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REPORT ON SAMPLING AND ANALYSIS UNDERTAKEN IN MAGELLAN SHIPPING CONTAINERS STORAGE AREA, FREMANTLE PORT

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Report prepared by

Department of Environment and Conservation
Pollution Response Unit
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EXECUTIVE SUMMARY

This report documents a sampling program conducted by the Department of Environment and Conservation (DEC) to investigate the potential emission of lead (in the form of lead carbonate concentrate, hereinafter simply referred to as lead) from the Magellan Mine transport and export operations at the Port of Fremantle.

DEC officers undertook this sampling program at the North Quay rail terminal of Fremantle Port between 4 and 7 January 2011, to assess whether lead from the Magellan Mine was present on or outside the shipping containers at the storage area. All samples were submitted to ChemCentre for analysis.

Most of the samples from the shipping containers' external surfaces, including the background samples, contained measurable traces of lead. Twenty-six of the thirty-two swab samples from Magellan shipping containers contained less lead than the two background samples. The six swab samples which exceeded the background lead concentration as well as the two background samples were analysed for their isotopic ratio to determine the source of the lead present. Based on this isotopic analysis Magellan lead is likely to be the primary source in five samples and part of a mixture of sources in the sixth; the two background samples showed no trace of Magellan lead. All concentrations of lead identified were significantly below DEC's clean up criterion for lead on hard infrastructure surfaces at ports.

During the sampling program a Magellan shipping container was temporarily opened to retrieve air monitoring equipment enabling DEC officers to collect swab samples from the container's interior. Analysis of two swab samples from interior container walls indicated lead concentrations below background. Analysis of two other inside swabs, taken from the outside of a lead carbonate bag and on the wooden floor, indicated lead concentrations above background, but these levels were still below DEC's clean up criterion for lead on hard infrastructure surfaces at ports. Isotopic ratio analysis concluded that Magellan was likely to be the primary source of lead in these two swab samples from inside the shipping container.

Isotopic ratio analysis of dust samples from the plastic vents on Magellan shipping containers indicated that Magellan was not a major source of the lead in three of those samples. Another two samples possibly had a slight contribution of Magellan lead to the total lead content, when compared with the background reference samples. Analysis of a sixth sample found that Magellan lead was likely to be the primary source of the lead present. Magellan lead was also found to be the primary source of lead in a small accumulation of dust on the external ledge of a container, although lead from other sources was also present.

The concentration of lead in all soil samples analysed was well below both the ecological investigation level and the health investigation level for commercial/industrial land use. Isotopic ratio analysis of six soil samples collected near the Intermodal Link Services' Magellan shipping container storage area, indicated possible contributions from Magellan lead. Isotopic ratio analysis of a soil sample from an open drain near Patrick's Magellan shipping container storage area did not appear to contain any lead from Magellan.

Small puddles of rainwater, from a recent rainfall event, were present on the hardstand at the time of sampling. Isotopic ratio analysis of five water samples (including solid particles) from the Magellan shipping container storage area indicated possible contributions from Magellan lead.

After consultation with the Department of Health (DoH), DEC concludes that the low concentrations of lead identified at Fremantle Port are indicative of the lead traces that can be found in any built-up environment. The levels of lead are well below relevant assessment criteria and do not pose a risk to human health, the environment or any environmental value. While Magellan lead appears to be part of the composition of some of the samples taken, the results of analysis do not indicate any significant presence of Magellan lead outside the shipping containers.

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1. INTRODUCTION

This report documents a sampling program conducted by the Department of Environment and Conservation (DEC) to investigate the potential deposition of lead (in the form of lead carbonate concentrate, hereinafter simply referred to as lead) from the Magellan Mine transport and export operations in the Port of Fremantle. This program stemmed from air monitoring undertaken inside the sealed shipping containers (also known as sea containers and hereinafter simply referred to as containers), that appeared to have detected lead outside the double-lined transport bags which are meant to completely contain the lead.

This report documents the observations, sampling methodology, results of analysis and conclusions of DEC's sampling program. The sampling program was conducted in an area where shipping containers, used for shipping lead from the Magellan Mine, are stored prior to loading onto container ships. The storage area sampled was the Intermodal Link Services lease area, North Quay rail terminal, Fremantle Port, North Fremantle.

DEC undertook this sampling program at North Quay rail terminal of Fremantle Port between 4 and 7 January 2011 to assess whether lead from the Magellan Mine was present on or outside the shipping containers at the storage area. This sampling and analysis program involved the collection and laboratory analysis of swab, soil and rainwater puddle samples from Intermodal Link Services' Magellan shipping container storage area. In addition a number of background samples were obtained to establish a baseline for comparative purposes. A number of Quality Assurance (QA) samples were also obtained, to demonstrate the reliability of the results. All samples were submitted to ChemCentre for analysis.

It should be noted that no ambient air quality sampling was undertaken during this sampling program.

The sampling program was carried out on 4, 5 and 7 January 2011 by officers of the Pollution Response Unit (PRU) Grant Hymus, Dale Stanton, Mark Brand and Peter May.

1.1 Objectives

The objectives of the sampling program were to:

1. Collect swab samples from external surfaces of the stored Magellan shipping containers to determine if lead from the Magellan Mine is present on the external surfaces.
2. Collect soil and pooled rainwater samples from the Magellan shipping containers' storage area and surrounds to determine if Magellan lead is present in soils or rainwater puddles present on the hardstand in the storage area.
3. Compare the analysis results with background levels and relevant screening guideline values, to assess whether any lead identified is present at concentrations that could pose a risk to people's health or the environment.

1.2. Scope of work

A scope of work was planned to achieve the above objectives:

1. Conduct Job Safety Analysis prior to the site inspection and sampling works and implement an appropriate Occupational Health and Safety Plan.
2. Conduct a site walkover around the Magellan shipping container storage area so as to gain an understanding of container movement and storage.
3. Implement appropriate sampling methodologies and Quality Assurance (QA) to ensure samples are collected in accordance with relevant Australian Standards.

4. Conduct a swab sampling program on stored Magellan shipping containers.
5. Conduct a soil and water sampling program at the Magellan shipping container storage area.
6. Collect swab, soil and water samples from locations where no Magellan shipping containers have been stored, but other shipping containers are stored, to assess background conditions.
7. Submit collected samples to the ChemCentre for laboratory analysis.
8. Prepare a report detailing the findings of the sampling and analysis program.

2. SITE BACKGROUND

This section describes the site, its location and observations made by DEC officers during the site walkover.

2.1 Site location and description

The Magellan containers are transferred by rail to Intermodal Link Services (hereinafter simply referred to as ILS), which is located at the North Quay rail terminal, Port Beach Road, North Fremantle. The containers are unloaded off the rail carts by an enclosed reach stacker (top loader) to an area designated for the storage of Magellan containers. The containers are then moved to designated areas at either Patrick Stevedores Yard (hereinafter simply referred to as Patrick's) or D P World Yard (hereinafter simply referred to as DPW) container storage areas prior to being loaded onto container ships. At the time of the sampling program there were no Magellan containers at either DPW or Patrick's. The sampling program was therefore undertaken mainly at the ILS storage area for Magellan containers. Figure 1 shows the location of all three Magellan container storage areas.

At ILS, Magellan containers are stored on a bitumen hardstand in a designated area at the northern end of yard. Bitumen hardstand extends for a significant distance away from the Magellan storage area on all sides except the south-eastern side where the bitumen ends approximately one metre from the storage area. A stormwater drain covered by a grate runs parallel to and approximately two metres in from the eastern bitumen boundary. At the time of the sampling program, containers were placed directly over the stormwater drain for much of its length. As the grate covering the stormwater drain was locked in place, DEC could not collect a water sample from the drain. DEC understands that the stormwater drain eventually leads to a gross pollutant sediment trap prior to discharge into the ocean.

