

June 2009

Remobilisation of Lead and Nickel Residues in Esperance

Report of the Working Group to the Steering Committee of the Esperance Cleanup and Recovery Project



Remobilisation of Lead and Nickel in Esperance

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Abbreviations

ADWG	Australian Drinking Water Guidelines
BOM	Bureau of Meteorology
DEC	Department of Environment and Conservation
DOH	Department of Health
EsPA	Esperance Port Authority
HiVol	High Volume Air Sampler
LED	Locals for Esperance Development
LOD	limit of detection (based on technical limitations)
LOR	limit of reporting (includes confidence assessment)
TEOM	Tapered Element Oscillating Microbalance
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mg/m ³	milligrams per cubic metre
µg/cm ²	micrograms per square centimetre
µg/m ³	micrograms per cubic metre
Pb (lead)	in general the form of lead referred to in connection with dust and potential contamination within the townsite is lead carbonate, PbCO ₃ , from the Magellan minesite.
Ni (nickel)	in general, the form of nickel referred to in connection with dust and potential contamination within the townsite is nickel sulphide, NiS.

Remobilization of Lead and Nickel in Esperance

Summary

If lead and nickel contamination in the Esperance townsite is to be effectively cleaned up it is important to ensure that cleaned areas do not become recontaminated by remobilization of contaminants from adjacent areas.

This study reviewed these sources of relevant monitoring and survey data with the following results:

- Air monitoring data has failed to detect any significant lead in the community for more than 12 months, suggesting that there is no significant remobilisation by air of lead dust, either from the port or from within the community. The proposed cleanup can progress with confidence that cleaned areas will not be significantly recontaminated from airborne lead dust.
- The same monitoring registered some levels of nickel below detection, but also found some ongoing ambient levels of nickel in the community, below the target level, but still above background level, particularly near the port. Some of this could be low level remobilisation, more research is needed. It also underlines the need for the handling of nickel at the port to adhere to best practice protocols.
- Rainwater tank sampling showed some recontamination after cleaning and some variations in lead unrelated to airborne lead or rainfall. Thorough cleaning of tanks and catchment roofs of target houses is required.
- Sampling of surfaces around homes showed the importance of thorough cleaning protocols so no surfaces or potential stores of contaminants are overlooked.
- Sampling of flowers and deciduous leaves confirms the finding that there is no significant lead dust in the air, though there are traces of lead on flowers near the port, possibly from dust accumulated on adjacent old leaves.
- Sampling of bird feathers found levels had dropped to almost undetectable levels.

The results suggest that the proposed cleanup, focused on houses identified by further sampling in the community, can proceed with no likelihood of significant recontamination by air-borne lead. If the cleanup is thorough it will remove dust accumulations in and around the houses (including ceiling voids, roofs and rainwater tanks) that might be sources of local recontamination.

Further study of nickel dust levels in relation to wind direction and port activities would give a clearer picture on nickel remobilisation in the community, though with best practice handling levels are likely to be low enough to avoid significant recontamination. Ongoing dust monitoring is also needed.

Further study is also warranted into the fate of lead in the Esperance environment and the question of possible bio-accumulation.

The proposed cleanup must be followed by verification sampling and periodic ongoing monitoring to confirm no recontamination.



1. Introduction

The town of Esperance was contaminated with lead carbonate during handling and loading of lead carbonate concentrate during the period April 2005 to March 2007. There is also nickel contamination as a result of a long history of the export of nickel through the port.

The cleanup of the contamination, in accordance with the Government's commitment, will be ineffective if lead or nickel is recirculating within the Esperance environment and potentially recontaminating cleaned areas. The purpose of this study is to review all the available data to determine whether they provide evidence of the occurrence or absence of remobilization of lead or nickel dust.

The Steering Committee established to oversee the Esperance Cleanup and Recovery Project (ECRP) formed a Working Group to investigate the question of remobilization of lead and nickel in the Esperance townsite, principally by reviewing the available survey and monitoring data.

Working group members were:

- Wayne Winchester, Project Director, ECRP;
- Michelle Crisp, Locals for Esperance Development;
- Paul Clifton, Manager, Health and Environment, Shire of Esperance;
- Anthony Stuart, Manager Science and Investigations, Air Quality Branch, Department of Environment and Conservation; and
- Jim Malcolm, Environmental Consultant.

The first three are members of the Steering Committee.

The Working Group met two times, on 26 May 2009 to initiate the project and agree an approach and on 16 June 2009 to consider a draft report. The final report was circulated for approval and minor amendment prior to submission to the Steering Committee.

2. Review of the available data

2.1 The available data

The Project Scope (Appendix 1) listed a number of ongoing and completed studies that may be of relevance to the review. Each of the data sets is reviewed below, with conclusions on their implications for the question of remobilization.

The data are from a range of sources. Some are monitoring data collected in compliance with requirements of the EsPA's environmental operating licence under the *Environmental Protection Act 1986*. Some are special surveys of affected premises or parts of the environment, either by government agencies or community environmental groups. The data have been collected for a range of purposes and have



not, in the main, been targeted at the question of remobilization of lead or nickel. Nevertheless, they provide useful information.

In a number of instances the readings now being reported are at or close to the limits of detection (LOD) or level of reporting (LOR) for the various forms of sampling and analysis used. It should be noted that as readings approach the LOD, the recorded figures have a much higher error margin, possibly as high as $\pm 100\%$. Readings approaching the limit of reporting should, therefore, be interpreted with caution. LOR is set to take some of this uncertainty into account, reporting only those measurements for which the analyst has a specified degree of confidence.

2.2 EsPA depositional gauge monitoring program

Since late 1995, in accordance with a requirement of its DEC licence, the Esperance Port Authority (EsPA) has been collecting data from a series of depositional gauges set up within the port boundary and in the surrounding community. These gauges passively collect ambient dust 24 hours a day, seven days a week on filter papers which are changed after about thirty days and analysed. Until mid 2007 this occurred one month in three, but since then the sampling and analysis has been done monthly.

There are no applicable standards for dust deposition, but the data are useful for comparisons through time. With their consistent availability these gauges would be expected to record any significant dust events during the month. They are non-directional and would be expected to collect ambient dust either from the port or the community, dependent upon the presence of dust and the wind direction. They should, therefore, record any dust remobilized in their immediate vicinity.

There is a vast amount of historical data available, but the focus of the study is “to determine if lead and/or nickel residues in the Esperance townsite are being mobilized”, so the most recent data are of the greatest relevance. Figure 1¹ shows the location of the depositional gauges (DG1 to DG13).

Those gauges within the townsite and closest to the port (e.g. DG4) are likely to be of most relevance for the study, though all community-based monitoring (e.g. DG8) is of interest. While data for all sites were studied and are presented in Appendix 2, Figures 2 and 3² show the data for DG4 and DG 8 respectively as indicative examples. SKM has observed³ that dust from the port would have the greatest potential to impact DG4 “during south-easterly and easterly winds” and DG8 “during easterly winds, and possibly north-easterly and south-easterly winds”. These winds are most common in summer.

¹ Provided by DEC.

² Both Figures 2 and 3 were provided by DEC. They have been updated for the most recent data.

³ SKM, *Historic Air Quality Monitoring Data Review and Proposed Air Quality Monitoring Plan*, December 2007, Appendix E – Dust Deposition Data Analysis.



Figure 1. Location of Depositional Gauges and Hivol Sampling Sites



Figure 2. Lead Deposition on Gauge DG4 at Esperance

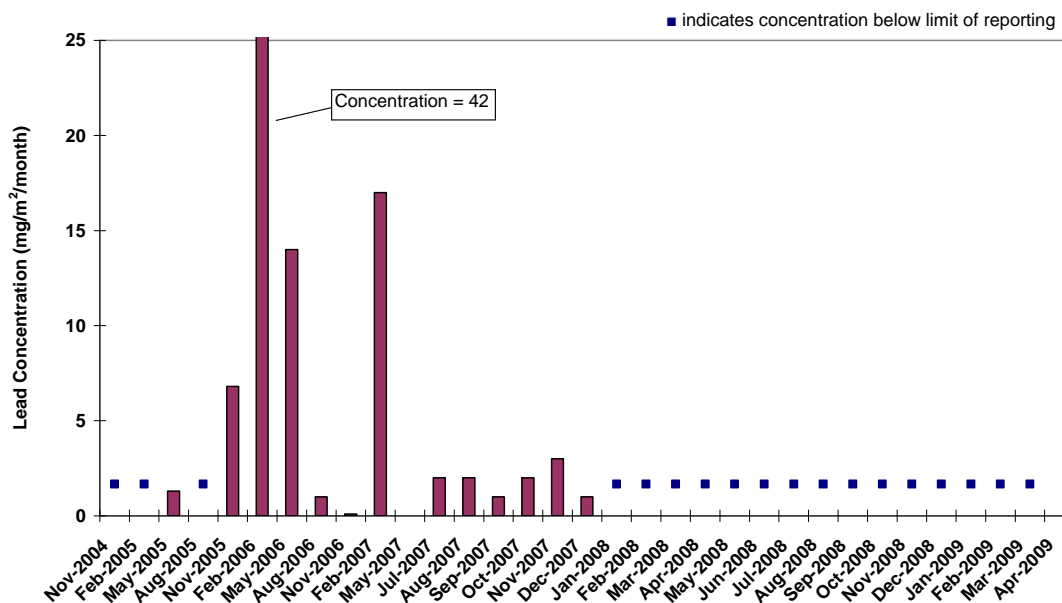
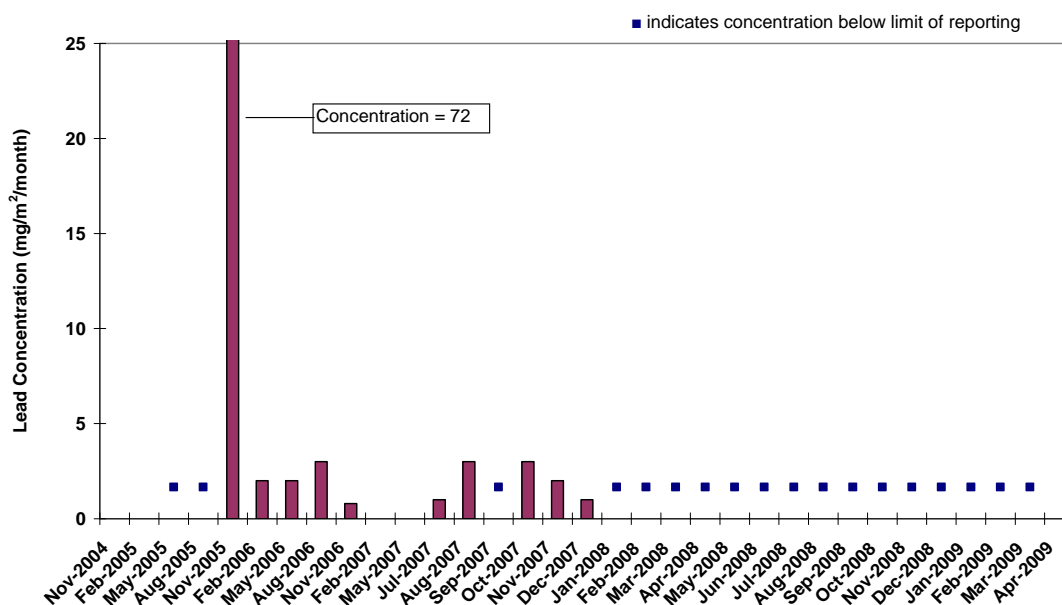


Figure 3. Lead Deposition on Gauge DG8 at Esperance



2.2.1 Lead in Depositional Gauges

The depositional gauges were in place some months before lead export commenced and at that time both DG4 and DG8 showed concentrations below the level of detection, indicating a low background level of atmospheric lead in the town. During the period when lead was being exported some quite high levels of lead were recorded.

