similar to 2010. EPSL only accepts IMO registered vessels that do not use TBT in antifouling. The MARPOL legislation that regulates international trading vessels on the use of TBT anti-fouling paint required commercial ships to cease application of paints containing TBT after September 2008.

7. RISK MANAGEMENT AND RECOMMENDATIONS

7.1 Actions taken since previous sediment analysis

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

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 or sulphur contaminated water from entering the harbour.

7.2. Further actions to be taken

1. Reduce potential contamination of marine sediments from stormwater drain inputs. EPSL received agreement from one of its long term lease holders in mid-2012 to help finance cleaning of the stormwater infrastructure. Cleaning of the infrastructure and surveying of the catchment is scheduled for summer 2012-13. This will 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 stormwater.

2. Future maintenance dredging works may remove contaminated sediments subject to the results of deeper sediment cores, approvals from the state and the

commonwealth and the availability of suitable dredge equipment. Deeper sediment cores were sampled in August 2012, for dredging scheduled for 2013, subject to approvals. If dredging occurs in 2013, this would potentially remove some of the nickel and lead contamination from the inner harbour.

3. Reduce potential future nickel contamination of the marine sediments by continuing to encourage companies to export their nickel product in sealed containers or bulker bags in order to reduce the potential for nickel entering the marine environment.

8. REFERENCES

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8. APPENDICES

Appendix A - T-test Results

Results for total nickel and lead between 15 inner harbour sites 2011/2010.

Test 1 - Nickel 2011 (with A10a) and 2010

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet1) Note: Variables were treated as independent samples						
	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2
Ni 2011 (A10a) vs. Ni 2010	54.22667	108.4467	-0.959720	28	0.345411	15	15

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet1) Note: Variables were treated as independent samples					
	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene
Ni 2011 (A10a) vs. Ni 2010	98.67501	195.2937	3.917076	0.015419	2.990027	28

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet1) Note: Variables were treated as independent samples
	p Levene
Ni 2011 (A10a) vs. Ni 2010	0.094791

Test 2 - Nickel 2011 (with A10b) and 2010 - Log10 Transformed Data

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet3) Note: Variables were treated as independent samples					
	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1
Ni 2011(A10b)Log10 vs. Ni 2010 Log10	1.376684	1.539844	-0.795550	28	0.432986	15

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet3) Note: Variables were treated as independent samples				
	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances
Ni 2011(A10b)Log10 vs. Ni 2010 Log10	15	0.403742	0.684051	2.870577	0.057905

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet3) Note: Variables were treated as independent samples		
	Levene F(1,df)	df Levene	p Levene
Ni 2011(A10b)Log10 vs. Ni 2010 Log10	1.686211	28	0.204695

Test 3 - Lead 2011 (with A10a) and 2010

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet5) Note: Variables were treated as independent samples						
	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2
Pb 2011 (A10a) vs. Pb 2010	23.13333	48.64444	-0.964177	28	0.343211	15	15

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet5) Note: Variables were treated as independent samples					
	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances	Levene F(1,df)	df Levene
Pb 2011 (A10a) vs. Pb 2010	44.30740	92.40125	4.349138	0.009468	3.024396	28

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet5) Note: Variables were treated as independent samples
	p Levene
Pb 2011 (A10a) vs. Pb 2010	0.093006

Test 4 - Lead 2011 (with A10b) and 2010 - Log10 Transformed Data

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet3) Note: Variables were treated as independent samples					
	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1
Pb2011(A10b)Log10 vs. Pb 2010 Log10	1.018827	1.258891	-1.33539	28	0.192503	15

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet3) Note: Variables were treated as independent samples				
	Valid N Group 2	Std.Dev. Group 1	Std.Dev. Group 2	F-ratio Variances	p Variances
Pb2011(A10b)Log10 vs. Pb 2010 Log10	15	0.388853	0.577544	2.205961	0.151010

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet3) Note: Variables were treated as independent samples		
	Levene F(1,df)	df Levene	p Levene
Pb2011(A10b)Log10 vs. Pb 2010 Log10	0.998473	28	0.326238

Results for total nickel for grouped sites that exceeded the ISQG-Low value in 2010.

