

## **MARINE VESSEL KING WHEAT**

# **ANALYSIS OF AIR QUALITY MONITORING DATA ASSOCIATED WITH BULK NICKEL SULPHIDE SHIP LOADING ON 22-23 JUNE 2011**

<b>Revision</b>	<b>Prepared</b>	<b>Reviewed</b>	<b>Approved</b>	<b>Date</b>	<b>Description</b>
1	N. Norrish	A Leonard	A Leonard	6/7/2011	

## CONTENTS

	Page No.
<b>1. INTRODUCTION.....</b>	<b>1</b>
1.1 Licence Reporting Conditions .....	1
1.2 Location of Monitoring Stations .....	1
1.3 Assessment Criteria.....	1
<b>2. ANALYSIS OF BULK NICKEL SHIP LOADING.....</b>	<b>3</b>
2.1 Port Activites .....	3
2.2 Meteorological Conditions .....	3
2.3 Odour and Dust Monitoring.....	4
2.4 Compliance to loading protocol.....	6
2.5 TEOM PM <sub>10</sub> Monitoring .....	6
2.6 TSP HVAS Data.....	9
<b>3. CONCLUSIONS.....</b>	<b>10</b>
<b>4. REFERENCES.....</b>	<b>11</b>
Appendix A Odour Record Sheet .....	12
Appendix B TEOM Site 3 and 4 - five minute PM10 concentration for 1700 hours to 1755 hours on 22/06/2011 .....	13
Appendix C Hourly Average PM10 Concentration .....	14
Appendix D MPL Laboratory reports .....	15

### FIGURES

Figure 1. Location of air quality monitoring sites. ....	2
Figure 2. Wind arc zones defined in EPSL (2008), where ‘red zone’ is 45° to 180° and ‘green zone’ is 180° to 45°, showing loading wind rose data measured at the meteorological station adjacent to E-Sampler 7 from 1748 hours on 22/06/2011 to 0407 hours on 23/06/2011. ....	5
Figure 3. Wind direction preceding and during loading of MV King Wheat. ....	8
Figure 4. Hourly PM10 concentrations and wind speed preceding and during loading of MV King Wheat. ....	9

### TABLES

Table 1. Pollution concentration targets from Table 1 in Licence L5099/1974/13....	1
Table 2. Daily 24-hr average TEOM results for PM <sub>10</sub> for 22/06/2011 to 23/06/2011 ...	7
Table 3. Daily HVAS monitoring results for TSP for 22/06/2011 to 23/06/2011 .....	10

## 1. INTRODUCTION

### 1.1 Licence Reporting Conditions

This document reports the air quality monitoring for the loading of the MV King Wheat between 1748 hrs on 22<sup>nd</sup> June 2011 to 0407 hrs on 23<sup>rd</sup> June 2011 at the Esperance Ports Sea and Land (EPSL). This report is compiled and issued in compliance with Condition 17 and includes data analysis consistent with requirements of Condition 14 of the Government of Western Australia Department of Environment and Conservation (DEC) Licence L5099/1974/13 ('the licence'). The licence was issued to EPSL on the 24<sup>th</sup> February 2011.

### 1.2 Location of Monitoring Stations

As required by the licence, ambient monitoring is being undertaken at four locations surrounding the Port operations and one community monitor 1.6 km from the Port (Figure 1). The monitor locations were chosen in consultation with the DEC and the Government of Western Australia Department of Health (DoH).

EPSL has an Australian Standards-compliant meteorological station adjacent to E-Sampler 7, located on the Port premises adjacent to Berth 3. This meteorological station records both wind speed and direction. Data from this station has been used for this report.

### 1.3 Assessment Criteria

The following ambient concentration targets are used in this assessment, as adapted from Table 1 in the licence:

**Table 1. Pollution concentration targets from Table 1 in Licence L5099/1974/13**

Parameter	Target
Nickel in air	0.14 µg/m <sup>3</sup>
Dust as PM <sub>10</sub>	50 µg/m <sup>3</sup>
Dust as TSP	90 µg/m <sup>3</sup>



Disclaimer: This map consists of shape files generated by EPSL (2011) and Landgate (2010). This map is not to be used for navigational purposes. Positional accuracy should be considered as approximate.