The container storage area is bounded by a wire fence topped with two strands of barbed wire. Access to the site is restricted by a staffed boom gate. Access for workers on foot is limited, due to the large number of vehicle movements. During the sampling program, DEC officers observed that all workers moving about on site were in vehicles.

2.2 Observations

At the time of the sampling program 102 Magellan containers were present at ILS, stacked up to four high, with 35 of the containers at the ground level and therefore accessible for sampling.

A variety of brands were represented amongst the Magellan containers, including MAERSK SEALAND, P&O Nedlloyd, RCL, CAPITAL, CMA CGM, GE SEACO, K-LINE, Triton, salmarin, gold container corp and MSC. The majority of the containers were branded MAERSK SEALAND.

The containers appeared to be in good condition with *Dangerous Goods* placards placed on them.

Varying quantities of red dust were visible on a number of shipping containers. Photograph 1 shows the Magellan shipping containers.

3. FIELD SAMPLING ACTIVITIES

This section documents the field activities that were conducted as part of the sampling program. Sampling procedures, location, number and types of samples collected and quality assurance (QA) procedures are discussed.

Prior to any on-site work, DEC officers liaised with ILS to gain access to the Magellan container storage area.

3.1 External surfaces of shipping containers

On 4 January 2011 swabs were taken from external surfaces of 20 Magellan containers (marked S1 – S20). An additional 12 swabs from Magellan containers (S21 – S32) were taken on 5 January 2011. Figure 2 shows the surface swab sampling locations.

Two background swabs (B1 and B2) were taken from non-Magellan containers. Figure 4 shows the background sampling locations.

Swab samples were taken from the surface of the Dangerous Goods placard stickers applied to external surfaces of the Magellan containers. DEC understands that these stickers were applied to the shipping containers by Magellan Metals before the containers left the mine site. The stickers were chosen as the sampling point because initial X-ray fluorescence (XRF) screening by DEC found that lead was incorporated into the material of the walls of a large proportion of containers tested (both Magellan containers and non-Magellan containers).

GhostWipe swabs (manufactured by Environmental Express for testing lead in dust) were used for swab sampling as follows:

1. Remove a *GhostWipe* from its package and unfold it.
2. Next fold the *GhostWipe* in half and wipe a measured 10cm by 10cm area, starting at the outside edge of the surface. Applying firm pressure, wipe the surface, progressing towards the centre by making concentric squares of decreasing size.
3. Fold wipe in half, with the used side in, and wipe the surface again by making concentric squares of decreasing size.
4. Fold the wipe in half again, used side in, and wipe surface a third time.

Photograph 2 shows a surface swab sample being collected, and Photograph 3 shows a Dangerous Goods placard sticker after sampling.

The *GhostWipe* swab was then placed in a sample jar and secured in an evidence bag before being transported to the ChemCentre for lead analysis.

Disposable non-powdered nitrile gloves were worn during sampling with new gloves used for each new sample, to minimise the risk of cross-contamination.

3.2 Vents on shipping containers

Five vent samples (marked V1 - V5) were obtained by swabbing the plastic ventilation points located on the top walls of the shipping containers on 4 January 2011. An additional two

swabs (VS-1 and VS-2) were obtained from vents on 5 January 2011. Figure 2 shows the vent sampling locations. Photograph 4 shows a plastic ventilation point.

Three background swabs (BGV1, BGV2 and BGV3) were taken from non-Magellan shipping containers on 7 January 2011. Figure 4 shows the background sampling locations.

Ventilation swabs were obtained directly from the ventilation point located on the top of the external walls of the shipping containers. Due to the varying sizes of the vents, the swab samples were submitted for laboratory analysis to determine the presence or absence of lead only, and cannot be used to determine the quantity of lead per unit area.

The *GhostWipe* swab was then placed in a sample jar and secured in an evidence bag before being transported to the ChemCentre for lead analysis.

Disposable non-powdered nitrile gloves were worn during sampling with new gloves used for each new sample, to minimise the risk of cross-contamination.

3.3 Sampling of Magellan shipping container opened for air monitoring

During sampling procedures on 4 January 2011, personnel from Inspectorate Cox (engaged by Magellan Metals) opened a Magellan container in order to collect air monitoring equipment from inside. Although unplanned, DEC officers took the opportunity to obtain swab samples from both internal and external surfaces on this container. Figure 2 shows the surface swab sampling locations.

Swab samples were obtained as follows:

C1 Interior of container, inside door next to air monitor.
C2 Interior of container, wooden floor.
C3 Outside surface of a product transportation bag containing lead carbonate, which had visible staining, and which was inside the container (Photograph 5).
C4 Interior of container, from a sticker.
C5 External surface of container, from an accumulation of red dust located on the bottom ledge (Photograph 6).

Swab samples (C1 – C4) were taken from measured 10cm by 10cm areas of the relevant surface using *GhostWipe* swabs as per the methodology for external surfaces of shipping containers cited above. Swab sample C5 was taken directly from the accumulated red dust on the ledge of the container. Each *GhostWipe* swab was then placed in a sample jar and secured in an evidence bag before being transported to the ChemCentre for lead analysis.

Disposable non-powdered nitrile gloves were worn during sampling with new gloves used for each new sample, to minimise the risk of cross-contamination.

3.4 Soil samples

A total of six soil samples (SS1 – SS6) were obtained from soils located southeast of the bitumen hardstand at ILS' Magellan container storage area on 5 January 2011. One soil sample (Drain Sample 1) was obtained from the open sluice drain adjacent to Patrick's container storage area . Figure 3 shows the soil sampling locations.

Two background samples (BGS1 and BGS2) were obtained from soils adjacent to container storage areas at the port where no Magellan containers have been stored. Figure 4 shows the background sampling locations.

Soil samples were collected directly into laboratory-supplied glass jars, thus eliminating the opportunity for cross-contamination from non-dedicated equipment. The soil sample was

then placed in a secured evidence bag before being transported to the ChemCentre for lead analysis. Photograph 7 shows one of the soil sampling locations.

Disposable non-powdered nitrile gloves were worn during sampling with new gloves used for each new sample, to minimise the risk of cross-contamination.

3.5 Water samples

A total of five water samples (WS-1 to WS-5) were obtained from small puddles of water that had accumulated on the hardstand around the sea containers following a recent rainfall event. The samples were collected in order to determine whether Magellan lead had been washed off the containers by rain and then accumulated on the hardstand surface. Figure 3 shows the water sampling locations.

Two background samples (BGW1 and BGW2) were obtained from water puddles adjacent to container storage areas at the port where no Magellan containers have been stored. Figure 4 shows the background sampling locations.

The water samples were extracted from the puddles using a new syringe for each sample. Each sample was then transferred into a laboratory-supplied sample container for metals analysis. The samples were not filtered in the field, to ensure that analysis would determine the total lead present (both dissolved and solid particles). Photograph 8 shows one of the water puddles.

Each water sample was then placed in a secured evidence bag before being transported to the ChemCentre for lead analysis.

3.6 Quality assurance (QA)

Quality assurance is an integral part of any sampling program to ensure the validity and reliability of the sampling program and subsequent analysis. DEC routinely applies QA to sampling programs to underpin the scientific robustness of the procedures used, ensure the cost-effectiveness of the sampling program and to provide assurance to the community of the validity of results. The following details the QA procedures applied to this program.

A transport blank and swab blank (QC1) comprising of an unused swab placed in a sampling container accompanied samples during storage and transportation of samples to the laboratory on 4 January 2011. Similarly, QC2 is the transport blank and swab blank for sampling on 5 January 2011, and QC3 is the transport blank and swab blank for sampling on 7 January 2011.

Two swab field blanks (S33 and S34) were obtained during swabbing activities to assess whether any atmospheric lead deposition contributed to measured lead concentrations.

A water sample field blank (WSFB-1), using deionised water, was collected at the time of water sampling to assess whether the syringe, sampling containers, sampling technique or cross-contamination could have contributed to lead concentrations measured in water samples.