Test 5 – Nickel 2011 (with A10a) and 2010

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet1) Note: Variables were treated as independent samples						
	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2
Ni 2011 (A10a) vs. Ni 2010	70.44545	145.8485	-1.01993	20	0.319940	11	11

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet1) Note: Variables were treated as independent samples						
	Mean Group 1	Mean Group 2	t-value	df	p	Valid N Group 1	Valid N Group 2
Ni 2011 (A10a) vs. Ni 2010	70.44545	145.8485	-1.01993	20	0.319940	11	11

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet1) Note: Variables were treated as independent samples
	p Levene
Ni 2011 (A10a) vs. Ni 2010	0.078910

Test 5 – Nickel 2011 (with A10b) and 2010

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet5) Note: Variables were treated as independent samples					
	Mean Group 1	Mean Group 2	t-value	df	p	t separ. var.est.
Ni 2011 (A10b) Log10 vs. Ni 2010 (Log10)	1.554169	1.853755	-1.86615	20	0.076755	-1.86615

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet5) Note: Variables were treated as independent samples				
	df	p 2-sided	Valid N Group 1	Valid N Group 2	Std.Dev. Group 1
Ni 2011 (A10b) Log10 vs. Ni 2010 (Log10)	14.73747	0.082048	11	11	0.238837

Group 1 vs. Group 2	T-test for Independent Samples (Spreadsheet5) Note: Variables were treated as independent samples		
	Std.Dev. Group 2	F-ratio Variances	p Variances
Ni 2011 (A10b) Log10 vs. Ni 2010 (Log10)	0.475866	3.969755	0.040177

Appendix B – Laboratory Reports

Marine and Freshwater
Research Laboratory
Environmental Science
Telephone: +61 8 93602907 Facsimile: +61 8 93606613

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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: 16/11/2012
Date Received: 25/11/2011
Our Reference: EPSL11-1
Your Reference: ENV08-763

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						**11120801**				
A5 Repl.1	22/11/2011	<2	<0.1	2.4	0.4	2.8	<0.7	<1	590	1.1
A5 Repl.2	22/11/2011	<2	<0.1	2.9	0.4	3.4	<0.7	<1	630	1.2
A5 Repl.3	22/11/2011	<2	<0.1	2.4	0.4	2.6	<0.7	<1	610	1.1
A6 Repl.1	22/11/2011	<2	<0.1	4.6	<0.2	4.6	<0.7	<1	730	0.6
A6 Repl.2	22/11/2011	<2	<0.1	4.9	<0.2	5.1	<0.7	<1	770	0.6
A6 Repl.3	22/11/2011	<2	<0.1	4.5	<0.2	4.8	<0.7	<1	700	<0.5
A7 Repl.1	21/11/2011	3	<0.1	2.8	<0.2	2.8	<0.7	<1	480	<0.5
A7 Repl.2	21/11/2011	3	<0.1	2.8	<0.2	2.7	<0.7	<1	520	0.8
A7 Repl.3	21/11/2011	3	<0.1	3.0	<0.2	2.9	<0.7	<1	510	0.5
A8 Repl.1	21/11/2011	<2	<0.1	5.2	87	5.5	2.2	9	1000	48
A8 Repl.2	21/11/2011	<2	<0.1	5.1	38	5.4	2.3	10	1100	70
A8 Repl.3	21/11/2011	<2	<0.1	5.2	3.7	5.1	1.9	7	970	9.2
A9 Repl.1	23/11/2011	<2	0.1	7.2	6.2	5.8	5.3	34	1100	13
A9 Repl.2	23/11/2011	<2	0.1	7.8	13	6.5	5.0	33	1100	14
A9 Repl.3	23/11/2011	<2	0.1	7.3	3.6	5.0	3.7	28	970	8.9
A10a Repl.1	20/11/2011	<2	<0.1	6.0	5.7	5.6	20	190	1000	25
A10a Repl.2	20/11/211	<2	<0.1	6.6	5.0	5.8	17	150	1100	45
A10a Repl.3	20/11/2011	<2	<0.1	7.2	6.6	6.3	24	180	1300	60
A10b Repl.1	20/11/2011	<2	<0.1	5.3	2.6	4.1	5.2	53	860	21
A10b Repl.2	20/11/2011	<2	<0.1	5.6	2.4	4.2	4.4	50	900	16
A10b Repl.3	20/11/2011	<2	<0.1	5.5	2.6	4.2	4.4	50	950	20