The export of lead concentrate ceased in March 2007 and no further high levels of lead were recorded at either site. Both sites recorded a low peak during October to December 2007, when EsPA was undertaking cleaning activities that appear to have remobilized some lead dust. While the levels recorded were lower than historic levels



(less than 3mg/m³) they indicate the sensitivity of the equipment to events leading to the possible mobilization of residues.

Since January 2008, a period of sixteen months, no lead dust has been detected at either site. This suggests that, during that time, regardless of seasonal effects like the wind direction or the presence of moisture, lead dust has not been remobilized in the ambient air in the townsite. Appendix 2 shows that the other sites tell a similar story.

**Figure 4. Nickel Deposits on Gauge DG1 at Esperance
 (neighbourhood gauge close to the Port)**

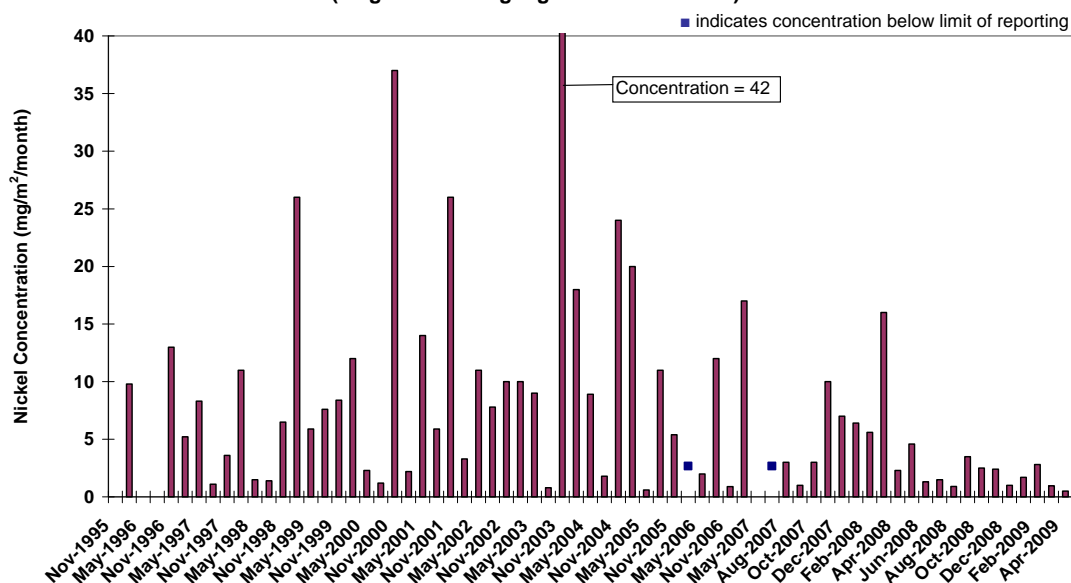
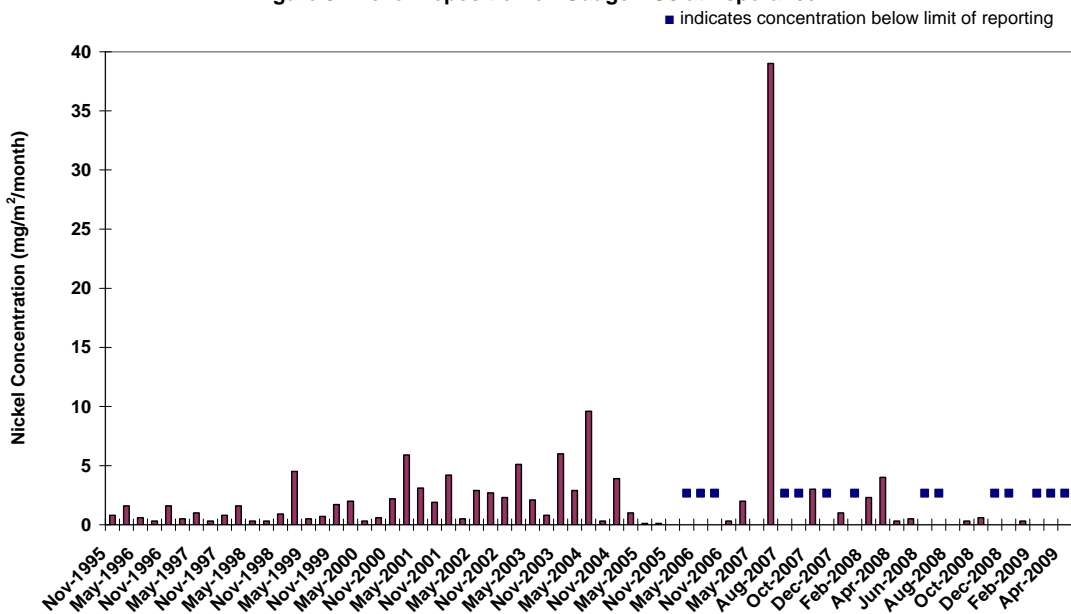


Figure 5. Nickel Deposition on Gauge DG5 at Esperance



2.2.2 Nickel in Depositional Gauges

Figure 4⁴ shows the levels of nickel found in dust at DG1, located within the townsite but close to the port and its ongoing nickel export activities. Of greatest relevance to

⁴ Provided by DEC.



the present study is the ongoing recording of nickel dust, albeit at a reduced level since mid-2005. While this indicates an ongoing ambient level of nickel dust, it is impossible to say from these data whether this is due to remobilization of existing residues or whether it is new dust arising from the ongoing nickel export.

Figure 5⁵ shows the results for DG5, located about 2km WNW from the port. Here the levels of nickel are much lower, especially in the last year, with no nickel detected in some months. This is suggestive of both improved handling practices at the port and an absence of remobilized nickel in the community this far from the port.

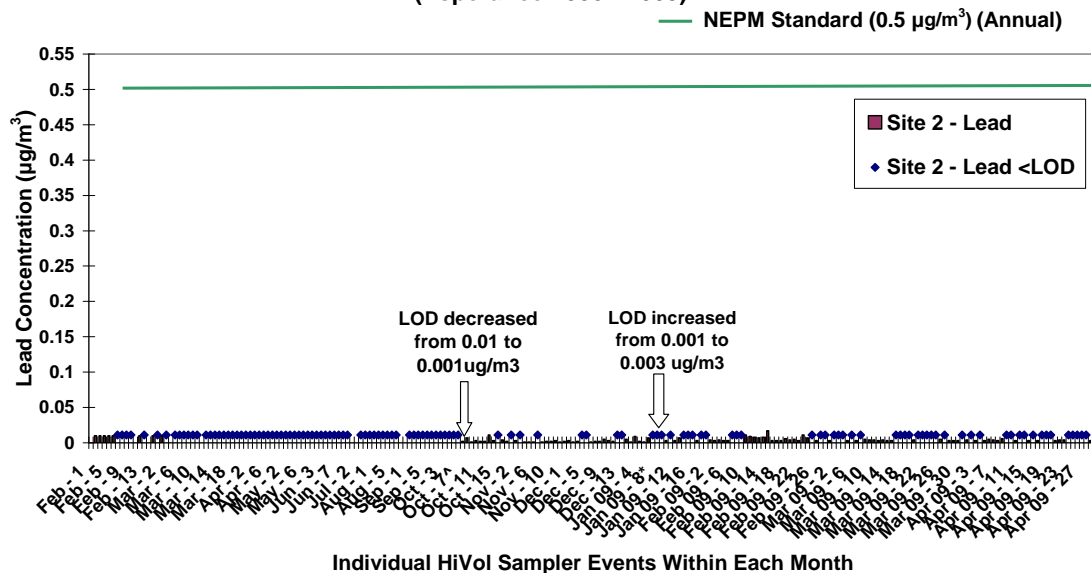
2.3 EsPA Hivol monitoring program

Since early 2008, in accordance with a requirement of its DEC licence, EsPA has operated a small network of high volume (Hivol) air sampling devices located within the port boundary and in the adjacent community.

Hivol samplers are operated for 24 hour periods with air drawn through a filter paper at a measured rate so that a known volume of air has been sampled. The filter paper can be analysed for dust, metals and sulphur. The national ambient air quality standard for lead (designed to be protective of human health) is $0.5\mu\text{g}/\text{m}^3$ for an annual averaging period, with no exceedances allowed.⁶

Figure 1 shows the location of four of the samplers (Site 1 to Site 4). Sites 1 and 2 are within the port boundary, Sites 3 and 4 in the community. A temporary site, Site 5, within the community adjacent to the port sheds, was installed in association with the removal of the lead concentrate stockpiled in the shed. A further three sites within the community are planned.

Figure 6. Lead Levels at Site 2 High Volume Air Sampler
 (Esperance 2008 - 2009)



⁵ Provided by DEC.

⁶ <http://www.esperanceport.com.au/envmon.asp>

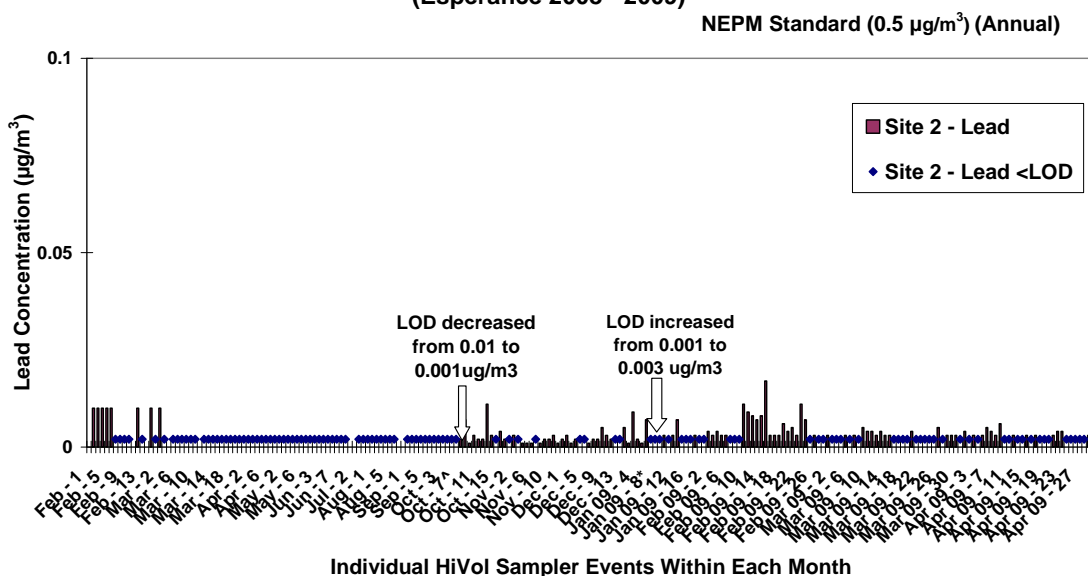


2.3.1 Lead in High Volume Air Samplers

Figure 6⁷ shows the lead levels recorded at Site 2, in the community but adjacent to the port. Over the 15 months from February 2008 to April 2009 inclusive virtually no lead was detected in the sampler. Of the ~200 readings taken in that period three quarters found no lead (i.e. if lead was present in the sampled air it was below the analytical laboratory's level of detection⁸) and the rest found only traces of lead. These findings are supportive of the conclusion that during that period lead dust has not been remobilized in the ambient air in the townsite.