A duplicate soil sample (DS-1, a duplicate of SS-1) was collected during soil sampling activities and used to demonstrate accuracy of laboratory sampling activities.

Table 1 summarises the location and type of all samples collected.

4. ANALYTICAL METHODS AND ASSESSMENT LEVELS

This section describes ChemCentre's analytical methods and approach, and discusses the selection of appropriate assessment levels for screening-level (Tier 1) risk assessment.

4.1 Analytical methods and approach

Soil, water and swab samples collected during the sampling program were transported to ChemCentre and analysed for lead by following methods:

- iMET1FCICP Metals in filters by acid digestion and ICPAES (NIOSH Method 7303 modified).
- iMET1SBICP Metals in swabs by Nitric/Hydrochloric digestion and ICPAES.
- iMET1WCMS Total dissolved metals by ICPMS (APHA 3125).
- Swabs and filters were digested using hot block mixed acid (Nitric/Hydrochloric) digestion, analysis of metals by ICPAES.
- Lead isotopic ratio analysis by quadrupole ICPMS (APHA 3125).

All background, soil and water samples were also submitted for lead isotopic ratio analysis in order to determine if Magellan lead was present in the sample. Surface and vent swab samples with lead concentrations above the background result were also submitted for lead isotopic ratio analysis.

4.2 Relevant assessment levels

For surface swab samples, the relevant assessment level is DEC's lead clean up criterion for infrastructure external surfaces at ports of 50µg/cm^2, which has been endorsed by the Department of Health.

For soil samples, the relevant assessment levels for lead are the ecological investigation level (EIL) of 600mg/kg and the health investigation level for commercial/industrial land use (HIL-F), which includes premises such as shops and offices as well as factories and industrial sites, of 1,500mg/kg, as published in the *National Environment Protection (Assessment of Site Contamination) Measure 1999 – Schedule B(1) Guideline on Investigation Levels for Soil and Groundwater* (National Environment Protection Council, 1999).

No relevant assessment levels were identified for total lead concentrations in water puddles on hardstand surfaces.

There are no relevant assessment levels for the vent or dust accumulation swab samples, as the area over which the swab sample was collected could not be reliably measured.

5. SUMMARY OF ANALYTICAL RESULTS

This section summarises the laboratory analysis results for the samples collected. The analysis results are presented in Tables 2 to 7. A separate report contains chain of custody forms for the samples and the laboratory certificates for total lead analysis. A summary of the lead isotope testing results, prepared by ChemCentre and the supporting laboratory certificates are also included in the separate report.

5.1 External surfaces of shipping containers – swab sample results

Both background samples from the external surfaces of non-Magellan containers indicated lead concentrations exceeding the laboratory's limit of reporting (LOR) of 0.005µg/cm^2; sample B1 indicated 0.08µg/cm^2, while B2 indicated 0.036µg/cm^2. Isotopic ratio analysis concluded that lead from the Magellan Mine was not a major source of the lead present in either background sample.

A total of 32 external surface swab samples were collected from 30 Magellan shipping containers. One swab sample fell below the LOR and 25 samples contained lead above LOR but below the (lower) background concentration (0.036µg/cm^2).

Six samples were above the background concentration with the lead concentration ranging from 0.049µg/cm^2 to 0.11µg/cm^2. Isotopic ratio analysis of these six samples concluded that Magellan lead was likely to be the primary source for five of the samples, and only a contributor to a mixture of lead from various sources in the sixth sample.

All concentrations of lead identified in external surface swab samples from containers are significantly below DEC's lead clean up criterion for infrastructure external surfaces at ports of 50µg/cm^2.

The analysis results for the external surface swab samples are presented in Table 2.

5.2 Vents on shipping containers – swab sample results

A total of seven swab samples were collected from vents on seven Magellan shipping containers. An additional three background samples were taken from three non-Magellan shipping container vents. All background samples and six of the seven Magellan shipping container samples were submitted for isotopic ratio analysis. The seventh Magellan vent sample (V5) was not submitted for isotopic ratio analysis because the lead content was below the lowest background vent sample.

The background vent samples contained from 2.9 µg to 11µg of lead. The Magellan vent samples reported 2.5µg to 18µg of lead.

The three background vent samples were used to provide reference isotopic ratio data for the assessment of Magellan vent sample results.

Isotopic ratio analysis for three of the Magellan vent samples (V2, V3 and V4) indicated that Magellan lead was not a major source of the lead present in those samples.

For two of the Magellan vent samples (VS-1 and VS-2) isotopic ratio analysis found a possible slight contribution of Magellan lead to the total lead content when compared with the background reference samples.

Isotopic ratio analysis of sample V1 concluded that Magellan lead was likely to be the primary source of the lead present. DEC notes that the laboratory used background surface swab sample B2 for reference, rather that the background vent samples.

The analysis results for the vent swab samples are presented in Table 3. There is no relevant assessment level for the vent swab samples.

5.3 Results of swab sampling of Magellan shipping container opened for air monitoring purposes

Four swab samples (C1 to C4) were collected from the interior of a Magellan container that had been opened to collect air monitoring equipment.

Two of the samples, from the inside of the door (C1) and a sticker inside the container (C4), indicated concentrations of lead of 0.014µg/cm^2 and 0.032µg/cm^2 respectively which were both below the external surface background concentration (0.036µg/cm^2).

Swab sample C2, from the wooden floor inside the container, reported a lead concentration of 7.5µg/cm^2, and isotopic ratio analysis concluded that Magellan lead was likely to be the primary source of the lead present.

Swab sample C3, from the outer surface of a bag containing lead carbonate, reported a lead concentration of 2.1µg/cm^2, and isotopic ratio analysis concluded that Magellan lead was likely to be the primary source of the lead present.

The lead concentrations of all four swab samples from the interior of the opened shipping container were below DEC's lead clean up criterion for infrastructure surfaces at ports of 50µg/cm^2.

A sample was also collected from an accumulation of dust on the lower (external) ledge of the container, using a swab. Isotopic ratio analysis concluded that Magellan lead was likely to be the primary source of the lead present, although there was some indication of a mixture of sources. There is no relevant assessment level for this dust sample.

The analysis results for samples C1 to C5 are presented in Table 4.

5.4 Soil sample results

Both background soil samples collected near non-Magellan containers indicated lead concentrations exceeding the laboratory's limit of reporting (LOR) of 0.5mg/kg. Sample BGS-1 indicated 23mg/kg, while BGS-2 indicated 13mg/kg. Isotopic ratio analysis concluded that BGS-1 was very similar to average earth crustal lead. The lead in BGS-2 was found to be from a unique lead source well removed from all other samples (including reference samples).

Soil samples SS1 to SS6, collected adjacent to ILS' Magellan container storage area indicated lead concentrations between 29mg/kg and 52mg/kg. Isotopic ratio analysis provided indications of a possible contribution from Magellan lead when compared with background reference sample BGS-1. However, ChemCentre noted that further analysis including a larger number of reference samples (BGS-2 was very different to all other samples) would be required to confirm whether Magellan lead was present in the soil samples (and not another lead source such as Broken Hill lead).

Soil marked 'Drain Sample 1' collected from an open sluice drain adjacent to Patrick's indicated a lead concentration of 44mg/kg. Isotopic ratio analysis found no evidence of Magellan lead when compared to background reference sample BGS-1.

All concentrations of lead in soil samples are well below the Ecological Investigation Level (600mg/kg) and the Health Investigation Level for commercial/industrial land use (1,500mg/kg).

The analysis results for the soil samples are presented in Table 5.

5.5 Water sample results

Both background samples from rainwater puddles collected near non-Magellan containers indicated total lead concentrations exceeding the laboratory's limit of reporting (LOR) of 0.02mg/L. Sample BGW1 indicated 0.11mg/L, while BGW2 indicated 0.08mg/L. Isotopic ratio analysis concluded that lead in both background water samples (including "sludge" particles) was similar to average earth crustal lead.