Title: Location of HVAS/TEOM monitoring sites 1 to 4, HVAS community monitoring site 5, E-Sampler 5 to 8 (EP5-EP8) and EP7 - Meteorological station

Scale: 1:10,000



Date: 5 January 2011

Map no.

Figure 1. Location of air quality monitoring sites.

## **2. ANALYSIS OF BULK NICKEL SHIP LOADING**

### **2.1 Port Activities**

The 'berthing period' in this report will refer to 1036 hours on 22/06/2011 to 0540 hours on 23/06/2011. The '**loading period**' in this report will refer to **1748 hours on 22/06/2011 to 0407 hours on 23/06/2011.**

Bulk nickel loading did not cease at any time because the wind was in the green zone for the entirety of the loading period. Approximately 6045 tonnes of BHP Billiton Nickel West nickel sulphide concentrate bulk was loaded.

The following marine vessels were also in Port during the loading period:

- Stella Eltanin was alongside Berth 1 (to be loaded with wheat) between 1854 on 22/6/2011 and 1912 on 25/06/2011 (although loading of wheat did not occur during nickel ship loading).

Products received/delivered other than by marine vessels, were:

- 17, 724 tonnes of iron ore averaged across 2 trains delivered to the Port.

### **2.2 Meteorological Conditions**

All wind speeds and directions described in this section are limited to the loading period.

- The wind direction was slightly variable and was spread from N (6%), NNW (36%), NW (15%) WNW (22%), W (20%) and WSW (1%) (Figure 2).
- The maximum hourly wind speed recorded was 3.4 m/s (12.1 km/hr) from the NNW direction (green zone), which occurred between 0100 hours and 0155 hours on 23/06/2011.
- The average wind speed during the loading periods was 2.4 m/s (8.6 km/h). The 'Beaufort Wind Force Scale' is a measure for understanding wind speeds descriptive terminology. A wind speed of 2.4 m/s is described as 'light' winds (BOM, 2010).

### **2.3 Odour and Dust Monitoring**

Pre-loading determination of the Nickel West concentrate was undertaken as per the requirement of EPSL 'Environmental Considerations for Nickel Ship Loading Procedure' (PR088) (EsPA, 2009). It was determined that the Nickel West concentrate was classified as 'very weak' typical of the Mount Keith concentrate, and had a low dust potential indicated by the average moisture of >8%. The nickel concentrate was therefore loaded as per Section 3.1 of the procedure (EsPA, 2009). The odour and moisture content record sheet is included in Appendix A.



**Figure 2.** Wind arc zones defined in EPSL (2008), where 'red zone' is 45° to 180° and 'green zone' is 180° to 45°, showing loading wind rose data measured at the meteorological station adjacent to E-Sampler 7 from 1748 hours on 22/06/2011 to 0407 hours on 23/06/2011.

## 2.4 Compliance to loading protocol

The loading was compliant with the loading protocol (Figures 2 and 3). The wind arc zones in which EPSL may or may not load bulk nickel sulphide concentrate (green and red respectively) are illustrated in Figure 2 and are documented within EPSL's internal procedures. These conditions are in place to minimise nickel particulate emitted from the Port to the community which is more sensitive than the marine environment. The effectiveness of these procedures has been demonstrated in the absence of any exceedances since implementation of the wind arc procedure in December 2008.

The bar chart in Figure 3 shows tonnes of nickel loaded (tonnes/hour) in relation to hourly averages of wind direction (line plot) and the red/green loading zones (background). During the loading of MV King Wheat the wind direction was in the green zone between 248 to 0 degrees during the entire loading period.

As a further restriction to minimise ship loading emissions, EPSL has to maintain less than 1000 tonnes per hour (tph) nominal ship loading rate as part of its protocol. This ship loading protocol (PR026) was not exceeded during the loading of the MV King Wheat (Figure 3). However, loading rates do not appear to be critical in controlling dust emissions from the Berth 2 shiploader based on recent ship loading events since the ship loader upgrades including a telescopic extension.