The low levels of readings recorded are somewhat hard to read because they are so much lower than the standard of $0.5\mu\text{g}/\text{m}^3$. In Figure 6a the lower portion of the chart has been expanded to make these small readings more visible. However, the comment in 2.1, above, recommending caution in the interpretation of readings close to the limit of detection applies.

**Figure 6a. Lead Levels at Site 2 High Volume Air Sampler
 (Esperance 2008 - 2009)**

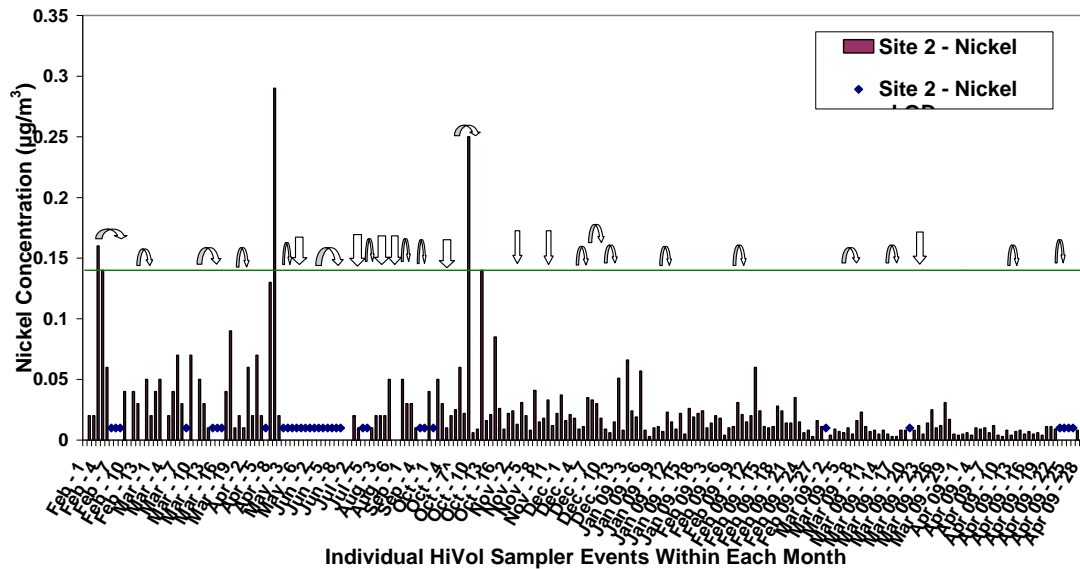


⁷ Provided by DEC.

⁸ Before October 2008 the level of detection was $0.01\mu\text{g}/\text{m}^3$, one fiftieth of the national standard. Since then it has been lower.



Figure 7. Nickel Levels at Site 2 High Volume Air Sampler (Esperance 2008 - 2009)



2.3.2 Nickel in High Volume Air Samplers

Figure 7⁹, which also relates the community site, Site 2, shows nickel levels recorded over the same period (February 2008 to April 2009). The chart also shows the periods during which ships were being loaded and the daily target nickel level of $0.14 \mu\text{g}/\text{m}^3$ set in EsPA's environmental licence to be protective of acute health effects. Again some samples recorded nickel below the level of detection, including during some loading events. On three occasions the target level was exceeded, on eight occasions peaks of between 0.05 and $0.1 \mu\text{g}/\text{m}^3$ were recorded during ship loading and lower quantities of nickel were detected at times when no loading occurred, for example, in the second half of February 2009.

This suggests that while some of the ambient nickel detected may be associated with ongoing export activities, some may be from receipts of nickel or remobilization of existing nickel residues in the townsite. It is not possible from these data to clearly determine the source of nickel. A more detailed study of wind directions during times when sampling detected nickel may assist in determining whether the source of the nickel was more likely to be port activities or recirculation within the townsite. BOM does not currently report wind data in an appropriate form for such a study.

2.4 EsPA TEOM monitoring program

EsPA has a third form of ongoing air monitoring under its DEC licence, the TEOM (Tapered Element Oscillating Microbalance) monitor. TEOM is a real time measurement of PM₁₀ (fine dust fraction) measured using a micro balance. However, TEOM monitoring does not include analysis of the lead or nickel content in the dust sample so it does not provide data sufficiently specific to address the possible remobilization of lead or nickel.

⁹ Provided by DEC.



2.5 EsPA monitoring of paired rainwater tanks.

Since January 2008 EsPA, under a licence requirement from DEC, has been monitoring five rainwater tanks paired with Deposition Gauges 3, 5, 8, 11 and 12. None of these tanks has been cleaned out (to avoid changing the status for continuity of data), but from 31 March 2009 DEC has asked EsPA to provide five clean tanks for comparison, at other locations and similarly paired with Depositional Gauges.

There are many confounding factors that make the interpretation of data from rainwater tanks problematic¹⁰.

- (a). Lead present in rainwater tanks may be from the air or from other lead sources like flashing or solder on the roofs or zinc gutters;
- (b). The roofing material may be rough (tending to hold lead dust on the roof) or smooth (with lead dust more easily shed);
- (c). The size of the tank relative to the size of the roof catchment may be small or large, leading to a different concentration of lead in the tank;
- (d). The tank may be constructed of concrete, galvanized iron, colourbond or plastic;
- (e). The gutters may have been washed or not, and if washed the washings may or may not have been diverted from the tank;
- (f). The tank may or may not have been cleaned;
- (g). The tank may or may not be fitted with a first flush device;
- (h). The rate of use of rainwater from the tank may be high or low; and
- (i). The effect of a rainfall event may be that the concentration of lead and nickel increases (due to the flushing in of new material) or decreases (due to dilution).¹¹

Comparative data have now been collected for over twelve months. During that time none of the paired Depositional Gauges has detected any lead¹². Nevertheless, there has been significant variability in the lead levels in rainwater tanks. This contrasts with samples from Albany tanks which were all below ADWG. It suggests that the reason for the detected lead levels in rainwater tanks is not because of remobilized lead dust in the air (since none has been detected) but rather one or more of the other confounding factors listed above. They include the possible remobilization of lead dust held on roofs and in gutters.

SKM in its monthly Ambient Air Quality Monitoring Reports for EsPA has referred to the work of Huston et. al. (2009)¹³ in quantifying the impact of dry and wet atmospheric deposition on rainwater tank contaminant concentrations in the greater Brisbane area. SKM quotes Huston et. al. as concluding:

¹⁰ Several of these confounding factors were listed by SKM in its monthly dust monitoring reports for EsPA. They also apply to the rainwater tank sampling conducted by the Shire and DOH.

¹¹ For example, in March 2008, with the break of the season, lead levels in two of the five monitoring sites went down, two went up significantly and the other increased slightly.

¹² Nor have the more sensitive community Hivol samplers closer to the port

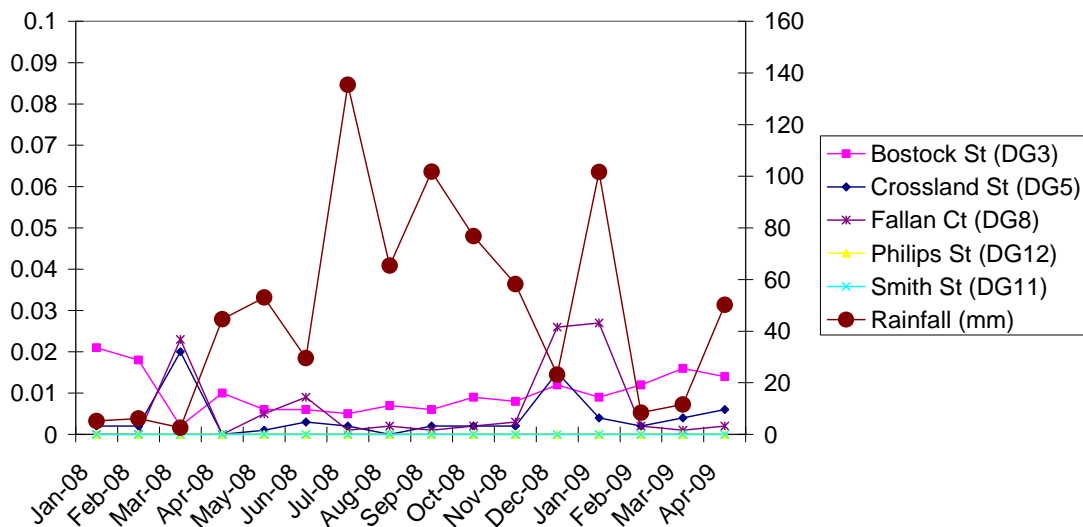
¹³ Huston, R., YC Chan, T Gardner, G Shaw & H Chapman, 2009, *Characterisation of atmospheric deposition as a source of contaminants in urban rainwater tanks*, *Water Research*, article in press, cited in *SKM, 2009, Ambient Air Quality Monitoring Report*, April 2009, Esperance Port Authority, 8 June 2009, (but not sighted by this study).



- “roof runoff contains elevated heavy metals such as lead, with the roof often acting as a source of the metals;
- the implication of the study’s results are that there are major sources of lead to the tank other than atmospheric deposition (e.g. roof tile lead flashing, old paint, lead-stabilised PVC drain pipes etc.); and
- atmospheric deposition does contribute to contaminants in rainwater in urban environments; however, the quality of water collected in a tank may not reflect that of the rainwater.”¹⁴

Figure 8 presents DEC’s graphical comparison of the monthly measured levels of lead in rainwater tanks with the monthly rainfall data for Esperance. Three of the five sites recorded some readings in excess of ADWG (in contrast to three tanks in Albany which were all below ADWG). There appears to be no clear correlation between a high monthly rainfall and an increased level of lead. As noted in (i) above, it may be that the flushing of new lead dust from roofs is counterbalanced by dilution with the additional rainwater. The data presently collected cannot resolve the question and it is doubtful, given the many confounding factors, if extended rainwater sampling would provide a clear answer.

Figure 8. Rainfall vs. Lead Concentration in Rainwater Samples Near Esperance Port 2008
 (guidelines set at 0.01mg/L for drinking water)



2.6 DEC annual [March] monitoring of vegetation.

In March 2008 and again in March 2009 DEC conducted a leaf and flower sampling program within the Esperance townsite.

The report of the first survey¹⁵ listed the objectives as

1. To determine levels of lead and nickel on plant material around Esperance Port and the surrounding township.

¹⁴ Op. cit. p39.

¹⁵ Department of Environment and Conservation, 2008, *Plant Leaf and Flower Sampling Report, Esperance*, September 2008.