Samples from rainwater puddles at the Magellan container storage area (WS-1 to WS-5) indicated lead concentrations between 0.03mg/L and 0.66mg/L. Isotopic ratio analysis found that all samples (and in particular WS-3 and WS-4) show indications of a possible contribution from Magellan lead when compared with the background reference samples, however, ChemCentre noted that further analysis would be required to confirm this.

The analysis results for the samples from rainwater puddles are presented in Table 6.

There are no relevant assessment levels for total lead concentrations in rainwater puddles on hardstand surfaces.

5.6 Quality Assurance (QA) results

None of the swab or water blank samples reported lead concentrations above the relevant LOR.

The relative percentage difference between lead concentrations in soil sample SS1 and field duplicate DS1 was 7 per cent, within acceptable range.

The QA analytical results are presented in Tables 7a to 7c.

There is no evidence of cross contamination occurring during sampling, storage and transportation.

6. DISCUSSION

Most swab samples taken from the external surfaces of containers, including the background samples, contained low but detectable traces of lead. Of the 32 swab samples from Magellan containers, 26 samples contained less lead than the background samples. The six swab samples from Magellan containers with lead concentrations above the lower background sample were subjected to isotopic ratio analysis to determine the source of the lead. This analysis found that Magellan lead was likely to be the primary source in five samples and part of a mixture of sources in the sixth. The two background samples showed no trace of Magellan lead. All concentrations of lead identified were significantly below DEC's clean up criterion for lead on hard infrastructure external surfaces at ports.

A Magellan container was temporarily opened to retrieve air monitoring equipment, which allowed DEC officers to collect swab samples from inside the container. Two swab samples from interior container walls indicated less lead than the background (external surface) samples. The other two inside swabs, taken from the outside of a lead carbonate bag and the wooden floor, contained higher concentrations of lead, but again the levels were below

DEC's clean up criterion for lead on hard infrastructure external surfaces at ports. Isotopic ratio analysis concluded that Magellan was likely to be the primary source of the lead on the outside of the lead carbonate bag and the wooden floor inside the container.

Isotopic ratio analysis of dust samples from the plastic vents on Magellan containers showed that Magellan was not a major source of the lead identified in three of the samples. Another two samples were found to have a possible slight contribution of Magellan lead when compared with the background reference samples. Analysis of the sixth sample found that Magellan lead was likely to be the primary source of the lead present. Magellan lead was also found to be the primary source of lead in a small accumulation of dust on the external ledge of a container, although there was some indication of a mixture of sources.

The lead concentrations in all soil samples analysed were well below both the Ecological Investigation Level and the Health Investigation Level for commercial/industrial land use. Isotopic ratio analysis found indications of a possible contribution from Magellan lead in six soil samples collected near ILS' storage area. However, ChemCentre noted that extensive further analysis including a larger number of reference samples would be required to confirm whether Magellan lead was present in the soil samples as opposed to another lead source such as Broken Hill lead (especially given that one of the two soil background reference samples, BGS-2, was found to be from a unique lead source very different to all other samples). A soil sample from an open drain near Patricks' did not contain Magellan lead.

Small puddles of rainwater were present on the hardstand at the time of sampling following a recent rainfall event. Isotopic ratio analysis of five water samples (including solid particles) from the Magellan container storage area found indications of a possible contribution from Magellan lead when compared with the background reference samples. However, ChemCentre noted that further analysis would be required to confirm this.

DEC officers discussed the results of the sampling and analysis program with the Department of Health's Principal Toxicologist, who provided the following advice:

"*The levels of lead detected on labels of containers, in soil and in water puddles are very low and would not pose a hazard to public health.*"

The low concentrations of lead identified at Fremantle Port are similar to background lead that can be found in any built-up environment. The levels of lead are well below relevant assessment criteria and do not pose a risk to human health, the environment or any environmental value. While Magellan lead is part of the composition of some of the samples, the results do not provide evidence of any significant presence of Magellan lead outside the shipping containers.