## 2.5 TEOM PM<sub>10</sub> Monitoring

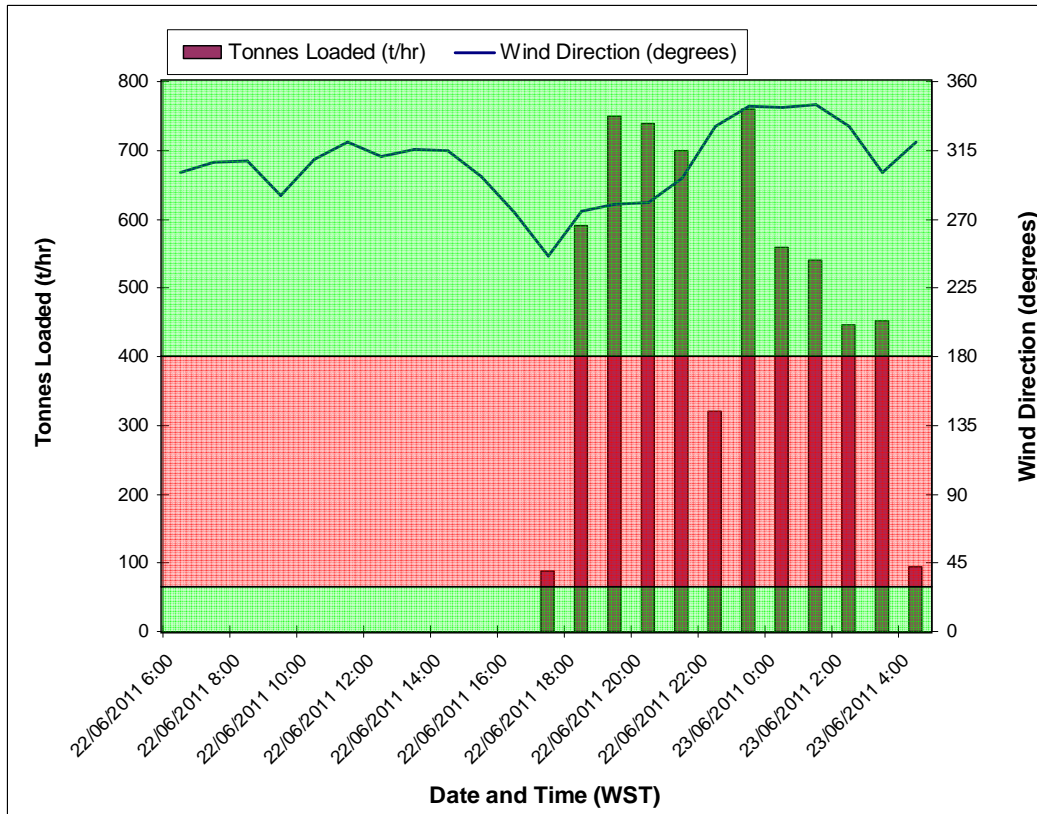
During the berthing period and prior to loading, the wind was in the green zone. During loading, a maximum PM<sub>10</sub> of 79.0 µg/m<sup>3</sup> at Site 4 and 75.7 µg/m<sup>3</sup> at Site 3 were recorded at 1700 hours on 22/06/2011. Nickel began loading at 1748 hours, so for the majority of this hour, there was no nickel being loaded. The Site 4 PM<sub>10</sub> five minute averages shows that the peak PM<sub>10</sub> during 1700 hours and 1800 hours on 22/6/2011 of 96.34 µg/m<sup>3</sup> at 1740 hours occurred before ship loading commenced (refer to **Appendix B** for table). Site 3 had a similar result with the five minute average showing a peak of 91.75 µg/m<sup>3</sup> at 1705 hours on 22/06/2011. After these peaks in PM<sub>10</sub>, the five minute averages for Site 3 and Site 4 began to decline before ship loading commenced. The wind direction during this hour was in a west north westerly direction. The PM<sub>10</sub> recorded at 1800 hours showed a significant

decrease, with PM<sub>10</sub> of 34.3 µg/m<sup>3</sup> at Site 4 and 30.1 µg/m<sup>3</sup> at Site 3. PM<sub>10</sub> continued to decrease throughout the loading period. Figure 4 graphs the hourly PM<sub>10</sub> concentration (µg/m<sup>3</sup>) and wind speed (m/s) against date. Throughout the loading of MV King Wheat the winds stayed in the green zone. Therefore the recorded PM<sub>10</sub> concentrations are likely to be from sources other than nickel loading operations. There is no correlation between wind speed and PM<sub>10</sub> during the loading period (refer to **Appendix C** for raw data).