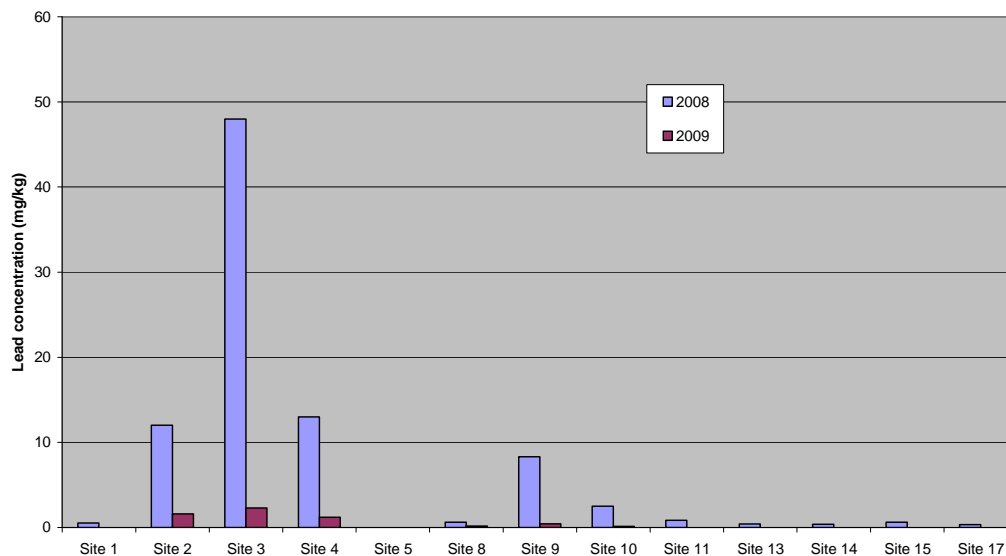
2. To determine if there is a spatial relationship between lead and nickel concentrations on plant material around Esperance, specifically in relation to distance from Esperance Port.
3. To determine if changes in lead and nickel concentrations correspond to the age of plant material (old leaf growth, flowers and new leaf growth).

The third objective potentially addresses the issue of remobilization. In respect of this objective the study report stated

“Twelve plant individuals had highest lead levels in old leaf growth, with lower levels detected in flowers and new leaf growth. Three of the plant individuals indicated that either new leaf growth or flowers had higher lead levels than old leaf samples. This indicates that lead is still present in the Esperance environment and continues to be deposited onto new growth leaves and flowers. The rate of deposition seems to be decreasing, however, as a result of the discontinuation of lead carbonate movement through Esperance Port”.

The 2009 re-sampling provides evidence of whether lead is still being “deposited onto new growth leaves and flowers”. Figure 9¹⁶ presents a comparison of the data from the two surveys for flower samples. These plant samples, being the shortest-lived, should reveal any current remobilization of lead dust.

Figure 9. Lead Concentration Changes in Flowers from plants at sites across Esperance in 2008 and 2009



Sites 2, 3, 4 and 9, where the highest readings were recorded in 2008, are the monitoring sites closest to the port. It may be that the lead detected was deposited on those flowers during the October to December 2007 cleanup of the port. Figure 9 shows the 2009 lead levels to be substantially lower than in 2008, with levels below detection at several sites. This suggests there was little or no remobilization of lead dust onto flowers of the sampled plants during the 2009 flowering period. This is supported by data for lead levels in leaves of deciduous trees which were very low and similar to the levels found in Albany (see Appendix 5).

¹⁶ The site numbers in this graph are a simplification of those used in the study. There is no data for some sites because no flowering plants were present at sampling.



Figure 10 looks more closely at the 2009 samples plotting lead levels against distance from the port. Although the levels found are low (<2.5 mg/kg), it is clear that some of the sites within a kilometer of the port are recording levels of lead significantly above background, as measured by the site 7 km from the port. Given the absence of airborne lead, it is likely that this lead has been transferred from older accumulations on adjacent leaves.

Figure 10. Lead in Flowers (2009) vs. Distance from Port

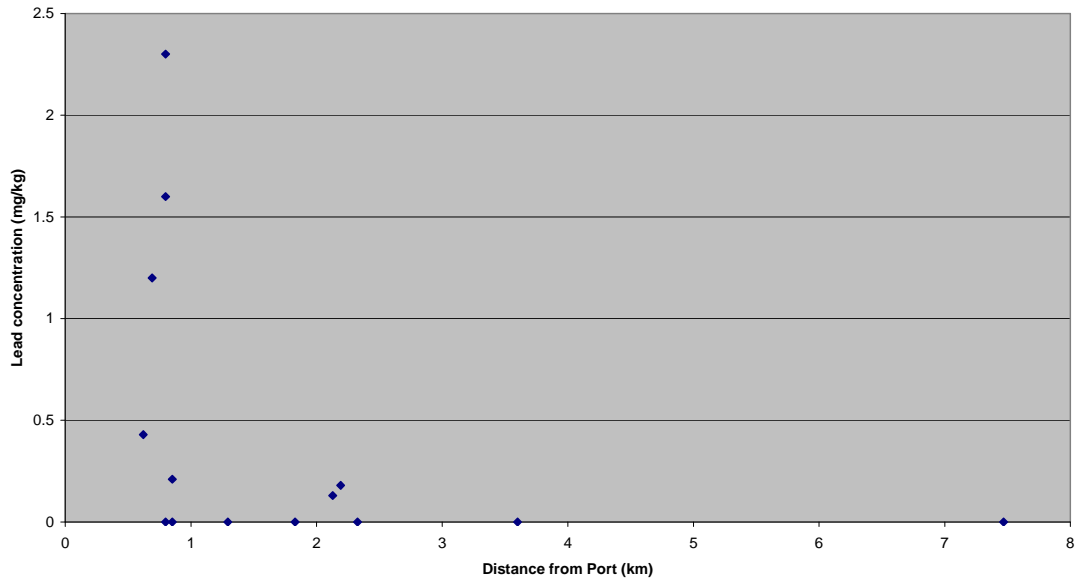
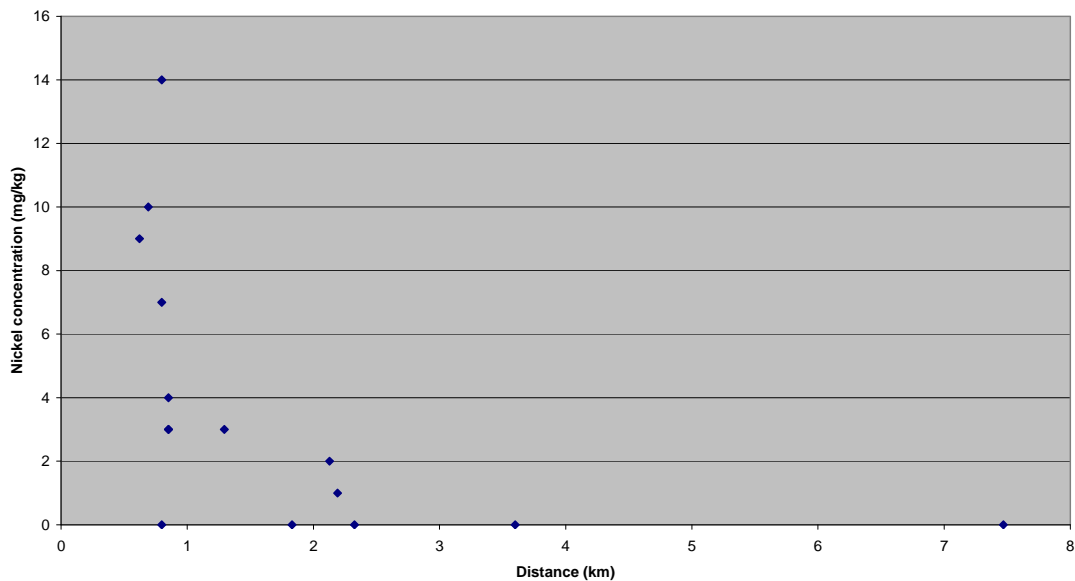


Figure 11 presents the data for nickel. The results are similar, with levels close to the port low (up to 14 mg/kg), but still elevated above background. Findings for deciduous leaves (Appendix 5) support this.

Figure 11. Nickel in Flowers (2009) vs. Distance from Port



2.7 DOH intensive monitoring of 21 Esperance homes.

Monitoring of lead blood levels of Esperance residents by DOH “identified a range of properties in Esperance where the residents had elevated blood lead levels”¹⁷. One of the actions taken in response was the cleaning of some houses by contractors employed by EsPA. DOH prepared a protocol for this cleaning (Appendix 3). This is the protocol used by the contract cleaners. The protocol lists an ongoing cleaning regime for residents of the cleaned houses. Whether this was followed is not known. Many other residents also undertook cleaning, possibly following methods similar to the protocol, but the standards achieved are not known.

DOH, in cooperation with the Shire of Esperance and the ChemCentre, has conducted monitoring of surfaces and materials in and around several residences in Esperance, including some of those cleaned, as follows:

- April 2007 - six residences sampled (internal surfaces) prior to cleaning;
- Between 1 July and 8 August 2007 – 18 residences (including five of the above) on four transects (selected related to prevailing wind patterns) radiating out from the port (see Figure 13) were sampled for a variety of internal and external surfaces as well as soils; and
- Between 23 and 25 February 2009 21 of the above properties were re-sampled for carpets, internal and external surfaces, soil, water and plants.

One purpose of the studies was to determine the efficacy of cleaning houses in reducing lead dust levels. The 2007 study concluded

“Overall the results suggest that cleaning did control lead dust contamination on internal surfaces. Externally, cleaning reduced the overall levels of dust contamination but recontamination with lead containing dust was occurring. These results show that properties near the Port of Esperance continue to be impacted by lead containing dust.”¹⁸

The study did not conclusively identify the source of the lead-containing dust. The export of lead ceased in March 2007, but cleanup operations at the port were not completed until December 2007, and lead dust was being recorded in some community-based Deposition Gauges in the period between cleaning and re-sampling.

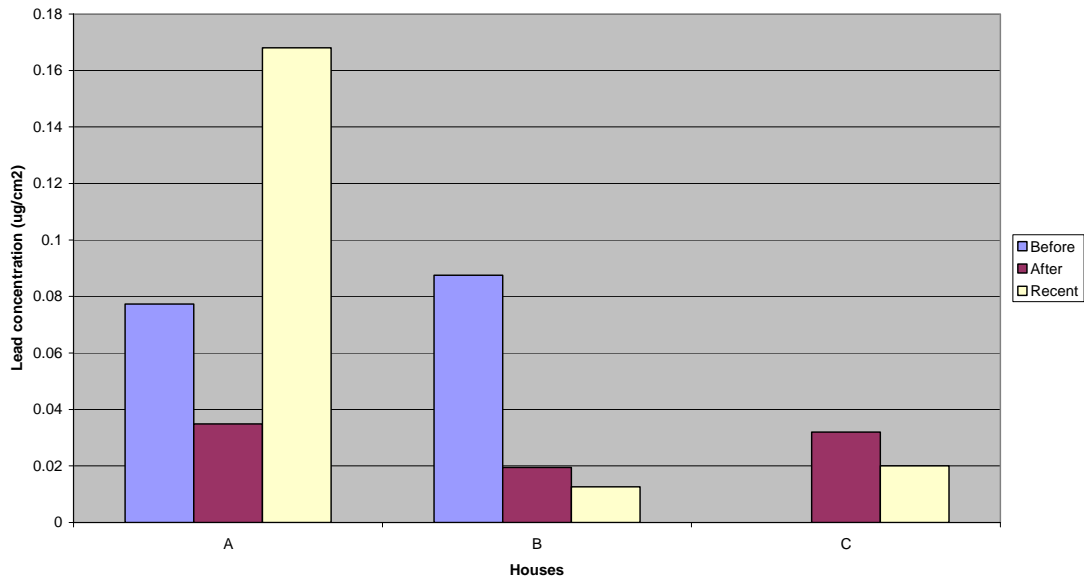
Figure 12 shows the average lead levels found in internal swabs taken in three houses that were cleaned. Two were sampled before cleaning, and all three were sampled after cleaning in 2007 and again in 2009.

¹⁷ Department of Health, 2007, *Report on Dust Swabbing and Soil Sampling Undertaken in Esperance on the weekend of 14 and 15 April 2007 by Toxicology Branch, Department of Health*, May 2007

¹⁸ Department of Health, 2007, *Report on Lead Dust Monitoring in residences undertaken in Esperance Between 1 July and 8 August 2007*, Department of Health, December 2007.