FIGURES

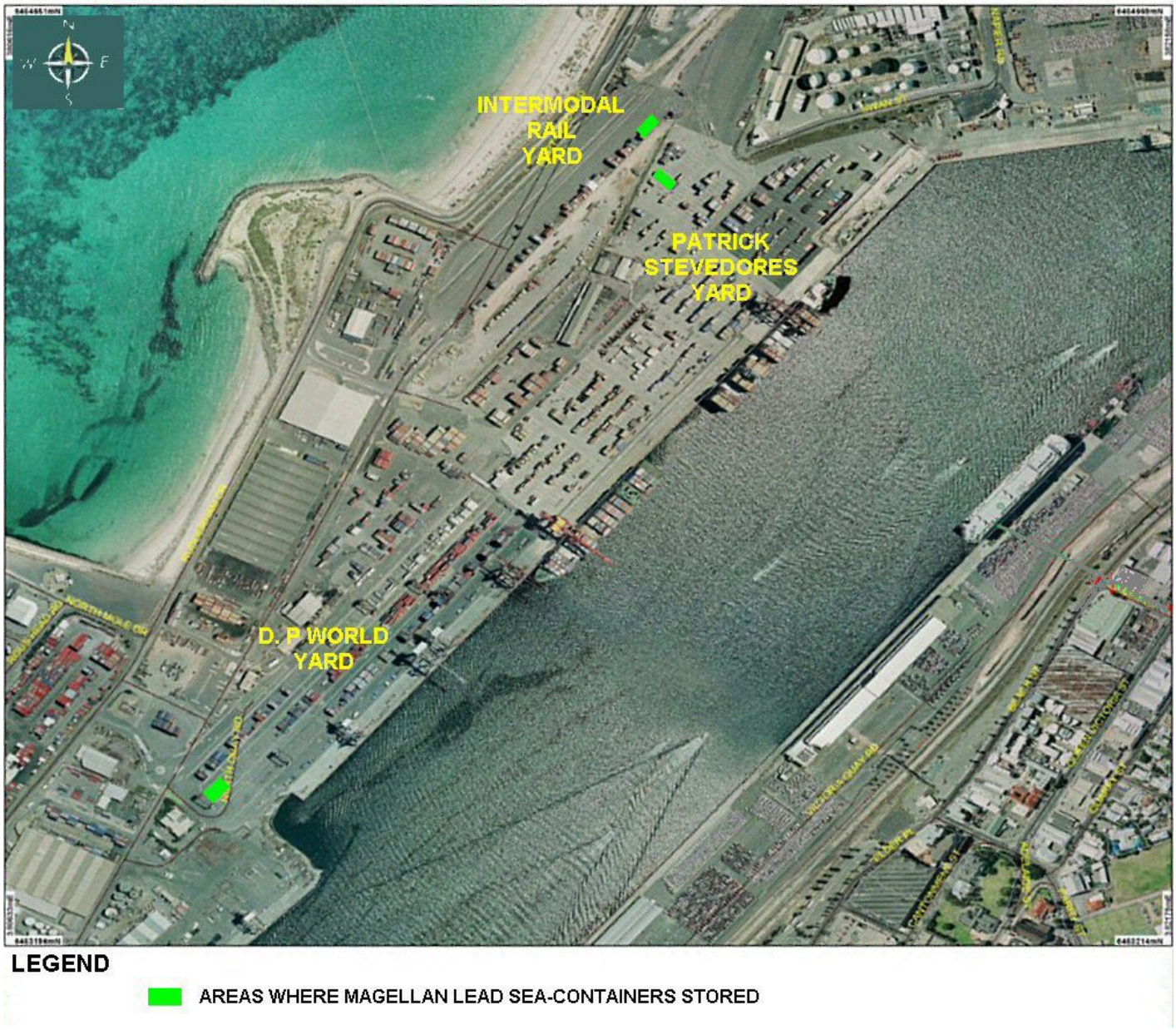
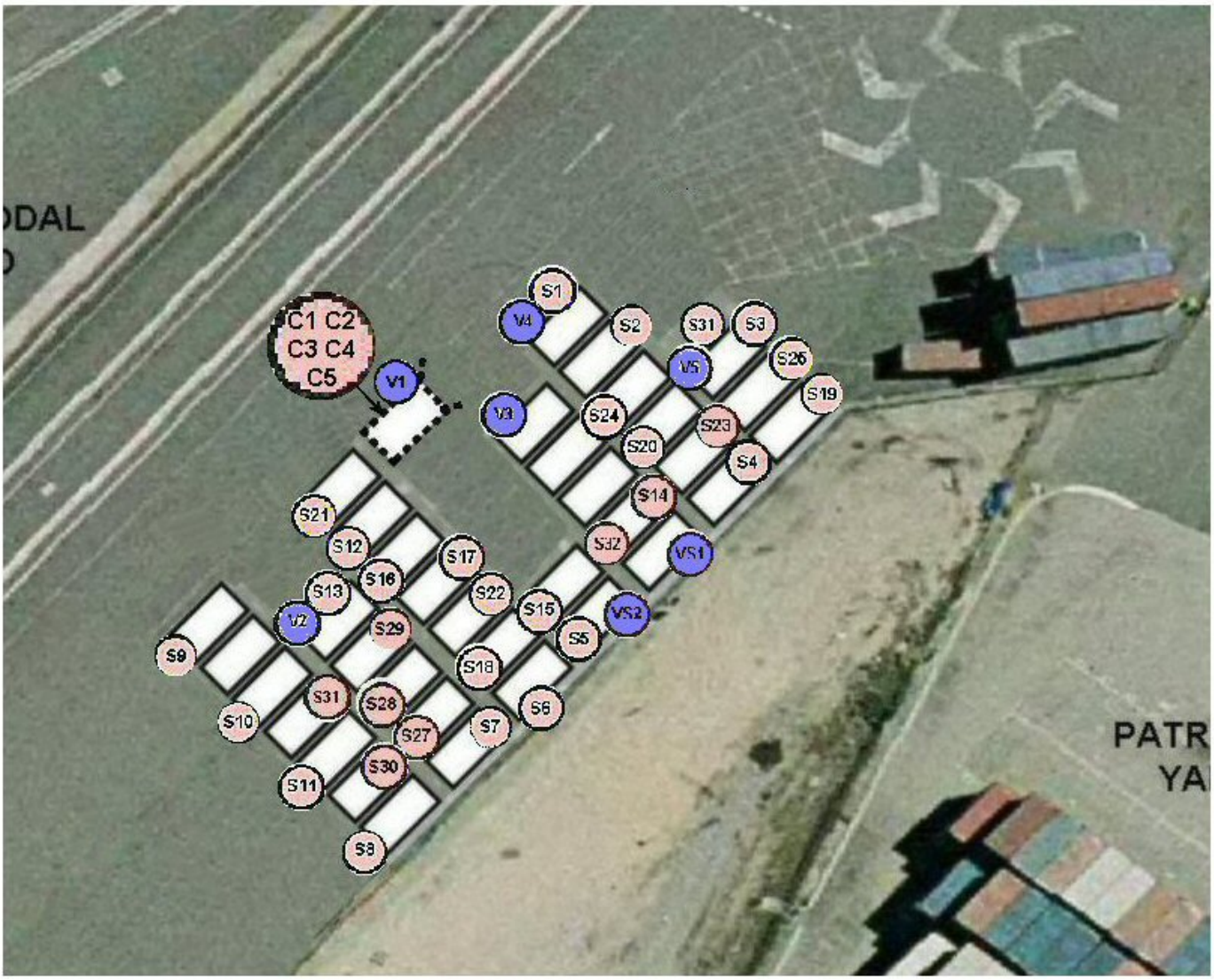


Figure 1: North Quay – Location of Magellan shipping (sea) container storage areas



Note: Dotted line indicates the shipping container that was temporarily opened to retrieve an air monitoring device.