The 24-hour average PM<sub>10</sub> concentrations for the monitoring period are presented in Table 2 as calculated at 1200 hours each date to coincide with the approximate time when TSP filter papers are changed. The 24-hour average licence target concentration of 50 µg/m<sup>3</sup> was not exceeded at any of the sites. The maximum daily average PM<sub>10</sub> concentration of 20.1 µg/m<sup>3</sup> was recorded at Site 2 between 1200 hours on 22/06/2011 and 1200 hours on 23/06/2011 and represents 40.2% of the assessment criterion (50 µg/m<sup>3</sup>).

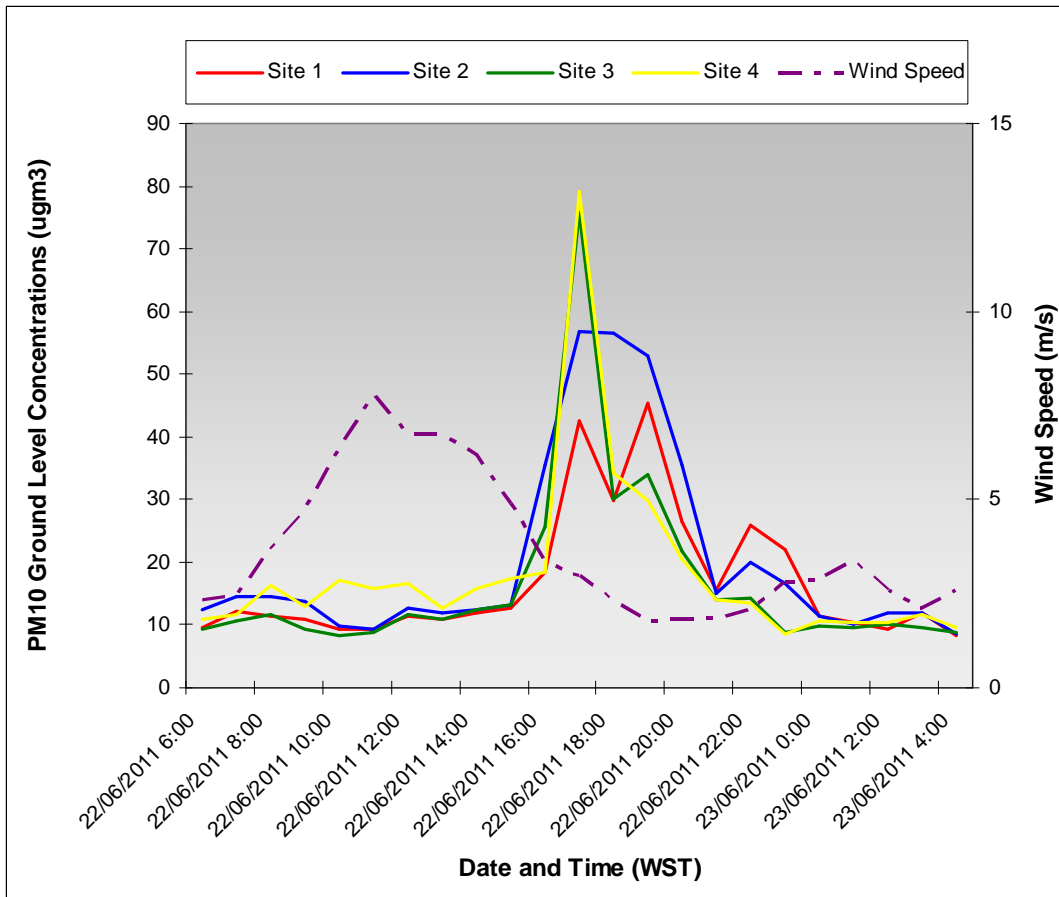
**Table 2. Daily 24-hr average TEOM results for PM<sub>10</sub> for 22/06/2011 to 23/06/2011**