Signatory:

Date: 16/11/2012

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Marine and Freshwater
Research Laboratory
Environmental Science
Telephone: +61 8 93602907 Facsimile: +61 8 93606613

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: 16/11/2012
Date Received: 25/11/2011
Our Reference: EPSL11-1
Your Reference: ENV08-763

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						**11120801**				
A11 Repl.1	22/11/2011	<2	<0.1	2.7	0.5	2.8	<0.7	3	510	2.7
A11 Repl.2	22/11/2011	<2	<0.1	2.5	0.4	3.5	<0.7	2	550	1.1
A11 Repl.3	22/11/2011	<2	<0.1	1.7	<0.2	1.3	<0.7	1	290	<0.5
A12 Repl.1	21/11/2011	<2	<0.1	3.2	0.6	3.5	<0.7	2	590	1.5
A12 Repl.2	21/11/2011	<2	<0.1	3.2	0.5	4.4	<0.7	2	620	1.5
A12 Repl.3	21/11/2011	<2	<0.1	3.3	0.8	5.1	0.7	3	740	3.0
A13 Repl.1	22/11/2011	<2	<0.1	6.1	2.3	5.4	3.0	8	1100	6.5
A13 Repl.2	22/11/2011	<2	<0.1	6.1	2.2	5.4	2.4	9	1200	5.7
A13 Repl.3	22/11/2011	<2	<0.1	6.2	2.3	5.6	2.9	7	1200	6.9
A14 Repl.1	23/11/2011						4.7	15		
A14 Repl.2	23/11/2011						4.0	14		
A14 Repl.3	23/11/2011						4.0	16		
A15 Repl.1	20/11/2011						1.7	6		
A15 Repl.2	20/11/2011						1.7	6		
A15 Repl.3	20/11/2011						2.0	7		
A16 Repl.1	20/11/2011						2.0	11		
A16 Repl.2	20/11/2011						1.8	7		
A16 Repl.3	20/11/2011						3.0	5		
A17 Repl.1	21/11/2011						2.4	10		
A17 Repl.2	21/11/2011						2.5	8		
A17 Repl.3	21/11/2011						2.8	14		

Signatory:

Date: 16/11/2012

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Address: PO Box 35 , Esperance WA 645

Date of Issue: 16/11/2012
Date Received: 25/11/2011
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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						11120801				
A18 Repl.1	23/11/2011						0.7	3		
A18 Repl.2	23/11/2011						1.1	4		
A18 Repl.3	23/11/2011						0.8	5		
A19 Repl.1	20/11/2011						0.8	11		
A19 Repl.2	20/11/2011						1.1	11		
A19 Repl.3	20/11/2011						1.1	9		
A20 Repl.1	20/11/2011						1.4	7		
A20 Repl.2	20/11/2011						2.2	12		
A20 Repl.3	20/11/2011						2.7	11		
A21 Repl.1	21/11/2011						2.4	10		
A21 Repl.2	21/11/2011						2.2	11		
A21 Repl.3	21/11/2011						3.7	16		
A22 Repl.1	21/11/2011						<0.7	1		
A22 Repl.2	21/11/2011						<0.7	1		
A22 Repl.3	21/11/2011						<0.7	<1		
A23 Repl.1	22/11/2011						2.3	11		
A23 Repl.2	22/11/2011						2.9	11		
A23 Repl.3	22/11/2011						2.9	10		

Signatory:

Date: 16/11/2012

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Reporting Limit		**<2**	**<0.1**	**<0.2**	**<0.2**	**<0.05**	**<0.7**	**<1**	**<10**	**<0.5**
File						**11120801**				
QA/QC DATA	**Criteria**									
Duplicate 1	<20% difference	Low Conc	Low Conc	6%	6%	6%	9%	5%	7%	9%
Duplicate 2	<20% difference	Low Conc	Low Conc	5%	5%	2%	3%	5%	3%	1%
Duplicate 3	<20% difference	Low Conc	Low Conc	1%	3%	3%	0%	23%	4%	1%
Duplicate 4	<20% difference	Low Conc	Low Conc	6%	13%	10%	13%	4%	8%	4%
SRM RECOVERY 1	80%-120%	90%	92%	103%	93%	92%	97%	92%	94%	110%
SRM RECOVERY 2	80%-120%	95%	97%	109%	94%	96%	103%	102%	101%	99%
CRM RECOVERY 1	80%-120%	89%	94%	113%	97%	102%	98%	92%	90%	94%