Figure 12. Internal Lead Levels in Cleaned Houses



The results for House B are as expected with a high level prior to cleaning, a much lower level after cleaning, though while the port cleanup was progressing, and an even lower level a year later. For House A, however, the 2009 reading is elevated. A look at the data shows that two of the ten swabs were very high (0.8 and $0.6 \mu\text{g}/\text{cm}^2$) but the other eight averaged $0.02 \mu\text{g}/\text{cm}^2$. It appears that the two elevated swabs are exceptional. All other swabs suggest that cleaning has been effective and there has been no general recontamination. These two swabs, in the Master Bedroom and Lounge appear to be specific examples of micro-remobilisation, perhaps from foot traffic.



Figure 13. Location of 18 houses on four transects sampled for lead dust in 2007 and 2009.



The purposes of the 2009 survey were:

- To gain a general indication of the current concentrations of lead and nickel in relation to the Esperance Port;
- To identify the likely locations of contamination within premises;
- To determine whether homes cleaned in 2007 have remained free of contamination; and
- To assist in the development of sampling protocols.¹⁹

A comprehensive report of the findings of the survey has not yet been published, but Table 1 presents a summary of the findings from data made available by DOH.

¹⁹ From a PowerPoint presentation on the Esperance Cleanup and Recovery Project by Michael Jackson.



Table 1. Summary of findings of 2009 DOH survey of 21 residences

Sample	Low	Medium	High	Total	Albany	DOH proposed cleanup goals ²⁰
Soil mg/kg	1.1-10	10.1-60	60.1-190		0.5-220	300 mg/kg (no sample above goal)
No of samples	36	17	5	58		
Percent	52%	29%	9%	100%		
Internal dust µg/cm²	<0.04	0.04-0.24	0.25-1		LOD-0.052	0.04 µg/cm ² for surfaces readily accessible by young children 0.4 µg/cm ² for others
Carpet dust No of samples	56	6	2	64		
Percent	88%	9%	3%	100%		
Internal swabs No of samples	119	16	4	139		
Percent	86%	11%	3%	100%		
External swabs µg/cm²	<0.04	0.04-0.39	0.4-1		LOD-0.39	0.04 µg/cm ² for young children 0.4 µg/cm ² for others
No of samples	47	23	5	75		
Percent	63%	31%	6%	100%		
Roof space dust µg/cm²	<0.04	0.04-0.39	0.4-7		LOD-8.2	No Aust. or world standard 0.4 µg/cm ² proposed.
No of samples	18	7	18	43		
Percent	42%	16%	42%	100%		

Analysis of soil samples taken revealed low levels of lead, well below the proposed cleanup standard of 300 mg/kg. The Principal Toxicologist has commented on the data:

“Most of the results we see are below 10 (mg/kg), there have been some between 10 and 50, the odd one a little bit higher. You’ll see that sort of variation if you did sampling around any suburb in Perth or other towns, and in

²⁰ DOH has recommended the following cleanup standards:

- Rainwater tanks: 0.01 mg/L for Lead; and 0.02 mg/L for Nickel.
- Soils: 300mg/kg for Lead; and 600 mg/kg for Nickel
- Internal surfaces readily accessed by young children: 0.04µg/cm² for lead. This includes floors, window ledges and other internal surfaces. It also includes external surfaces such as ‘cubby houses’ and play equipment used by young children.
- Surfaces readily accessed by adults: 0.4µg/cm² for lead.

DOH advised that there are no national or international standards or guidance for roof spaces, but the Standing Committee is developing appropriate standards



fact in Albany, out of six houses done, they ranged from fairly low up to 240. So that (the Esperance soil lead data) was a fairly typical distribution.”²¹

Internal dust samples were of two sorts, carpet dust and swabs of other internal surfaces; the same standard applies to both. While over 80% of samples met the standard for young children some significant exceedances remained. The location of these exceedances was briefly noted; for example:

- Carpet near window (in a house close to the port);
- Top window cupboard;
- Pantry cupboard top;
- Top display cabinet, lounge; and
- Top rangehood.

Some, but not all, of these surfaces were out of the reach of children. It is not clear from the data whether these surfaces have been re-contaminated or simply overlooked in cleaning. In general, cleaning appears to have been effective, but the data do not, in their present form enable a clear determination of whether or not there has been recontamination of cleaned areas by remobilized lead dust. Matisons (DOH) considers the exceedances were related to surfaces overlooked in cleaning and advises “We don’t believe there is a recirculation problem”²².

The data for external swabs suggest that the cleaning of external surfaces has been less effective than for internal surfaces. Whether this is due to remobilization of lead dust is not known. However, the five instances where the standard for surfaces readily accessible by adults was exceeded were accompanied by the following observations:

- Top meter box on front porch;
- Brick window sill;
- Spare room window sill;
- Window sill – punt (port?) side; and
- Rainwater tank top.

It is not clear if these surfaces would be easily accessible to children, and again, they may have been overlooked in cleaning. If the proposed cleanup is to be effective it cannot be assumed that those householders who have undertaken cleaning of their homes will have cleaned all accessible surfaces.

The roof space dust samples show that roof voids remain a potential source of lead dust that could be remobilized, contaminating an otherwise clean residence. DOH has suggested that

“This can be done by minimizing any point of entry between roof space and the interior of the house and by cleaning up any dust that may arise from the roof cavity.”²³

²¹ Martin Matisons, Principal Toxicologist, Department of Health, Meeting with Jim Malcolm, 8 June 2009.

²² Ibid. He later explained that this referred to “macro-recirculation” in the broader environment. He did not rule out “micro-recirculation” from, say, a ceiling void to other parts of the home.

²³ Department of Health, 2007, *Report on Lead Dust Monitoring in residences undertaken in Esperance Between 1 July and 8 August 2007*, Department of Health, December 2007.



The large difference between results of roof space samples and internal swabs is, Matisons believes, evidence of no significant remobilization from ceiling voids to internal surfaces.

2.8 DOH/University of WA Rain Water Tank Survey²⁴

Between April and June 2007 DOH and the Shire of Esperance sampled rainwater in 1539 rainwater tanks in the Esperance township. Testing showed that lead levels in rainwater exceeded the Australian Drinking Water Guidelines values in 285 (19%) of tanks. As a result of testing for other metals, it was discovered that nickel levels in 369 (24%) of rainwater tanks also exceeded the Australian Drinking Water Guidelines.

Subsequently, EsPA coordinated the cleaning of rainwater tanks and gutter systems for residences with high results in their tank rainwater sample or in an area deemed by the Department of Health as more likely to have been impacted. A total 423 tanks were cleaned by EsPA as a part of this program.

“Once the cleaning program was completed the Department of Health conducted a pilot survey to provide an indication on whether the cleaning program had been effective in reducing lead levels below the ADWG. Twelve tanks were selected for sampling in this initial pilot survey with eight of these samples selected on the basis that their original lead levels were the highest of the samples taken. The results of this pilot survey showed that four of the samples still exceeded the ADWG, albeit marginally. All four samples were located in close proximity to the Port, and had shown very high levels on the first sampling.”²⁵

In view of the findings of this pilot study a more extensive sampling program was implemented, covering 176 tanks, including some of those that had been cleaned. This sampling occurred during October 2007, at which time, as has been noted above, depositional gauges in the community noted a small peak in lead dust apparently associated with the EsPA cleanup activities. The study commented:

“These results indicate that the nickel levels have reduced to a greater extent than lead between March and October 2007. Cleaning of tanks appears to have had a greater influence on reducing the nickel concentrations rather than lead concentrations.”

The study concluded that tank-cleaning had led to a reduction in lead levels, but that a level of lead persisted, though this may be associated with the EsPA cleanup. The study did conclude that lead concentration following tank cleaning was related to distance from the port, suggesting that the port was the source of the additional lead²⁶. Further sampling would be required to demonstrate whether there has been a further decrease since the port cleaning activities were completed.

The study also addressed the possible sources of the persistent lead. It canvassed a wide range of variables associated with the construction, design, cleaning and maintenance of roof catchments, gutters and rainwater tanks. The study found “no significant differences in the distribution of lead concentration by tank and catchment characteristics”, though

²⁴ Heyworth, J. 2008, *Retesting of Lead and Nickel Levels in Rainwater Tanks at Esperance*, February, 2008, University of Western Australia, School of Population Health.

²⁵ Ibid. p1.

²⁶ It is also possible that the houses closer to the port are older, leading to different roof condition and paint histories.



given the reported deficiencies in the available data some of these characteristics are probably still significant in individual cases.

The study posed some possibilities of significance for the present investigation:

“The effect of the variable “distance from the Port” on follow- up lead levels could reflect one of three possibilities. It may be that :

1. The Port is a source of ongoing lead contamination. While lead carbonate is no longer handled the Esperance Port, the buildings, railway lines and the ground surrounding the areas where the lead carbonate was unloaded from kibbles and loaded onto ships may still be contaminated with lead. This lead could then be re-entrained into the air and contaminate tanks closer to the Port. The extent and success of any cleaning programs undertaken at the Port as a result of environmental notices issued by the Department of Environment and Conservation need further consideration;
2. The existing contamination in the surrounding environment is still circulating and being deposited into tank rainwater. It may be that trees and shrubs and possibly soil in the local environment are still contaminated with lead and this is being re-entrained by wind into the air and then deposited on roof catchments;
3. It is a combination of the above. “

The study did not present evidence to indicate which of the above options should be favoured. In hindsight, and given the present low levels of lead being recorded in depositional gauges in the community, it would appear likely that the source of recontamination noted was primarily from the port cleanup operations in late 2007.

The study also questioned the adequacy of the cleaning protocol used for cleaning tanks and parts of roof catchments.

“The cleaning protocol for rainwater required that the “bottom part of the roof” be cleaned. Cleaning of the roof catchment may not have adequately removed lead from this environment, with those closest to the Port having the higher levels of lead deposition in the past. With time this contamination has been washed into the rainwater tanks.”

It appears that there may have been different expectations for cleaning of the roof.

The DOH Information Sheet on cleaning tanks²⁷ refers to cleaning gutters but makes no mention of the cleaning of roofs.

The EsPA Tank Cleaning Procedure states:

“All gutters that feed the rainwater tank are to be cleaned. The bottom part of the roof must also be cleaned as this is where material can also deposit.”²⁸

By contrast, the ChemCentre prepared a procedure for cleaning roofs that states:

²⁷ Department of Health, undated, *INFORMATION TO RESIDENTS Cleaning / Decontamination of Rainwater Tanks*.

²⁸ Esperance Port Authority, 2007, *Rainwater Tank Cleaning Procedure*, 3 May 2007.



“..the primary objective is to eliminate the vector by which lead might be washed into rainwater tanks. Hence only that part of the roof which provides the catchment for the rainwater needs to be cleaned.”²⁹

Despite ChemCentre’s recommendation to clean the whole area of roof forming a catchment for the rainwater tank, the cleaning under the auspices of EsPA was restricted to the gutters and approximately 1 metre of the adjacent roof. This left the possibility of recontamination from other parts of the catchment beyond the 1 metre limit of cleaning. It would be advisable for future tank/roof cleaning protocols to adopt ChemCentre’s more complete approach.

2.9 LED survey of lead and nickel residues in Esperance homes,

On 11 June 2008 Locals for Esperance Development (LED) conducted a pilot study³⁰ sampling dust in ten houses within 1.5 km of the EsPA offices because of ongoing concerns fugitive lead dust persisting in private houses after the cessation of lead exports.