Sampling Start	Sampling Finish	Site 1 (µg/m <sup>3</sup> )	Site 2 (µg/m <sup>3</sup> )	Site 3 (µg/m <sup>3</sup> )	Site 4 (µg/m <sup>3</sup> )
1200 22/06/2011	1200 23/06/2011	16.4	20.1	16.3	17.7
<b>Assessment Criterion (µg/m<sup>3</sup>)</b>		<b>50</b>			



**Figure 3. Wind direction preceding and during loading of MV King Wheat.**

Note: loading occurred from 1748 hours on 22/06/2011 to 0407 hours on 23/06/2011.



**Figure 4. Hourly PM10 concentrations and wind speed preceding and during loading of MV King Wheat.**

## 2.6 TSP HVAS Data

The results from the laboratory analysis of the TSP filter papers are presented in Table 3 and the laboratory reports are provided in Appendix D. There were no exceedances of the 90  $\mu\text{g}/\text{m}^3$  24-hour average concentration target for TSP during the monitoring period. The maximum recorded daily average TSP concentration of 48  $\mu\text{g}/\text{m}^3$  recorded at Site 5 between 1200 hours on 22/06/2011 and 1200 hours on 23/06/2011 represents 53.3% of the assessment criterion (90  $\mu\text{g}/\text{m}^3$ ). This is a typical value for background dust levels, and is within the TSP concentration criteria.

The 24-hour average licence target of 0.14  $\mu\text{g}/\text{m}^3$  for nickel was not exceeded during the monitoring period. The highest 24-hour average nickel concentration recorded during the monitoring period was 0.006  $\mu\text{g}/\text{m}^3$  which occurred at Site 2

between 1200 hours 22/06/2011 to 1200 hours 23/06/2011 representing 4% of the assessment criterion ( $0.14 \mu\text{g}/\text{m}^3$ ). Overall the nickel levels were low and this supports the origin of the high  $\text{PM}_{10}$  being from a source other than nickel ship loading.

**Table 3. Daily HVAS monitoring results for TSP for 22/06/2011 to 23/06/2011**

Sampling Start <sup>1</sup>	Sampling Finish <sup>1</sup>	Site 1 ( $\mu\text{g}/\text{m}^3$ )		Site 2 ( $\mu\text{g}/\text{m}^3$ )		Site 3 ( $\mu\text{g}/\text{m}^3$ )		Site 4 ( $\mu\text{g}/\text{m}^3$ )		Site 5 ( $\mu\text{g}/\text{m}^3$ )	
		TSP	Ni	TSP	Ni	TSP	Ni	TSP	Ni	TSP	Ni
1200 22/06/2011	1200 23/06/2011	26	0.003	45	0.006	28	0.003	32	0.003	48	0.003
<b>Assessment Criterion (<math>\mu\text{g}/\text{m}^3</math>)</b>		<b>90</b>	<b>0.14</b>	<b>90</b>	<b>0.14</b>	<b>90</b>	<b>0.14</b>	<b>90</b>	<b>0.14</b>	<b>90</b>	<b>0.14</b>

<sup>1</sup> These times are approximate for all five monitoring sites.

**Bold** - exceedance of the  $90\mu\text{g}/\text{m}^3$  24-hour average concentration target for TSP  
 $0.001 \mu\text{g}/\text{m}^3$  is the limit of detection for the analysis of nickel.

### 3. CONCLUSIONS

Loading of the MV King Wheat was consistent with EPSL operational procedures, ship loading only occurred when the wind was blowing from within the green zone and loading rates were less than 1,000 tonnes/hour. Therefore, the potential for dust and odour impacts were significantly reduced.

No odour complaints were reported to EPSL during this period consistent with the 'very weak' product odour assessment result. There have been no odour complaints reported to EPSL since December 2008 that are attributable to the activities of the Port.

The licence targets for  $\text{PM}_{10}$ , TSP and nickel were not exceeded at any of the four monitoring sites during the berthing or loading periods of the MV King Wheat. None of these parameters significantly increased during the loading period.

These results warranted no further emission reduction measures.