Signatory:

Date: 16/11/2012

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Reporting Limit		<2	<0.1	<0.2	<0.2	<0.05	<0.7	<1	<10	<0.5
File						11121901-02A				
A5 Repl.1	22/11/2011	<2	<0.1	3.5	2.7	5.0	2.0	1	830	3.0
A5 Repl.2	22/11/2011	<2	<0.1	4.0	1.2	5.3	2.3	<1	800	2.7
A5 Repl.3	22/11/2011	2	<0.1	3.4	1.0	5.5	1.9	<1	870	2.2
A6 Repl.1	22/11/2011	<2	<0.1	6.0	0.3	7.1	1.0	<1	1000	0.9
A6 Repl.2	22/11/2011	<2	<0.1	6.4	0.4	7.0	0.9	<1	1200	1.3
A6 Repl.3	22/11/2011	<2	<0.1	5.9	0.3	6.8	0.9	<1	970	0.9
A7 Repl.1	21/11/2011	4	<0.1	3.5	<0.2	3.8	<0.7	<1	590	0.6
A7 Repl.2	21/11/2011	3	<0.1	3.7	0.2	4.6	<0.7	<1	580	0.8
A7 Repl.3	21/11/2011	4	<0.1	4.1	0.3	4.3	<0.7	<1	740	0.8
A8 Repl.1	21/11/2011	2	<0.1	8.6	170	13	28	13	2100	73
A8 Repl.2	21/11/2011	2	<0.1	8.4	180	8.9	34	11	2100	66
A8 Repl.3	21/11/2011	<2	<0.1	7.3	11	7.8	23	8	1600	9.9
A9 Repl.1	23/11/2011	3	0.2	9.6	36	9.4	130	50	2200	60
A9 Repl.2	23/11/2011	<2	0.1	8.2	30	7.3	120	35	1700	40
A9 Repl.3	23/11/2011	2	0.1	8.8	21	7.1	71	33	1600	32
A10a Repl.1	20/11/2011	6	<0.1	9.2	30	10	460	200	2400	35
A10a Repl.2	20/11/211	4	<0.1	8.7	26	9.2	360	160	2200	33
A10a Repl.3	20/11/2011	4	<0.1	8.9	25	9.0	380	180	2200	36
A10b Repl.1	20/11/2011	2	0.1	7.9	12	7.3	76	58	1400	31
A10b Repl.2	20/11/2011	2	<0.1	8.5	10	8.3	96	63	1800	36
A10b Repl.3	20/11/2011	<2	<0.1	7.4	11	7.2	87	55	1400	40

Signatory:

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Reporting Limit		<2	<0.1	<0.2	<0.2	<0.05	<0.7	<1	<10	<0.5
File						11121901-02A				
A11 Repl.1	22/11/2011	<2	<0.1	3.9	0.9	4.5	3.4	4	730	1.8
A11 Repl.2	22/11/2011	<2	<0.1	4.6	0.8	5.3	2.9	2	810	1.7
A11 Repl.3	22/11/2011	<2	<0.1	4.6	0.3	2.6	1.9	1	480	0.9
A12 Repl.1	21/11/2011	<2	<0.1	5.1	2.5	5.5	6.9	3	870	3.4
A12 Repl.2	21/11/2011	<2	<0.1	5.0	1.8	6.4	5.8	2	960	3.3
A12 Repl.3	21/11/2011	<2	<0.1	5.4	2.3	7.1	8.7	3	1200	3.7
A13 Repl.1	22/11/2011	3	0.1	9.0	9.1	8.7	26	9	1900	14
A13 Repl.2	22/11/2011	3	<0.1	8.5	9.4	7.9	30	9	1900	16
A13 Repl.3	22/11/2011	3	<0.1	8.8	9.8	8.6	25	8	1900	14
A14 Repl.1	23/11/2011						52	15		
A14 Repl.2	23/11/2011						39	31		
A14 Repl.3	23/11/2011						48	18		
A15 Repl.1	20/11/2011						15	7		
A15 Repl.2	20/11/2011						13	6		
A15 Repl.3	20/11/2011						21	9		
A16 Repl.1	20/11/2011						27	12		
A16 Repl.2	20/11/2011						24	10		
A16 Repl.3	20/11/2011						33	7		
A17 Repl.1	21/11/2011						20	10		
A17 Repl.2	21/11/2011						22	9		
A17 Repl.3	21/11/2011						31	14		