The sampling techniques used were comparable to those used in the DOH surveys and the sampling was independently overseen by a representative of the Shire of Esperance. The data are summarized in Table 2, in a form comparable with those from the 2009 DOH survey. The descriptions of the sampling locations and the groupings used in Table 2 are shown in Appendix 4.

The pilot study focused on houses closer to the port and showed levels of lead higher than those found in the DOH survey. The study assessed the surfaces swabbed according to their accessibility to children. It found that 60% of homes sampled had surfaces accessible to children (such as low window sills) with lead levels above the 0.04 $\mu\text{g}/\text{cm}^2$ standard adopted by DOH.

²⁹ McCafferty, P, undated, *Suggested Procedure to Remove Lead Contamination from Roofs*, ChemCentre

³⁰ Crisp, M L, and P M Norris, 2008, *Lead and Nickel in House Dust in Esperance*, July 2008



Table 2. Summary of lead findings of 2008 LED survey of 11 residences

Sample	Low	Medium	High	Total	DOH proposed cleanup goals
Internal dust µg/cm ²	<0.04	0.04-0.24	0.25-1		0.04 µg/cm ² for surfaces readily accessible by young children 0.4 µg/cm ² for others
Internal swabs No of samples	10	6	0	16	
Percent	62.5%	37.5%	0%	100%	
External swabs µg/cm ²	<0.04	0.04-0.39	0.4-12		0.04 µg/cm ² for young children 0.4 µg/cm ² for others
No of samples	4	6	5	15	
Percent	27%	40%	33%	100%	
Roof swabs µg/cm ²	<0.04	0.04-0.39	0.4-12		No Aust. or world standard 0.4 µg/cm ² proposed.
No of samples	1	6	0	7	
Percent	14%	86%	0%	100%	
Roof space dust µg/cm ²	<0.04	0.04-0.39	0.4-7		No Aust. or world standard 0.4 µg/cm ² proposed.
No of samples	2	2	2	6	
Percent	33%	33%	33%	100%	

The study conclusions included the following observation:

“Overall, external surfaces showed high levels of contamination whereas indoor surfaces showed the lowest levels of contamination for both lead and nickel, probably as a result of reduced exposure to dust and more thorough cleaning practices indoors.

Importantly, 80% of the houses sampled had at least one surface with dust that exceeded the WA DOH’s recommended level of lead in areas accessible to young children or adults. Fifteen months after the EsPA ceased handling lead at their facility, 80% of houses remain contaminated and thus continue to provide an ongoing source of lead exposure for children and adults.”

While the study did not directly address the issue of current remobilization of lead, it identified deposits of lead around houses that could be remobilized by, for example, incidental contact, cleaning, home improvement or demolition activities. The findings of the study should be used to inform the protocols for any proposed cleanup.

2.10 Risk Assessment Report by Golder Associates [April 2009]

In April 2009 Golder Associates reported to DEC on a risk assessment based on a detailed study of the available data related to lead dust in Esperance. This DEC report is to be made public but has not yet been cleared for release and was not available to



the Working Group for review³¹. The study was of data available approximately 12 months ago, so may be less relevant to the question of current remobilisation.

2.11 Conservation Council of WA bird feather studies.

Between 8 and 14 October 2007, “approximately six months after the last reported Pb dusting event”³² Nick Dunlop et. al. sampled 62 birds from seven species at four sites in and near Esperance. Two sites were selected to represent areas where impacts on bird populations had been noted (Dempster Head Water Reserve and Cemetery Reserve). The other two sites were reference sites, “selected because they lay well outside the known distribution of bird mortalities”. They were Bandy Grove, 5.25km east of the port, and Woody Island, 13.5km south east of the port.

A specific, consistently identifiable feather was taken from each bird and subjected to analysis. Feathers of birds from the impact sites had high to very high levels of lead – so high, the authors noted, that it could not come from ingestion of lead and incorporation into growing feathers, as the level would likely have proved fatal. Rather, they concluded, it must have been lead dust accumulated externally on the feathers, much like a feather duster. The levels of lead found on feathers from the reference sites were much lower.

A follow-up sampling and analysis took place a year later, but the results have not yet been written up. Nick Dunlop has provided some of the data which is presented in Figure 14. This compares the 2007 and 2008 results for a New Holland Honeyeater from the Woody Island reference site with results for New Holland Honeyeater, Silvereeye and Scrubwren from the impact sites.

As expected, the lead levels at the Woody Island reference site were very low, though not below detection, indicating a low background level of lead in the environment. Interestingly, the reference site level was lower in 2008, after lead exports had ceased, suggesting either ambient dust at the reference site or a wider than expected range of movement for the birds sampled.

Figure 14 shows the lead levels for birds at the impact sites were much higher than for the reference site in 2007, particularly for the Scrubwren. Dunlop et. al. suggest that this may be due to this species’ habit of foraging in dense undergrowth, perhaps contacting dust-laden foliage. By 2008 lead levels in feathers at impact sites had dropped to such an extent that sample weights had to be increased for readings to exceed detection limits.

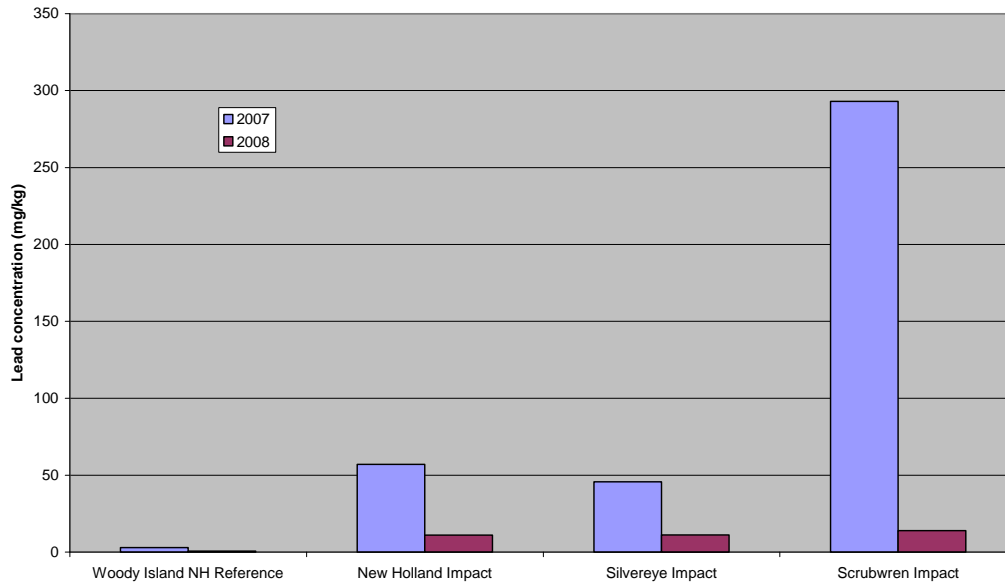
From the first survey Dunlop et. al. recommended “monitoring, and where feasible, remediation, needs to be continued until the Pb in Esperance bush birds has returned to background levels”. From the results of the second survey this point appears to have been almost reached.

³¹ Unreferenced, as the report has not been made available to the Working Group.

³² J.N. Dunlop, .G.Smith. K. Marrs & M. Harvey, *Monitoring point source Lead and Nickel Contamination of a Terrestrial Environment using the Feathers of Common Bush Birds*, Conservation Council of Western Australia, 25 June 2008.



Figure 14. Lead in Bushbird Feathers 2007 and 2008



A hypothesis for the second study was that the lead in the environment might concentrate in “hot spots” in litter or drainage sumps leading to incorporation into the food chain. Nick Dunlop³³ advises that results to date provide no evidence to support that hypothesis.

It seems that birds are mainly carrying the lead on their plumage. Despite preening involving the licking of feathers it appears that the lead is not being ingested, but is remaining bound (physically and perhaps chemically) to the feathers. Ten silvereyes were sacrificed and analysis found no relationship between lead in plumage and lead in liver.

The report noted that the ultimate fate of the lead in the environment was not known and suggested that there was a risk of bioaccumulation of lead in Esperance. Sampling of predators at the top of the food chain such as hawks or possibly feral cats may be instructive.

Investigating possible food chains and sinks, Dunlop found lichens highly contaminated, though this varied with aspect and exposure. Ants were sampled as a possible link in the food chain, but their lead levels were not elevated. Some sampling of bees was undertaken by the Department of Agriculture and the data is being made available.

Dunlop observed that lead seems to bind to surfaces, which would mean that remobilisation is less likely but that cleanup is more difficult.

2.12 Shire of Esperance monitoring of lead in playgrounds

The Shire of Esperance took swabs of playground equipment and samples of ‘soft fall’ sand for analysis of lead and nickel content. Four samples were taken at 2-3 monthly intervals in 2008 and a follow-up sample was taken in February 2009.

³³ Phone conversation with Jim Malcolm, 4 June 2009.



The Shire has yet to report formally on its findings, but some of the raw data were made available to this study.

All 'soft fall' sand samples were well below the clean up standard for lead in soil, but some of the swabs showed high levels of lead on the equipment. Where this occurred the equipment was cleaned and the 'soft fall' sand replaced where applicable. A second high reading after cleaning would tend to indicate recirculation of lead. In some instances this was found, however isotopic analysis of some samples showed it to be not necessarily from the Magellan mine site.

The data do not provide a clear answer to the question of remobilization of lead from the port at the present time.

Nickel levels in playground equipment swabs were commonly below the level of detection, including all sites in the February 2009 sampling. Soil samples were 4 mg/kg or less, compared with the health investigation trigger level of 600 mg/kg.

3. Conclusions

3.1 The air monitoring data provide clear evidence that lead dust is not recirculating widely in the Esperance townsite.

3.2 The same monitoring data show that nickel is being detected, albeit at levels below the 24-hour target, in atmospheric dust in the Esperance townsite. Whether this is recirculated nickel from previous dust events or new nickel from ongoing port activities is not clear.

3.3 Sampling of rainwater tanks shows some ongoing levels of both lead and nickel, though the source of the elements is not clear, given the low ambient air levels. Some lead may be from roofing and guttering materials and some from inadequately cleaned roofs.

3.4 Sampling of some houses close to the port shows some surfaces potentially accessible to children that exceed the standard for lead. This may be due to local micro-remobilisation (from uncleaned areas) or it may be due to sampling targeting surfaces overlooked in cleaning.

3.5 Sampling of flowers shows that levels of both lead and nickel were still elevated in samples within a kilometer of the port, when compared with those 7km from the port. Given the low ambient air levels of lead, it is likely that this lead has been transferred to sampled flowers from older accumulations on adjacent leaves.

3.6 Sampling of bird feathers in 2007 detected high levels of lead and nickel at impact sites in the town compared with remote reference sites. By 2008 the level of lead in feathers had greatly declined. Data for nickel were not available. It appears that the source of lead that contaminated feathers in 2007 has now declined to such an extent as to be scarcely measurable, confirming the absence of ambient air lead and suggesting that birds are not encountering significant lead stocks when foraging.



4. Recommendations

- 4.1 The proposed cleanup of lead contamination in targeted houses can proceed with confidence that there will be no significant recontamination from ambient air remobilization of lead residues in the township.
- 4.2 Nevertheless, evidence of contamination of surfaces in houses, especially near the port, emphasises that the cleaning protocol for the targeted houses must be thorough, including all dust accumulations that could be remobilized in the future (e.g. ceiling voids).
- 4.3 A closer study of wind directions and port activities (receivals and ship-loading) at the time of ambient nickel readings may give a clearer answer to the question of ambient air recirculation of nickel in the townsite.
- 4.4 It is essential that EsPA adheres to best practice dust controls and avoidance of nickel handling in onshore winds if the threat of recontamination with nickel is to be avoided.
- 4.5 To confirm the absence of remobilization there should be ongoing assessment of EsPA's air quality monitoring results, including new monitoring sites that are established in the future.
- 4.6 The cleanup must be followed by exhaustive validation sampling to ensure no dust accumulations have been overlooked.
- 4.7 There should be periodic sampling to confirm that no recontamination has occurred. This should include isotopic analysis to establish the origin of any lead or nickel found.
- 4.8 Further research is warranted into the fate of lead in the environment and the possibility of bio-accumulation of lead in predators.