#### **4. REFERENCES**

Bureau of Meteorology (BOM), 2009. Beaufort Wind Scale. Access online 20 June 2011, <http://www.bom.gov.au/lam/glossary/beaufort.shtml>

DEC 2009, Licence for prescribed premises, licence number L5099/1074/13, Western Australian Department of Environment and Conservation, Australia, [www.dec.wa.gov.au](http://www.dec.wa.gov.au)

Esperance Port Authority 2009, PR088: Environmental conditions for nickel ship loading, document number PR088, issued May 2009, Esperance Port Authority.

Esperance Port Authority 2010, Marine Vessel Ratu Tembaga – Analysis of Air Quality Monitoring Data Associated with Bulk Nickel Sulphide Ship Loading on 3-5 July 2010.

NATA 2009, Facilities and labs: MP Laboratories a division of Coffey Environments Pty Ltd, Accessed online 5 April 2011, <http://mpl.com.au/>

Standards Australia 2008, Methods for sampling and analysis of ambient air, method 9.8: determination of suspended particulate matter – PM10 continuous direct mass method using a tapered element oscillating microbalance analyser, AS 3580.9.8-2008, Accessed online 6 February 2009, <http://www.saiglobal.com/online/autologin.asp?br=true&userid=7439352104>.

**Appendix A Odour Record Sheet**

 <p><b>ESPERANCE PORTS</b> Sea &amp; Land</p>	Form No : FM239
	Revision: 2
Title: Odour Record Sheet	Issue Date: 8/12/02009
	Page: 1 of 1
	Reference: PR089

Tram  
G11/2467

ODOUR INTENSITY	
Extremely Strong	6
Very Strong	5
Strong	4
Distinct	3
Weak	2
Very Weak	1
Not Perceptible	0

Ship Name: KING WHEAT Sampled by: DR. LEONARD

Odour Assessor(s)	Date	Time	Sample#	Location	Temperature (°C)	pH	%moisture	Odour intensity (Rate 1 to 6)
AR	21/6/09	10:25	1			8.12	9.1	1
↓			2			7.10	7.9	2
			3			7.01	8.5	1
			4			7.05	9.1	1
			5			6.90	8.9	1
			6			8.02	9.6	1

**Appendix B      TEOM Site 3 and 4 - five minute PM10 concentration for  
1700 hours to 1755 hours on 22/06/2011**

<b>Date/Time</b>	<b>Site 3 PM10 (ug/m<sup>3</sup>)</b>	<b>Site 4 PM10 (ug/m<sup>3</sup>)</b>
22/06/2011 17:00	78.69	85.48
22/06/2011 17:05	91.75	77.00
22/06/2011 17:10	89.49	72.31
22/06/2011 17:15	78.33	72.46
22/06/2011 17:20	74.61	68.88
22/06/2011 17:25	82.30	75.69
22/06/2011 17:30	86.76	88.55
22/06/2011 17:35	88.65	95.70
22/06/2011 17:40	85.52	96.34
22/06/2011 17:45	73.25	91.94
22/06/2011 17:50	51.20	74.35
22/06/2011 17:55	28.07	49.54