Signatory:

Date: 16/11/2012

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Address: PO Box 35 , Esperance WA 645

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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 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						11121901-02A				
A18 Repl.1	23/11/2011						12	4		
A18 Repl.2	23/11/2011						18	6		
A18 Repl.3	23/11/2011						11	6		
A19 Repl.1	20/11/2011						15	14		
A19 Repl.2	20/11/2011						16	12		
A19 Repl.3	20/11/2011						15	9		
A20 Repl.1	20/11/2011						22	8		
A20 Repl.2	20/11/2011						40	13		
A20 Repl.3	20/11/2011						35	13		
A21 Repl.1	21/11/2011						26	12		
A21 Repl.2	21/11/2011						27	13		
A21 Repl.3	21/11/2011						45	18		
A22 Repl.1	21/11/2011						2.7	2		
A22 Repl.2	21/11/2011						2.1	1		
A22 Repl.3	21/11/2011						2.3	2		
A23 Repl.1	22/11/2011						33	12		
A23 Repl.2	22/11/2011						31	11		
A23 Repl.3	22/11/2011						34	13		

Signatory:

Date: 16/11/2012

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Reporting Limit		<2	<0.1	<0.2	<0.2	<0.05	<0.7	<1	<10	<0.5
File						11121901-02A				
QA/QC DATA	Criteria									
Duplicate 1	<20% difference	Low Conc	Low Conc	0%	6%	8%	11%	10%	1%	1%
Duplicate 2	<20% difference	Low Conc	Low Conc	5%	5%	0%	6%	10%	10%	12%
Duplicate 3	<20% difference	Low Conc	Low Conc	3%	1%	3%	6%	7%	3%	5%
Duplicate 4	<20% difference	Low Conc	Low Conc	1%	2%	2%	6%	7%	2%	3%
SRM RECOVERY 1	80%-120%	95%	97%	96%	95%	96%	94%	95%	94%	97%
SRM RECOVERY 2	80%-120%	100%	103%	111%	101%	107%	105%	106%	112%	108%
CRM RECOVERY 1	80%-120%	93%	99%	100%	99%	97%	97%	98%	103%	93%

Signatory:

Date: 16/11/2012

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REPORT OF ANALYSIS

Report No. RN890429

Client	: ESPERANCE PORTS SEA & LAND	Job No.	: ESPE03/111129/1
	PO BOX 35	Quote No.	: QT-01780
	ESPERANCE WA 6450	Order No.	: 120689
		Date Sampled	:
		Date Received	: 29-NOV-2011
Attention	: NATASHA NORRISH	Sampled By	:
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W11/025688	A8	MARINE SEDIMENT
W11/025689	A9	MARINE SEDIMENT
W11/025690	A10 A	MARINE SEDIMENT
W11/025691	A10 B	MARINE SEDIMENT

Lab Reg No.		W11/025688	W11/025689	W11/025690	W11/025691	
Sample Reference	Units	A8	A9	A10 A	A10 B	Method
Organotins						
Monobutyltin as Sn	ng/g	5.6	< 0.5	< 0.5	< 0.5	NR_35
Dibutyltin as Sn	ng/g	48	0.82	1.2	0.78	NR_35
Tributyltin as Sn	ng/g	650	1.8	3.2	1.9	NR_35
Surrogate: Tripropyltin	%REC	147	128	104	117	NR_35
Dates						
Date extracted		30-NOV-2011	30-NOV-2011	30-NOV-2011	30-NOV-2011	
Date analysed		3-DEC-2011	3-DEC-2011	3-DEC-2011	3-DEC-2011	