5. Acknowledgements

This study has been greatly assisted by a number of people who gave freely of their time, data and analyses of relevance to the subject. The assistance of the following is gratefully acknowledged:

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- Michelle Crisp Locals for Esperance Development;
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- Nick Dunlop, Conservation Council of Western Australia;
- Richard Grant, Corporate Relations Manager, Esperance Port Authority;
- Michael Jackson, Coordinator, Esperance Community Consultations
- Martin Matisons, Principal Toxicologist, Department of Health;
- Peter McCafferty, Chief, Natural Resources Chemistry Laboratory, Chemistry Centre;
- Peter Skitmore, A/Manager, Licensing and Permitting Branch, Department of Environment and Conservation;



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Appendix 1 – Project Scope

Objective

The purpose of the Consultancy is to determine if lead and/or nickel residues in the Esperance townsite are being remobilised and if so by what mechanism.

Background

The town of Esperance was contaminated with lead carbonate during handling and loading of lead carbonate concentrate during the period April 2005 to March 2007.

The Parliamentary Inquiry into the cause and extent of lead pollution in the Esperance Area by the Education and Health Standing Committee, tabled in the Legislative Assembly on 6 September 2007 provides definitive background.

The Inquiry showed that as a result of emissions of lead from the Port of Esperance, residential and commercial premises in the town of Esperance, as well as the environment, have been contaminated by lead dust, with consequential impacts on the environment and community including elevated blood lead levels in children.

There remains some lead, and to a lesser extent, nickel contamination in the town of Esperance.

The Government has given a commitment to a comprehensive cleanup of the Esperance townsite. The Premier's statements to the Legislative Assembly on 3 December 2008 refer.

A Steering Committee has been established to oversee the Esperance Cleanup and Recovery Project [ECRP]. This Steering Committee includes officers from relevant government agencies [Department of Health (DOH), Department of Environment and Conservation (DEC), LandCorp, the Department for Planning and Infrastructure], the Shire of Esperance and community representatives [including the Esperance Chamber of Commerce and Industry].

The Department for Planning and Infrastructure [DPI] is the responsible agency to manage the cleanup project. Other Government agencies involved in this cleanup project include DOH, DEC and the ChemCentre.

Description of the Project Task.

In order for the cleanup project to be effectively carried out, it is essential to establish whether lead and/or nickel is recirculating within the Esperance environment and if so the mechanisms by which this may be occurring. The assessment should determine whether there are implications of any remobilisation to public health and the project of cleaning the premises in the townsite.

There are several existing data sets which can be interrogated in order to assess this issue. Those data sets include:

- The ongoing high vol and depositional gauge environmental monitoring program conducted by the Esperance Port Authority,



- The ongoing environmental monitoring program conducted by the Department of Environment and Conservation [DEC]. This includes annual [March] monitoring of vegetation.
- Recent [February 2009] intensive monitoring of 21 homes in Esperance which includes re-sampling of homes previously cleaned.
- The DOH/University of WA Survey of Lead and Nickel Levels in Esperance Rain Water Tanks
- Locals for Esperance Development (LED) survey of lead and nickel residues in Esperance homes,
- Risk Assessment Report by Golder Associates [April 2009]
- Studies by the Conservation Council of WA on lead content in bird feathers.
- Monitoring of lead concentrations in Esperance playgrounds by the Shire of Esperance.

This listing of data sets is not exclusive. Further studies are planned or in the course of implementation. The relevance of these further studies should be assessed in relation to the question of remobilisation.

The *Consultant* will be required to investigate the issue with relevant agencies and NGO's including:

- Department of Environment and Conservation.
- Department of Health - Environmental Health Branch
- Conservation Council
- Esperance Port Authority and its relevant consultants
- Locals for Esperance Development
- Shire of Esperance

The *Consultant* will provide advice and recommendations on whether the existing data is adequate to provide a definitive answer to the question or whether additional studies are required or desirable.

Accountability and Key Stakeholders

The *Consultant* will be directly accountable to the Project Director, Esperance Cleanup and Recovery Project.

A small Working Group is to be established by the Project Director to co-ordinate the work of the *Consultant*. The Working Group includes representatives from DEC, DOH, the Shire of Esperance and the Esperance Community [LED]. The *Consultant* will report in the first instance to this Working Group.

Project Deliverables

The *Consultant* is required to prepare a report of the assessment and to provide a presentation of the findings to the ECRP Steering Committee.



Format of Report

The *Consultant* shall provide an electronic copy (suitable for use with Microsoft Windows 2000) of any drafts and for the final report. The Report shall be of a professional standard and include:

- a summary;
- introduction;
- documentation of the findings of all investigations;
- assumptions made and their basis;
- consultation undertaken;
- conclusions and recommendations and the rationale behind these;
- relevant figures; and
- references to or/and appendix of data accessed.

Timing and Contract Period

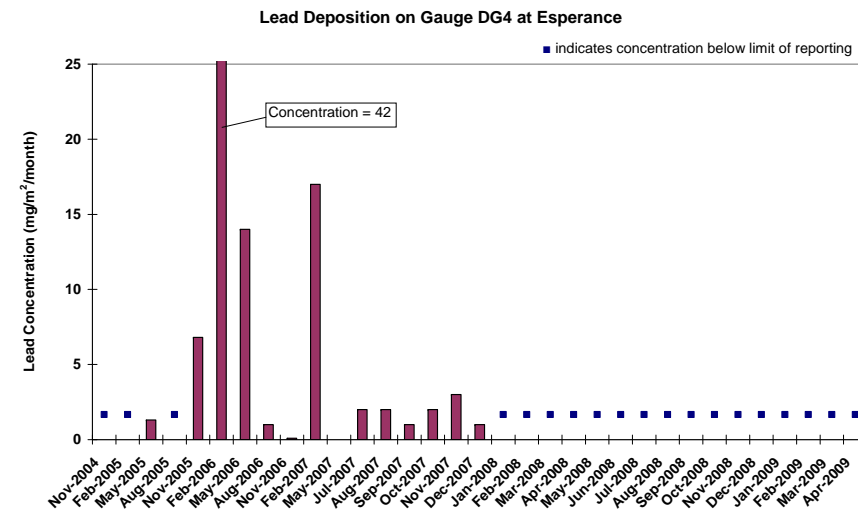
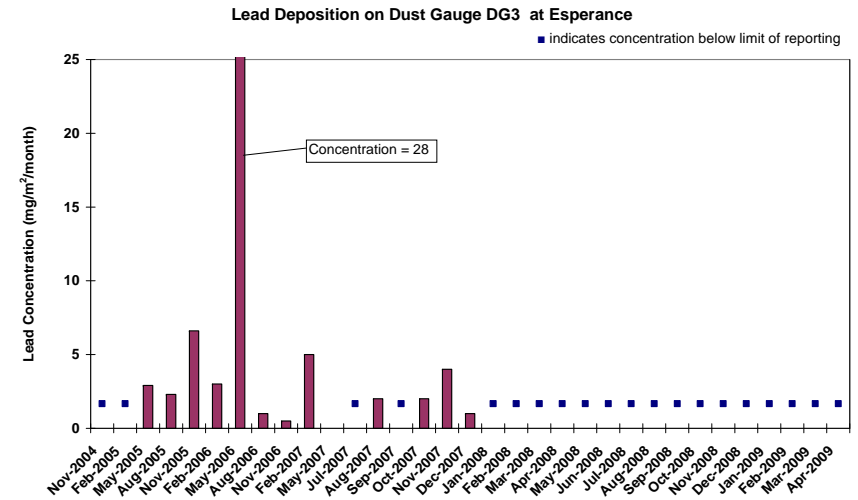
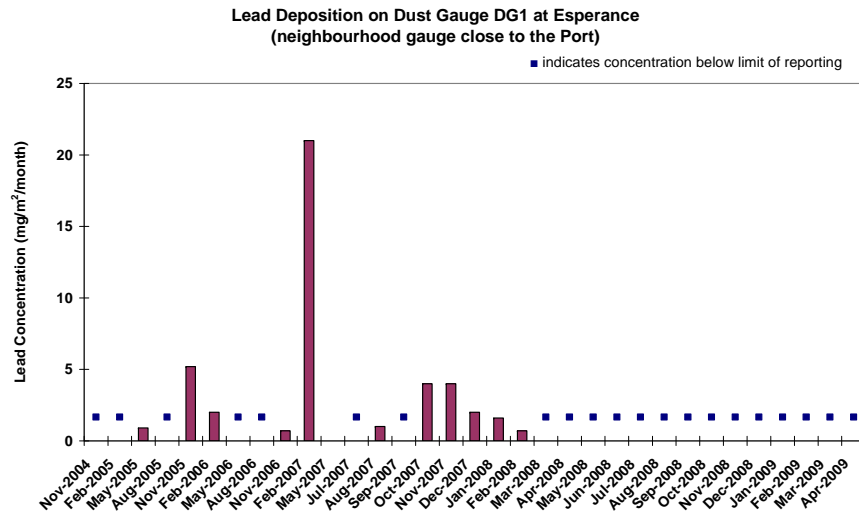
It is anticipated that the *Consultant* will commence around late May and submit their final report by 30 June 2009. This is a period of approximately 6 weeks though the *Contract* will remain in place until the *Services* are completed to the satisfaction of the *Principal*.

It is estimated that 100 hours will be sufficient to complete the required investigation.