Figure 2: Magellan shipping containers – swab sample locations

Figure 3: Magellan shipping (sea) containers – soil and water sample locations

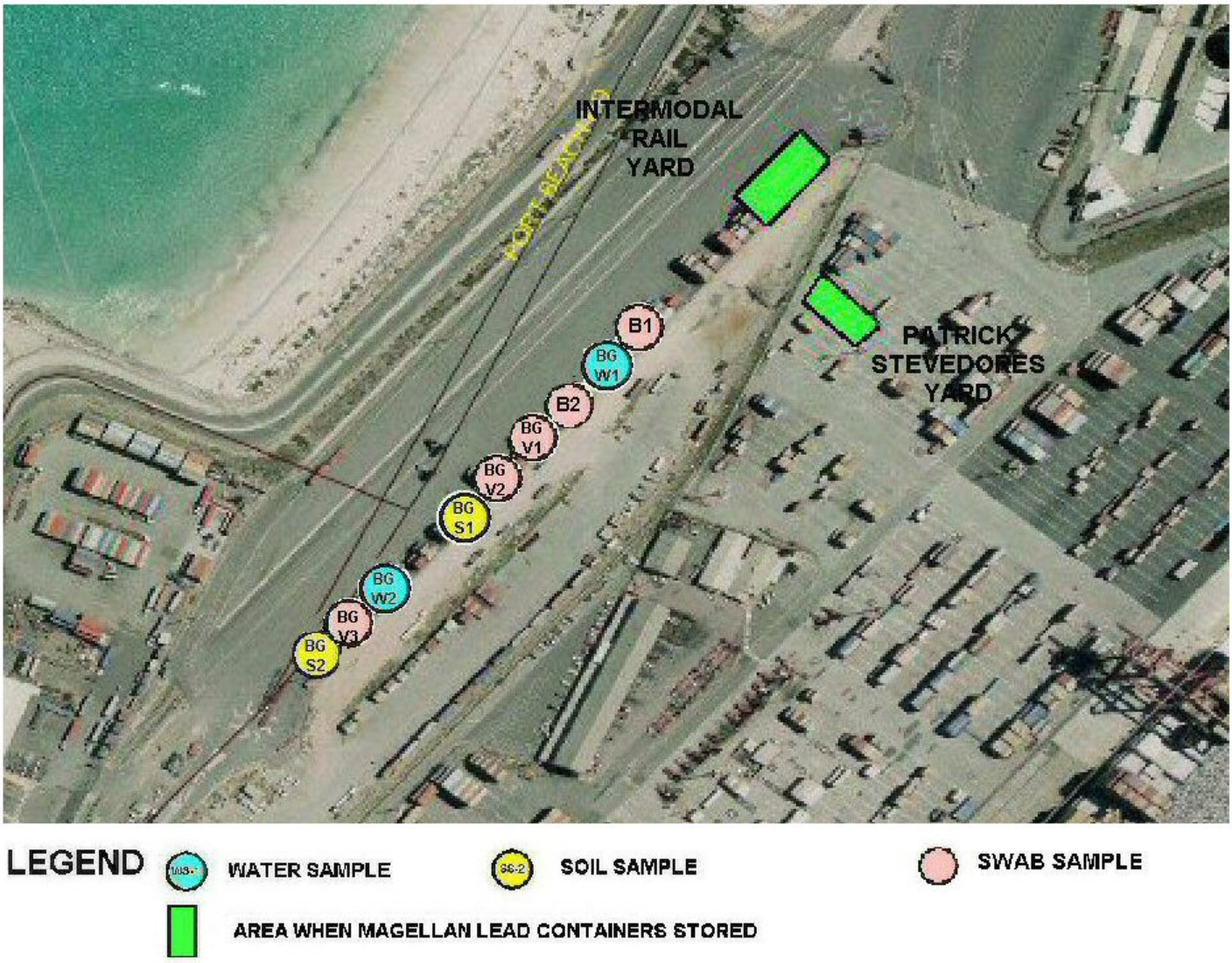


Figure 4: North Quay - background sample locations

TABLES

Table 1 – Summary of sample locations

Sample ID	Evidence bag #	Type	Observation
Swab samples			
S1	7278	Swab	Magellan sea container – sticker
S2	7280	Swab	Magellan sea container – sticker
S3	7285	Swab	Magellan sea container – sticker
S4	7287	Swab	Magellan sea container – sticker
S5	7279	Swab	Magellan sea container – sticker
S6	7290	Swab	Magellan sea container – sticker
S7	7289	Swab	Magellan sea container – sticker
S8	7286	Swab	Magellan sea container – sticker
S9	7295	Swab	Magellan sea container – sticker
S10	7296	Swab	Magellan sea container – sticker
S11	7297	Swab	Magellan sea container – sticker
S12	7298	Swab	Magellan sea container – sticker
S13	7299	Swab	Magellan sea container – sticker
S14	7254	Swab	Magellan sea container – sticker
S15	7255	Swab	Magellan sea container – sticker
S16	7256	Swab	Magellan sea container – sticker
S17	7258	Swab	Magellan sea container – sticker
S18	7257	Swab	Magellan sea container – sticker
S19	7253	Swab	Magellan sea container – sticker
S20	7259	Swab	Magellan sea container – sticker
S21	2424	Swab	Magellan sea container – sticker
S22	2425	Swab	Magellan sea container – sticker
S23	2426	Swab	Magellan sea container – sticker
S24	2427	Swab	Magellan sea container – sticker
S25	2428	Swab	Magellan sea container – sticker
S26	2429	Swab	Magellan sea container – sticker
S27	2430	Swab	Magellan sea container – sticker
S28	2431	Swab	Magellan sea container – sticker
S29	2432	Swab	Magellan sea container – sticker
S30	2433	Swab	Magellan sea container – sticker
S31	2434	Swab	Magellan sea container – sticker
S32	2435	Swab	Magellan sea container – sticker
B1	7260	Swab	Background non-Magellan sea container sticker
B2	7261	Swab	Background non-Magellan sea container sticker
S-33	2436	Swab	Field blank
S-34	2097	Swab	Field blank
Vent samples			
V1	7262	Swab	Vent – Magellan sea container
V2	7264	Swab	Vent – Magellan sea container
V3	7263	Swab	Vent – Magellan sea container
V4	7265	Swab	Vent – Magellan sea container
V5	7266	Swab	Vent – Magellan sea container
VS-1	2139	Swab	Vent – Magellan sea container
VS-2	2140	Swab	Vent – Magellan sea container
BGV1	2094	Swab	Vent – Background non-Magellan sea container

Sample ID	Evidence bag #	Type	Observation
BGV2	2095	Swab	Vent – Background non-Magellan sea container
BGV3	2096	Swab	Vent – Background non-Magellan sea container
Swab samples – opened shipping container			
C1	7300	Swab	Inside door Magellan sea container
C2	7293	Swab	Inside floor Magellan sea container
C3	7294	Swab	Side of lead bag inside Magellan sea container
C4	7291	Swab	Sticker on inside sea container
C5	7292	Swab	Visible red dust outside sea container
Rainwater puddle samples			
WS-1	2136	Water	Puddle water around Magellan sea containers
WS-2	2137	Water	Puddle water around Magellan sea containers
WS-3	2138	Water	Puddle water around Magellan sea containers
WS-4	7276	Water	Puddle water around Magellan sea containers
WS-5	7277	Water	Puddle water around Magellan sea containers
WS FB-1	7267	Water	Water sample field blank
BGW1	2091	Water	Puddle water around non-Magellan sea containers
BGW2	2093	Water	Puddle water around non-Magellan sea containers
Soil samples			
SS-1	7269	Soil	Soil sample adjacent Magellan sea containers
SS-2	7271	Soil	Soil sample adjacent Magellan sea containers
SS-3	7272	Soil	Soil sample adjacent Magellan sea containers
SS-4	7273	Soil	Soil sample adjacent Magellan sea containers
SS-5	7274	Soil	Soil sample adjacent Magellan sea containers
SS-6	7275	Soil	Soil sample adjacent Magellan sea containers
Drain sample 1	7268	Soil	Soil sample adjacent Patricks sea container storage area
BGS-1	7251	Soil	Soil sample adjacent non-Magellan sea containers
BGS-2	7283	Soil	Soil sample adjacent non-Magellan sea containers
DS-1	7270	Soil	QA/QC Duplicate sample
Swab transport blanks			
QC1	7252	Swab	Transport blank 4/1/2011
QC2	2451	Swab	Transport blank 5/1/2011
QC3	2098	Swab	Transport blank 7/1/2011

Table 2 – Lead concentrations in external surface swabs and isotopic ratio analysis results

ChemCentre ID	DEC ID	Date	Area	Lead	Lead	Lead isotopic analysis most probable source summary
Method code			**iMET1FCICP**	**iMET1FCICP**	**iMET1SBICP**	
LOR			**1**	**0.5**	**0.005**	
Units			**cm^2**	**µg/swab**	**µg/cm^2**	
10E1350/001	**S1 7278**	**4/1/2011**	**100**	**2.2**	**0.022**	
10E1350/002	**S2 7280**	**4/1/2011**	**100**	**2.7**	**0.027**	
10E1350/003	**S3 7285**	**4/1/2011**	**100**	**2.7**	**0.027**	
10E1350/004	**S4 7287**	**4/1/2011**	**100**	**2.4**	**0.024**	
10E1350/005	**S5 7279**	**4/1/2011**	**100**	**1.7**	**0.017**	
10E1350/006	**S6 7290**	**4/1/2011**	**100**	**1.6**	**0.016**	
10E1350/007	**S7 7289**	**4/1/2011**	**100**	**1.4**	**0.014**	
10E1350/008	**S8 7286**	**4/1/2011**	**100**	**1.9**	**0.019**	
10E1350/009	**S9 7295**	**4/1/2011**	**100**	**5.9**	**0.059**	**Lies within 2 sigma range of pure Magellan lead, Magellan likely primary source.**

10E1350/010	S10 7296	4/1/2011	100	1.4	0.014	
10E1350/011	S11 7297	4/1/2011	100	2.1	0.021	
10E1350/012	S12 7298	4/1/2011	100	1.9	0.019	
10E1350/013	S13 7299	4/1/2011	100	11	0.11	Lies just outside 2 sigma range of pure Magellan lead but appears likely to contain Magellan lead as a mixture.
10E1350/014	S14 7254	4/1/2011	100	3	0.03	
10E1350/015	S15 7255	4/1/2011	100	2.5	0.025	
10E1350/016	S16 7256	4/1/2011	100	0.9	0.009	
10E1350/017	S17 7258	4/1/2011	100	1.2	0.012	
10E1350/018	S18 7257	4/1/2011	100	5.2	0.052	Lies within 2 sigma range of pure Magellan lead, Magellan likely primary source
10E1350/019	S19 7253	4/1/2011	100	2.6	0.026	
10E1350/020	S20 7259	4/1/2011	100	2.7	0.027	
10E1358/001	S21 2424	5/1/2011	100	2.9	0.029	
10E1358/002	S22 2425	5/1/2011	100	2.2	0.022	
10E1358/003	S23 2426	5/1/2011	100	2.1	0.021	
10E1358/004	S24 2427	5/1/2011	100	<0.5	<0.005	
10E1358/005	S25 2428	5/1/2011	100	1.6	0.016	
10E1358/006	S26 2429	5/1/2011	100	1.8	0.018	
10E1358/007	S27 2430	5/1/2011	100	8.6	0.086	Lies within 2 sigma range of pure Magellan lead, Magellan likely primary source.
10E1358/008	S28 2431	5/1/2011	100	4.9	0.049	Lies within 2 sigma range of pure Magellan lead, Magellan likely primary source
10E1358/009	S29 2432	5/1/2011	100	2.1	0.021	
10E1358/010	S30 2433	5/1/2011	100	1.3	0.013	
10E1358/011	S31 2434	5/1/2011	100	7	0.07	
10E1358/012	S32 2435	5/1/2011	100	11	0.11	Lies within 2 sigma range of pure Magellan lead, Magellan likely primary source.
10E1350/021	B1 7260	4/1/2011	100	8	0.08	Background - Lies close to average earth crust lead, well away from Magellan type.
10E1350/022	B2 7261	4/1/2011	100	3.6	0.036	Background - Lies well away from Magellan lead, Magellan is not a major source
DEC infrastructure surfaces clean up criterion for ports					50 µg/cm^2	

Samples with concentrations in excess of lower background concentration
Background concentrations
Lead isotopic analysis summary - Data analysis should primarily refer to 'plot position of ratios' data as provided in relation to suitable reference points/sources, possibly over time to track changes.
Summary information above is an approximation based on references to hand at the time of reporting.