Luke Baker, Analyst
Organics - NSW
Accreditation No. 198

9-DEC-2011

Lab Reg No.		W11/025688	W11/025689	W11/025690	W11/025691	
Sample Reference	Units	A8	A9	A10 A	A10 B	Method
Trace Elements						
Total Solids	%	68.4	76.8	74.3	72.2	NT2_49

REPORT OF ANALYSIS

Report No. RN890429

Lab Reg No.		W11/025688	W11/025689	W11/025690	W11/025691	
Sample Reference		A8	A9	A10 A	A10 B	
	Units					Method

Ling Shuang Lu, Analyst
Inorganics - NSW
Accreditation No. 198

9-DEC-2011

Lab Reg No.		W11/025688	W11/025689	W11/025690	W11/025691	
Sample Reference		A8	A9	A10 A	A10 B	
	Units					Method
Miscellaneous						
Carbon - Total Organic	mg/kg	5300	2900	3300	4900	NW_S15

Wei Huang, Analyst
Inorganics - NSW
Accreditation No. 198

9-DEC-2011

All results are expressed on a dry weight basis.

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Results relate only to the sample(s) tested.

This Report supersedes reports: RN889140 RN890360 RN890385

Australian Government

National Measurement Institute

REPORT OF ANALYSIS

Report No. RN890455

Client	: ESPERANCE PORTS SEA & LAND	Job No.	: ESPE03/111129
	PO BOX 35	Quote No.	: QT-01780
	ESPERANCE WA 6450	Order No.	: 120689
		Date Sampled	:
		Date Received	: 29-NOV-2011
Attention	: NATASHA NORRISH	Sampled By	:
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W11/025679	A6-REP 1	MARINE SEDIMENT
W11/025680	A6-REP 2	MARINE SEDIMENT
W11/025681	A6-REP 3	MARINE SEDIMENT

Lab Reg No.		W11/025679	W11/025680	W11/025681		
Sample Reference	Units	A6-REP 1	A6-REP 2	A6-REP 3		Method
Trace Elements						
Lead	mg/kg	0.55	0.54	0.55		NT2_49
Nickel	mg/kg	< 0.2	0.3	< 0.2		NT2_49
Total Solids	%	79.0	80.3	78.9		NT2_49

Ling Shuang Lu, Analyst
Inorganics - NSW
Accreditation No. 198

12-DEC-2011

All results are expressed on a dry weight basis.

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: RN890426

REPORT OF ANALYSIS

Report No. RN890456

Client	: ESPERANCE PORTS SEA & LAND	Job No.	: ESPE03/111129
	PO BOX 35	Quote No.	: QT-01780
	ESPERANCE WA 6450	Order No.	: 120689
		Date Sampled	:
		Date Received	: 29-NOV-2011
Attention	: NATASHA NORRISH	Sampled By	:
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W11/025682	A11-REP 1	MARINE SEDIMENT
W11/025683	A11-REP 2	MARINE SEDIMENT
W11/025684	A11-REP 3	MARINE SEDIMENT
W11/025685	A9-REP 1	MARINE SEDIMENT

Lab Reg No. / Sample Reference	Units	W11/025682 A11-REP 1	W11/025683 A11-REP 2	W11/025684 A11-REP 3	W11/025685 A9-REP 1	Method
Trace Elements						
Arsenic	mg/kg	0.77	0.88	0.75	2.2	NT2_49
Cadmium	mg/kg	< 0.1	< 0.1	< 0.1	0.14	NT2_49
Chromium	mg/kg	3.8	3.7	4.7	7	NT2_49
Copper	mg/kg	1	0.95	< 0.2	24	NT2_49
Lead	mg/kg	1.5	1.6	1.1	32	NT2_49
Manganese	mg/kg	4.5	4.9	2.3	6.8	NT2_49
Nickel	mg/kg	1.9	2.1	1	140	NT2_49
Zinc	mg/kg	1.7	1.9	4.1	44	NT2_49
Total Solids	%	79.1	81.2	84	78.9	NT2_49
Sulphur	mg/kg	830	860	480	1690	NT2_49