**Appendix C**
**Hourly Average PM10 Concentration**

Date and Time	Hourly Average PM10 in $\mu\text{g}/\text{m}^3$				Hourly Averaged Wind Speed (m/s)	Hourly Averaged Wind Vector (°)	Hourly Averaged Product Loaded (tonnes)
	Site 1	Site 2	Site 3	Site 4			
22/06/2011 6:00	9.536389	12.45389	9.305832	10.95028	2.3235	301	-
22/06/2011 7:00	12.30389	14.48639	10.50611	11.77805	2.464992	307	-
22/06/2011 8:00	11.29833	14.61639	11.70028	16.45389	3.662906	308	-
22/06/2011 9:00	10.97028	13.63055	9.235835	13.06611	4.716676	286	-
22/06/2011 10:00	9.328053	9.736669	8.371388	17.24139	6.415335	309	-
22/06/2011 11:00	9.31389	9.346946	8.823889	15.69667	7.768302	320	-
22/06/2011 12:00	11.48722	12.62778	11.7878	16.52861	6.741516	311	-
22/06/2011 13:00	10.76389	11.81667	10.89305	12.66889	6.760583	316	-
22/06/2011 14:00	12.02417	12.53527	12.365	15.93917	6.163471	315	-
22/06/2011 15:00	12.78	13.30389	13.20166	17.25917	4.89292	298	-
22/06/2011 16:00	18.525	35.52444	25.72139	18.32528	3.338901	274	-
22/06/2011 17:00	42.62111	56.86694	75.71972	79.02082	2.986872	246	89
22/06/2011 18:00	29.83444	56.45361	30.10056	34.32972	2.279452	275	591
22/06/2011 19:00	45.31389	52.94416	33.86833	29.8525	1.787159	280	750
22/06/2011 20:00	26.37833	35.66139	21.67278	20.58194	1.806319	281	740
22/06/2011 21:00	15.58083	14.97778	13.99417	14.08722	1.838003	297	700
22/06/2011 22:00	25.89778	19.96694	14.28917	13.58806	2.068798	331	320
22/06/2011 23:00	22.12778	16.69167	8.815556	8.651666	2.80279	344	760
23/06/2011 0:00	11.35028	11.51944	9.777222	10.50778	2.850217	343	560
23/06/2011 1:00	10.48111	10.06111	9.668889	10.35056	3.37511	345	540
23/06/2011 2:00	9.459445	11.85583	10.01806	10.44306	2.612604	331	447
23/06/2011 3:00	11.82972	11.81917	9.614999	11.67056	2.138277	301	453
23/06/2011 4:00	8.249444	8.521388	8.773888	9.561666	2.573261	320	95

**Appendix D**

**MPL Laboratory reports**

## **CERTIFICATE OF ANALYSIS 112451**

**Client:**

**Esperance Ports - Sea and Land**

PO Box 35

Esperance

WA 6450

**Attention:** N Norrish

**Sample log in details:**

Your Reference:

No. of samples:

Date samples received:

Date completed instructions received:

Location:

**Dust Analysis**

12 High Volume Filters

27/06/11

27/06/11

NA

**Analysis Details:**

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

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

***Please refer to the last page of this report for any comments relating to the results.***

**Report Details:**

Date results requested by:

4/07/11

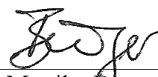
Date of Preliminary Report:

Not issued

Issue Date:

4/07/11

**Results Approved By:**



Dr Monika Buerger  
Supervisor – Micro, Asbestos, Dust

**Client Reference: Dust Analysis**

Metals in High Volume Filters							
Our Reference:	UNITS	PQL	112451-1	112451-2	112451-3	112451-4	112451-5
Your Reference	--	--	PAE353	PAE354	PAE355	PAE356	PAE357
Location	--	--	Site 4	Site 3	Site 2	Site 1	Site 5
Date Sampled			19/06/11	19/06/11	19/06/11	19/06/11	19/06/11
Dust	mg/filter	0.1	38	34	37	31	30
Dust in Air	µg/m <sup>3</sup>	0.1	23	20	22	19	18
Iron	µg/filter	5	500	380	450	280	240
Iron in Air	µg/m <sup>3</sup>	0.005	0.30	0.23	0.27	0.17	0.14
Nickel	µg/filter	2	6	4	5	3	3
Nickel in Air	µg/m <sup>3</sup>	0.002	0.004	0.003	0.003	<0.002	<0.002
Lead	µg/filter	5	<5	<5	<5	<5	<5
Lead in Air	µg/m <sup>3</sup>	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Lithium	µg/filter	2	3	3	3	3	2
Lithium in Air	µg/m <sup>3</sup>	0.001	0.002	0.002	0.002	0.002	0.001
Sulfur	µg/filter	50	1,500	1,500	1,200	1,300	950
Sulfur in Air	µg/m <sup>3</sup>	0.02	0.89	0.93	0.72	0.76	0.57
Zinc	µg/filter	5	2,816	3,061	2,487	2,613	2,106
Zinc in Air	µg/m <sup>3</sup>	0.002	1.7	1.8	1.5	1.6	1.3