Table 3 – Lead isotopic ratio analysis results for shipping container vents

The results below summarise the most probable sources of lead identified by ChemCentre in swabs from shipping container vents, based on references available at the time of reporting.

ChemCentre ID	DEC ID	Date	Lead	Lead isotopic analysis most probable source summary
Method code			iMET1FCICP	
LOR			0.5	
Units			µg/swab	
10E1350/023	V1 7262	4/1/2011	12	Lies outside the 2 sigma range of pure Magellan lead but if corrected for an assumed background sample (B2 7261) and concentration then portion remaining is consistent with Magellan lead primary source.
10E1350/024	V2 7264	4/1/2011	18	Point lies well away from Magellan lead, Magellan lead is not a major source.
10E1350/025	V3 7263	4/1/2011	13	Point lies well away from Magellan lead, Magellan lead is not a major source.
10E1350/026	V4 7265	4/1/2011	16	Point lies well away from Magellan lead, Magellan lead is not a major source.
10E1350/027	V5 7266	4/1/2011	2.5	No isotopic analysis conducted as ug/swab concentration is below lower background concentration.

10E1358/014	VS-1 2139	5/1/2011	6.4	VS-1 and VS-2 .Possible slight contribution of lead is from Magellan type based on position verses BGV1-3 reference swabs. The overall lead content is similar/equal to this background – the vector for VS-1 and VS-2 may well be mine site lead dust strongly adhered to the surface not dust from the vents.
10E1358/015	VS-2 2140	5/1/2011	12	
10E1372/003	BGV1 2094	7/1/2011	6.6	Back ground - Reference vent swab sample
10E1372/004	BGV2 2095	7/1/2011	2.9	Back ground - Reference vent swab sample
10E1372/005	BGV3 2096	7/1/2011	11	Back ground - Reference vent swab sample
There are no relevant assessment levels for µg/swab			*****	

***** Due to the varying sizes of vents, the samples could not be taken from measured 10 cm x 10 cm areas. The results are reported as µg/swab and used for isotopic ratio analysis only.

Table 4 – Lead results from swab sampling of Magellan shipping container opened for air monitoring purposes

ChemCentre ID	DEC ID	Date	Area	Lead	Lead	Lead isotopic most probable source summary
Method code			**iMET1FCICP**	**iMET1FCICP**	**iMET1SBICP**	
LOR			**1**	**0.5**	**0.005**	
Units			**cm^2**	**µg/swab**	**$µg/cm^2$**	
10E1350/028	C1 7300	4/1/2011	100	1.4	0.014	
10E1350/029	C2 7293	4/1/2011	100	750	7.5	Lies within 2 sigma range of pure Magellan lead, Magellan likely primary source.
10E1350/030	C3 7294	4/1/2011	100	210	2.1	Lies close to Magellan lead and is likely Magellan lead primary source.
10E1350/031	C4 7291	4/1/2011	100	3.2	0.032	
10E1350/032	C5 7292	4/1/2011	See comment #	260	See comment #	Lies close to Magellan lead and is likely Magellan lead primary source (some mixing)
DEC infrastructure surfaces clean up criterion for ports					**50 $µg/cm^2$**	
There are no relevant assessment levels for µg/swab				*****		

The results summarise the most probable sources of lead identified by ChemCentre in the swabs analysed, based on references available at the time of reporting.

Due to the location of visible dust on the bottom ledge along the wall of the sea container, the sample could not be taken from a measured 10 cm x 10 cm area. The result is reported as µg/swab and used for isotopic ratio analysis only.

Table 5 – Lead concentrations in soil samples and isotopic ratio analysis results

The results below summarise the most probable sources of lead identified by ChemCentre in the soil samples analysed, based on references available at the time of reporting.

ChemCentre ID	DEC ID	Date	Lead	
Method code			**iMET2SAICP**	
LOR			**0.5**	
Units			**mg/kg**	**Comments**
10E1358/023	SS-1 7269	5/1/2011	29	All soil samples (SS-1 to SS-6) show indications of a possible shift in ratio verses assumed reference sample BGS1 towards Magellan type lead ratio. However this possible shift would require confirmation by further analysis including more reference soil (BGS-2 was very different) and that the shift is towards Magellan lead and not another lead type such as Broken Hill type lead (determination of the array direction using 204 ratio analysis of multiple samples).
10E1358/024	SS-2 7271	5/1/2011	35	
10E1358/025	SS-3 7272	5/1/2011	36	
10E1358/026	SS-4 7273	5/1/2011	51	
10E1358/027	SS-5 7274	5/1/2011	52	
10E1358/028	SS-6 7275	5/1/2011	39	
10E1358/31	Drain	3/1/2011	44	There is no evidence of Magellan contribution based on reference to BGS1.

	sample 1			
10E1358/029	BGS-1 7251	5/1/2011	23	Background reference sample v. similar to average earth crustal lead.
10E1358/030	BGS-2 7283	5/1/2011	13	Unique lead source lies well removed from all others and references.
Ecological Investigation Level			**600 mg/kg**	
Health Investigation Level for commercial/industrial sites			**1500 mg/kg**	

Table 6 – Total lead concentrations in rainwater puddle samples and isotopic ratio analysis results

The results below summarise the most probable sources of lead identified by ChemCentre in the rainwater puddle samples analysed, based on references available at the time of reporting.

ChemCentre ID	DEC ID	Date	Lead	
Method code			**iMET1WTICP**	
LOR			**0.02**	
Units			**mg/L**	**Comments**
10E1358/017	WS-1 2136	5/1/2011	0.14	All water samples (WS-1 to WS-5 and in particular WS-3 and WS-4) show indications of a possible shift in ratio verses assumed reference samples BGW1 and BGW2 towards the Magellan type ratio. However this possible shift would require confirmation by further analysis particularly for 204 ratio to confirm the direction of a possible array between Magellan and the two reference water/sludges. Present analysis suggest such an array of results.
10E1358/018	WS-2 2137	5/1/2011	0.03	
10E1358/019	WS-3 2138	5/1/2011	0.42	
10E1358/020	WS-4 7276	5/1/2011	0.66	
10E1358/026	WS-5 7277	5/1/2011	0.26	
10E1372/001	BGW1 2091	7/1/2011	0.11	Background - Reference water/sludge sample approaching average earth crustal.
10E1358/028	BGW2 2093	7/1/2011	0.08	Background - Reference water/sludge sample approaching average earth crustal.
There are no relevant assessment levels for total lead in rainwater puddles on hardstand surfaces			*****	