Ling Shuang Lu, Analyst
Inorganics - NSW
Accreditation No. 198

12-DEC-2011

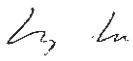
REPORT OF ANALYSIS

Report No. RN890456

Client	: ESPERANCE PORTS SEA & LAND	Job No.	: ESPE03/111129
	PO BOX 35	Quote No.	: QT-01780
	ESPERANCE WA 6450	Order No.	: 120689
		Date Sampled	:
		Date Received	: 29-NOV-2011
Attention	: NATASHA NORRISH	Sampled By	:
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W11/025686	A9-REP 2	MARINE SEDIMENT
W11/025687	A9-REP 3	MARINE SEDIMENT

Lab Reg No.		W11/025686	W11/025687			
Sample Reference	Units	A9-REP 2	A9-REP 3			Method
Trace Elements						
Arsenic	mg/kg	1.9	2.1			NT2_49
Cadmium	mg/kg	0.15	<0.1			NT2_49
Chromium	mg/kg	8.1	7.5			NT2_49
Copper	mg/kg	27	32			NT2_49
Lead	mg/kg	40	40			NT2_49
Manganese	mg/kg	7.1	6.2			NT2_49
Nickel	mg/kg	110	87			NT2_49
Zinc	mg/kg	44	31			NT2_49
Total Solids	%	79.2	79.5			NT2_49
Sulphur	mg/kg	1680	1570			NT2_49



Ling Shuang Lu, Analyst
Inorganics - NSW
Accreditation No. 198

12-DEC-2011

All results are expressed on a dry weight basis.

REPORT OF ANALYSIS

Accreditated for compliance with ISO/IEC 17025.
This report shall not be reproduced except in full.
Results relate only to the sample(s) tested.

This Report supersedes reports: RN890426

Australian Government

National Measurement Institute

REPORT OF ANALYSIS

Report No. RN890457

Client	: ESPERANCE PORTS SEA & LAND	Job No.	: ESPE03/111129
	PO BOX 35	Quote No.	: QT-01780
	ESPERANCE WA 6450	Order No.	: 120689
		Date Sampled	:
		Date Received	: 29-NOV-2011
Attention	: NATASHA NORRISH	Sampled By	:
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W11/025679/1	A6-REP 1	MARINE SEDIMENT
W11/025680/1	A6-REP 2	MARINE SEDIMENT
W11/025681/1	A6-REP 3	MARINE SEDIMENT

Lab Reg No.		W11/025679/1	W11/025680/1	W11/025681/1		
Sample Reference	Units	A6-REP 1	A6-REP 2	A6-REP 3		Method
Trace Elements						
Lead	mg/kg	0.36	0.32	0.52		NT2_49
Nickel	mg/kg	0.23	0.29	0.35		NT2_49
Total Solids	%	79.0	80.3	78.9		NT2_49

W11/025679/1
- W11/025681/1
Method used for Bioavailable Metals: Sample was extracted with 1M HCl then analysed by ICP-MS and ICPAES.
This method is not NATA accredited.

Ling Shuang Lu, Analyst
Inorganics - NSW

12-DEC-2011

All results are expressed on a dry weight basis.

Results relate only to the sample(s) tested.
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Australian Government

National Measurement Institute

REPORT OF ANALYSIS

Report No. RN890458

Client	: ESPERANCE PORTS SEA & LAND	Job No.	: ESPE03/111129
	PO BOX 35	Quote No.	: QT-01780
	ESPERANCE WA 6450	Order No.	: 120689
		Date Sampled	:
		Date Received	: 29-NOV-2011
Attention	: NATASHA NORRISH	Sampled By	:
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W11/025682/1	A11-REP 1	MARINE SEDIMENT
W11/025683/1	A11-REP 2	MARINE SEDIMENT
W11/025684/1	A11-REP 3	MARINE SEDIMENT
W11/025685/1	A9-REP 1	MARINE SEDIMENT