Metals in High Volume Filters							
Our Reference:	UNITS	PQL	112451-6	112451-7	112451-8	112451-9	112451-10
Your Reference	--	--	PAE358	PAE371	PAE372	PAE373	PAE374
Location	--	--	Blank	Site 4	Site 3	Site 2	Site 1
Date Sampled				22/06/11	22/06/11	22/06/11	22/06/11
Dust	mg/filter	0.1	4.3	51	44	72	42
Dust in Air	µg/m <sup>3</sup>	0.1	[NA]	32	28	45	26
Iron	µg/filter	5	190	800	470	2,100	650
Iron in Air	µg/m <sup>3</sup>	0.005	[NA]	0.50	0.29	1.3	0.41
Nickel	µg/filter	2	4	6	4	9	5
Nickel in Air	µg/m <sup>3</sup>	0.002	[NA]	0.003	0.003	0.006	0.003
Lead	µg/filter	5	<5	<5	<5	<5	<5
Lead in Air	µg/m <sup>3</sup>	0.005	[NA]	<0.005	<0.005	<0.005	<0.005
Lithium	µg/filter	2	3	3	3	3	2
Lithium in Air	µg/m <sup>3</sup>	0.001	[NA]	0.002	0.002	0.002	0.001
Sulfur	µg/filter	50	690	1,400	1,300	1,100	1,000
Sulfur in Air	µg/m <sup>3</sup>	0.02	[NA]	0.89	0.84	0.70	0.65
Zinc	µg/filter	5	2,444	2,498	2,401	2,272	2,097
Zinc in Air	µg/m <sup>3</sup>	0.002	[NA]	1.6	1.5	1.4	1.3

**Client Reference: Dust Analysis**

Metals in High Volume Filters	UNITS	PQL	112451-11	112451-12	112451-13
Our Reference:	--	--	112451-11	112451-12	112451-13
Your Reference	--	--	PAE375	PAE376	Lab Blank
Location	--	--	Site 5	Blank	
Date Sampled			22/06/11		
Dust	mg/filter	0.1	77	3.5	[NA]
Dust in Air	µg/m <sup>3</sup>	0.1	48	[NA]	[NA]
Iron	µg/filter	5	600	100	180
Iron in Air	µg/m <sup>3</sup>	0.005	0.37	[NA]	[NA]
Nickel	µg/filter	2	5	<2	<2
Nickel in Air	µg/m <sup>3</sup>	0.002	0.003	[NA]	[NA]
Lead	µg/filter	5	<5	<5	<5
Lead in Air	µg/m <sup>3</sup>	0.005	<0.005	[NA]	[NA]
Lithium	µg/filter	2	3	<2	2
Lithium in Air	µg/m <sup>3</sup>	0.001	0.002	[NA]	[NA]
Sulfur	µg/filter	50	1,100	350	630
Sulfur in Air	µg/m <sup>3</sup>	0.02	0.66	[NA]	[NA]
Zinc	µg/filter	5	2,141	1,295	180
Zinc in Air	µg/m <sup>3</sup>	0.002	1.3	[NA]	[NA]

**Client Reference: Dust Analysis**

Method ID	Methodology Summary
<b>DUST-004</b>	Airborne samples analysed according to AS 2985 for Respirable Dust or AS 3640 for Inhalable Dust . Sample results based on volume data supplied by client. Samples tested as received, *accreditation does not cover sampling.
<b>METALS-020</b>	Metals in soil and water by ICP-OES.

**Report Comments:**

INS: Insufficient sample for this test; NT: Not tested; PQL: Practical Quantitation Limit; <: Less than; >: Greater than  
RPD: Relative Percent Difference; NA: Test not required; LCS: Laboratory Control Sample; NR: Not requested  
NS: Not specified; NEPM: National Environmental Protection Measure  
DOL: Sample rejected due to particulate overload

**Quality Control Definitions**

**Blank:** This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

**Duplicate:** This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

**Matrix Spike:** A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

**LCS (Laboratory Control Sample):** This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

**Surrogate Spike:** Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

**Laboratory Acceptance Criteria**

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

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spike and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and Speciated Phenols is acceptable.

Surrogates: 60-140% is acceptable for general organics and 10-140% for SVOC and Speciated Phenols.