Table 7a – QA results for swab samples

ChemCentre ID	DEC ID	Date	Area	Lead	Lead	
Method code			**iMET1FCICP**	**iMET1FCICP**	**iMET1SBICP**	
LOR			**1**	**0.5**	**0.005**	
Units			**cm^2**	**µg/swab**	**$µg/cm^2$**	**Comments**
10E1350/033	QC1 7252	4/1/2011	100	<0.5	<0.005	TRANSPORT BLANK AND SWAB BLANK
10E1358/032	QC2 2451	5/1/2011	100	<0.5	<0.005	TRANSPORT BLANK AND SWAB BLANK
10E1372/007	QC3 2098	7/1/2011	100	<0.5	<0.005	TRANSPORT BLANK AND SWAB BLANK
10E1358/013	S33 2436	5/1/2011	100	<0.5	<0.005	FIELD BLANK
10E1372/006	S34 2097	4/1/2011	100	<0.5	<0.005	FIELD BLANK

Table 7b – QA results for water samples

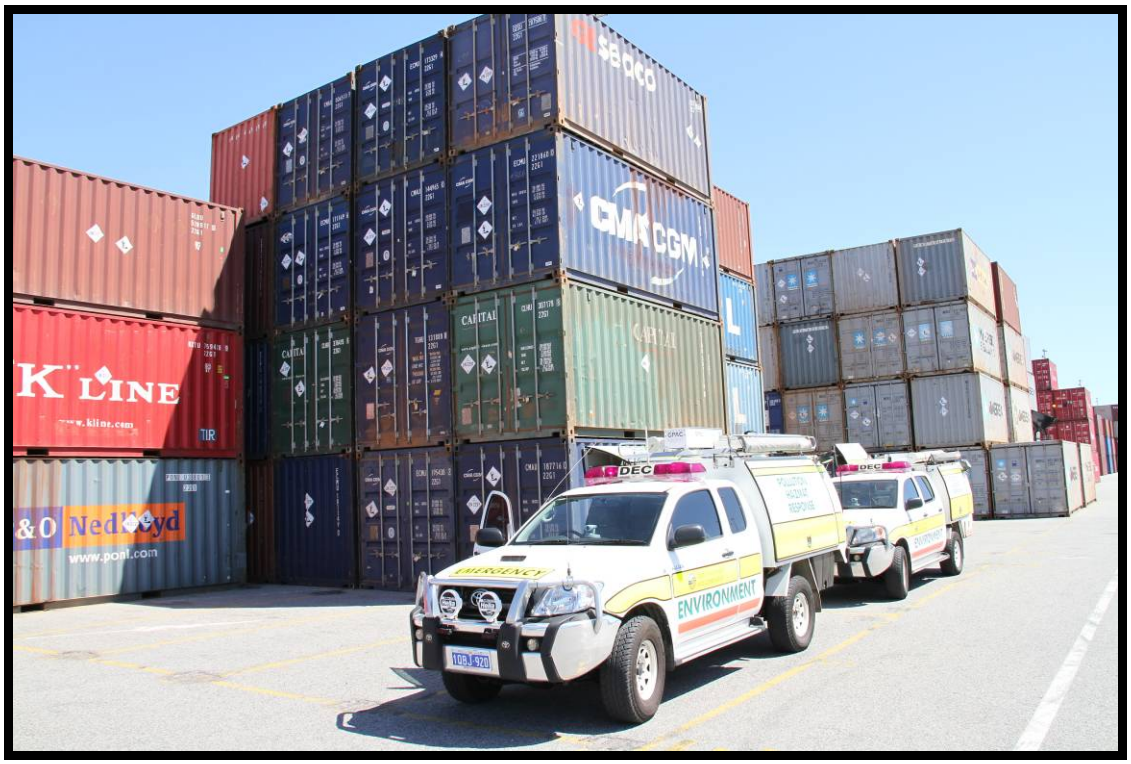
ChemCentre ID	DEC ID	Date	Lead	
Method code			**iMET1WTICP**	
LOR			**0.02**	
Units			**mg/L**	**Comments**
10E1358/016	WS FB-1		<0.02	

	7267	5/1/2011		TRANSPORT, FIELD AND CONTAINER BLANK

Table 7c – QA results for soil samples

ChemCentre ID	DEC ID	Date	Lead	
Method code			**iMET2SAICP**	
LOR			**0.5**	
Units			**mg/kg**	**Comments**
10E1358/022	DS-1 7270	5/1/2011	27	DS1 is a duplicate sample of SS-1
10E1358/023	SS-1 7269	5/1/2011	29	
			7%	Relative percentage difference

PHOTOGRAPHS

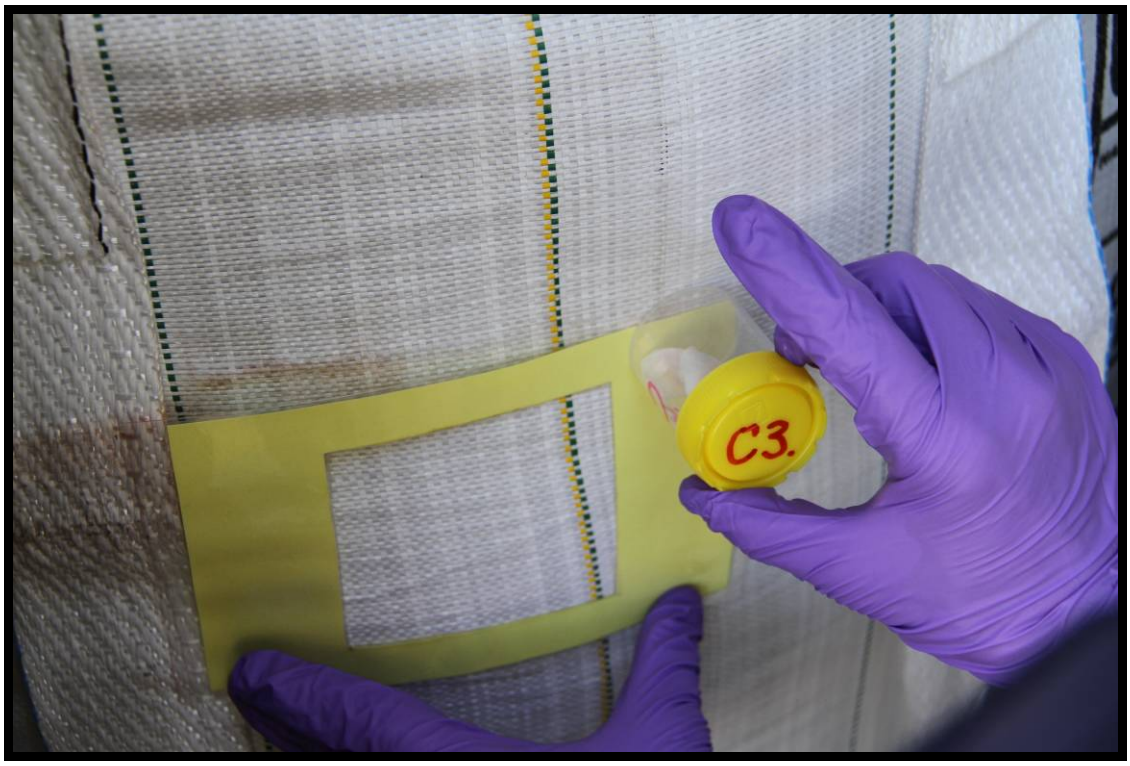


Photograph 1: Stored Magellan shipping (sea) containers

Photograph 2: A DEC inspector collecting a swab sample

Photograph 3: A dangerous goods placard sticker on a Magellan shipping (sea) container

Photograph 4: Swab sample V2 collected from a plastic vent



Photograph 5: Swab sample C3 as collected from the outermost bag which was inside the Magellan shipping (sea) container

Photograph 6: A small dust deposit on the outside of the Magellan shipping (sea) container, swab sample C5 was collected from this location.

Photograph 7: A soil sample collected along the boundary of the container storage facility.

Photograph 8: A water sample collected after rainfall occurred at the container storage facility.