Lab Reg No.		W11/025682/1	W11/025683/1	W11/025684/1	W11/025685/1	
Sample Reference	Units	A11-REP 1	A11-REP 2	A11-REP 3	A9-REP 1	Method
Trace Elements						
Arsenic	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	NT2_49
Cadmium	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	NT2_49
Chromium	mg/kg	2.8	2.5	1.9	6.4	NT2_49
Copper	mg/kg	< 0.2	< 0.2	< 0.2	4.1	NT2_49
Lead	mg/kg	1.3	1.1	0.54	22	NT2_49
Manganese	mg/kg	3.3	4	1.1	4.7	NT2_49
Nickel	mg/kg	0.71	0.47	0.46	3.9	NT2_49
Zinc	mg/kg	1.6	1.5	< 0.5	11	NT2_49
Total Solids	%	79.1	81.2	84.0	78.9	NT2_49
Sulphur	mg/kg	850	790	340	1280	NT2_49

W11/025682/1
- W11/025687/1
Method used for Bioavailable Metals: Sample was extracted with 1M HCl then analysed by ICP-MS and ICPAES.
This method is not NATA accredited.

Ling Shuang Lu, Analyst
Inorganics - NSW

12-DEC-2011

REPORT OF ANALYSIS

Report No. RN890458

Client	: ESPERANCE PORTS SEA & LAND	Job No.	: ESPE03/111129
	PO BOX 35	Quote No.	: QT-01780
	ESPERANCE WA 6450	Order No.	: 120689
		Date Sampled	:
		Date Received	: 29-NOV-2011
Attention	: NATASHA NORRISH	Sampled By	:
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
W11/025686/1	A9-REP 2	MARINE SEDIMENT
W11/025687/1	A9-REP 3	MARINE SEDIMENT

Lab Reg No.		W11/025686/1	W11/025687/1			
Sample Reference	Units	A9-REP 2	A9-REP 3			Method
Trace Elements						
Arsenic	mg/kg	< 0.5	< 0.5			NT2_49
Cadmium	mg/kg	0.11	< 0.1			NT2_49
Chromium	mg/kg	6.4	6.3			NT2_49
Copper	mg/kg	4.6	3			NT2_49
Lead	mg/kg	44	22			NT2_49
Manganese	mg/kg	4.4	4.4			NT2_49
Nickel	mg/kg	4.6	3.7			NT2_49
Zinc	mg/kg	14	12			NT2_49
Total Solids	%	79.2	79.5			NT2_49
Sulphur	mg/kg	1460	1400			NT2_49

Ling Shuang Lu, Analyst
Inorganics - NSW

12-DEC-2011

All results are expressed on a dry weight basis.

Results relate only to the sample(s) tested.
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Australian Government

National Measurement Institute

QUALITY ASSURANCE REPORT

Client: ESPERANCE PORTS SEA& LAND

NMI QA Report No: ESPE03/111129

Sample Matrix: MARINE SEDIMENT

Analyte	Method	LOR	Blank	Duplicates			Recoveries	
				Sample	Duplicate	RPD	LCS	Matrix Spike
		mg/kg	mg/kg	mg/kg	mg/kg	%	%	%
Inorganics Section				**W10/025687**				**W10/025687**
Arsenic	NT2.49	0.5	<0.5	2.2	2.1	5	105	104
Cadmium	NT2.49	0.1	<0.1	<0.1	<0.1	ND	93	91
Chromium	NT2.49	0.2	<0.2	7.5	7.5	0	90	95
Copper	NT2.49	0.2	<0.2	32	32	0	97	93
Lead	NT2.49	0.5	<0.5	40	40	0	96	94
Manganese	NT2.49	0.5	<0.5	6.2	6.1	2	90	97
Nickel	NT2.49	0.2	<0.2	88	86	2	99	101
Sulphur	NT2.49	0.5	<0.5	1560	1570	1	99	#
Zinc	NT2.49	0.5	<0.5	30	31	3	102	96

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Legend:
Acceptable recovery is 75-120%.
Acceptable RPDs on duplicates is 44% at concentrations >5 times LOR. Greater RPD may be expected at <5 times LOR.
LOR = Limit Of Reporting
RPD = Relative Percent Difference
LCS = Laboratory Control Sample.
ND = Not Determined
NA = Not Applicable
#: Spike level is less than 50% of the sample's concentration, hence the recovery data cannot be reported.
**: reference value not available

Comments:
Results greater than ten times LOR have been rounded to two significant figures.
This report shall not be reproduced except in full.

Signed:

Dr Michael Wu
Inorganics Section, NMI-Pymble

Date: **9/12/2011**