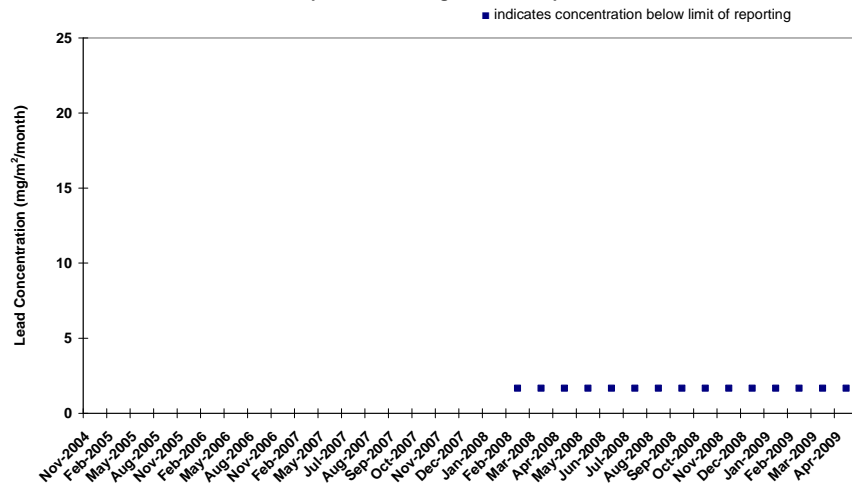


Appendix 2 – Charts for all Community Deposition Gauges and Hivols

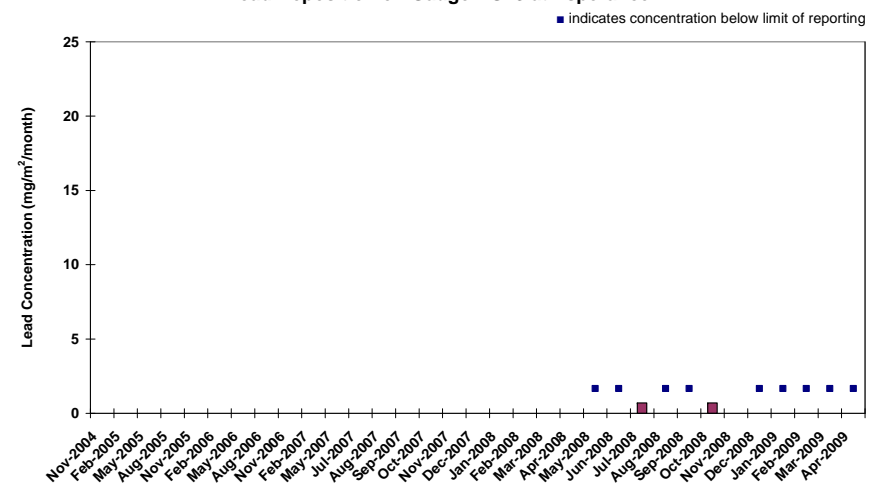
1. Deposition Gauges



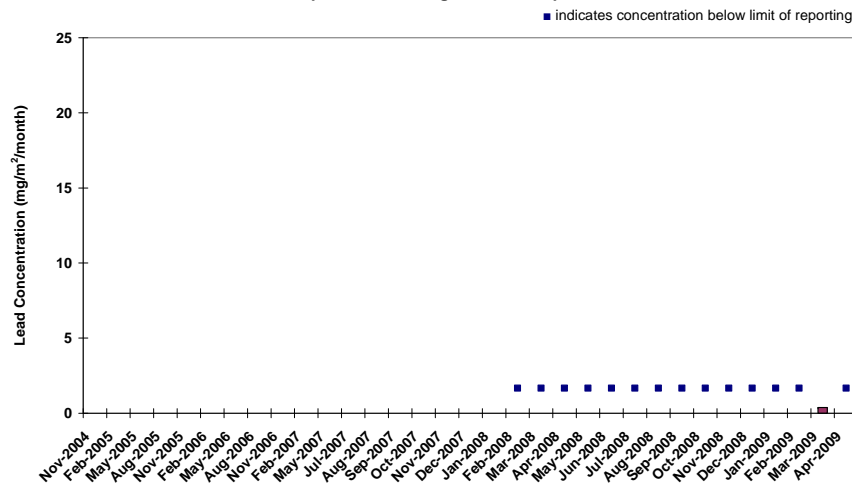
Lead Deposition on Gauge DG11 at Esperance



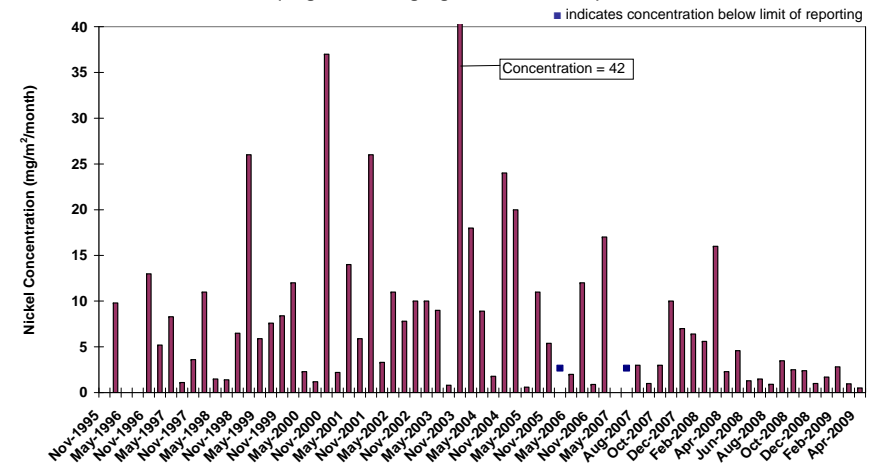
Lead Deposition on Gauge DG13 at Esperance



Lead Deposition on Gauge DG12 at Esperance

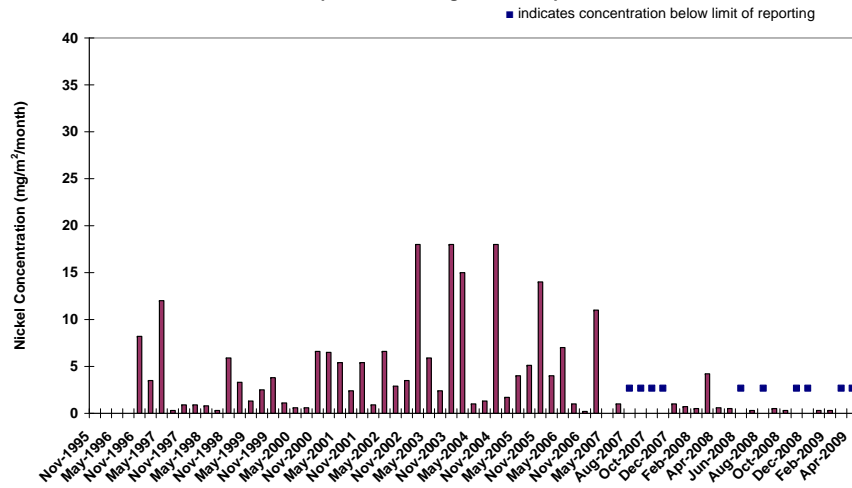


Nickel Deposits on Gauge DG1 at Esperance
 (neighbourhood gauge close to the Port)

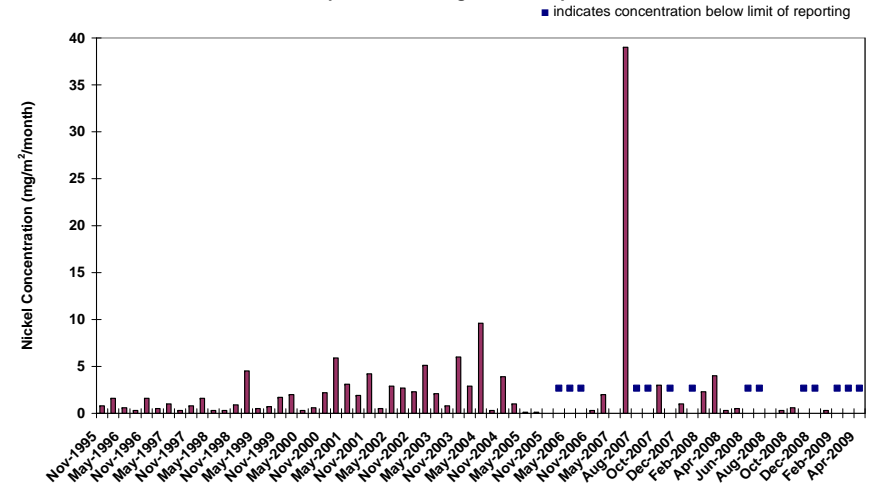


Remobilisation of Lead and Nickel in Esperance
 Report of the Working Group to the Steering Committee of the
 Esperance Cleanup and Recovery Project

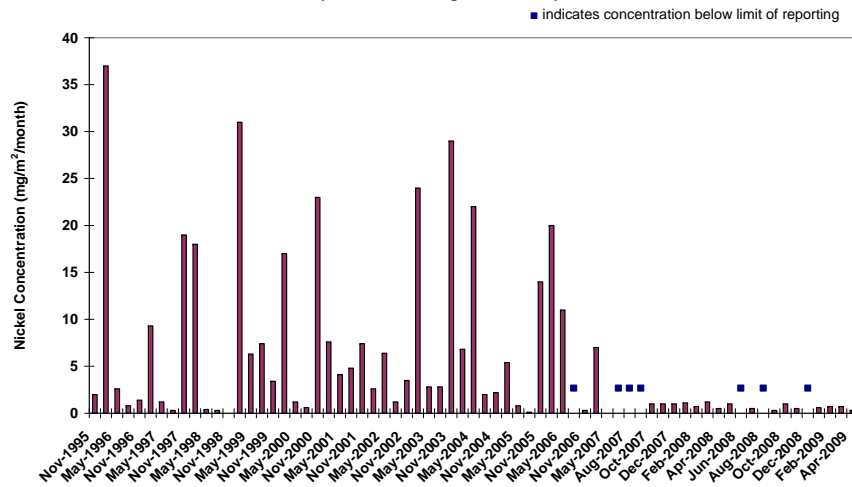
Nickel Deposition on Gauge DG3 at Esperance



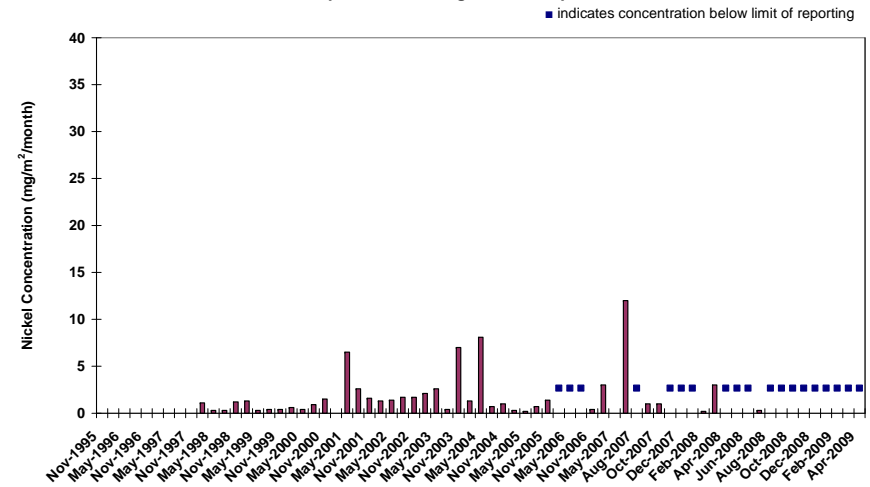
Nickel Deposition on Gauge DG5 at Esperance



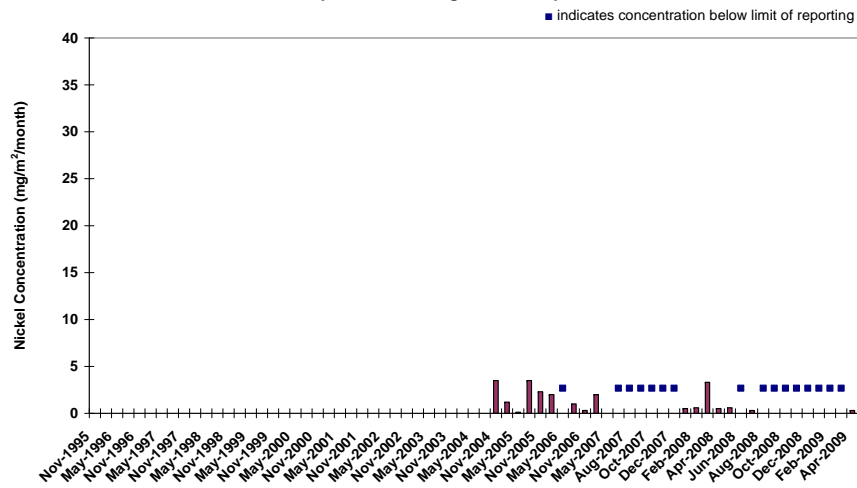
Nickel Deposition on Gauge DG4 at Esperance



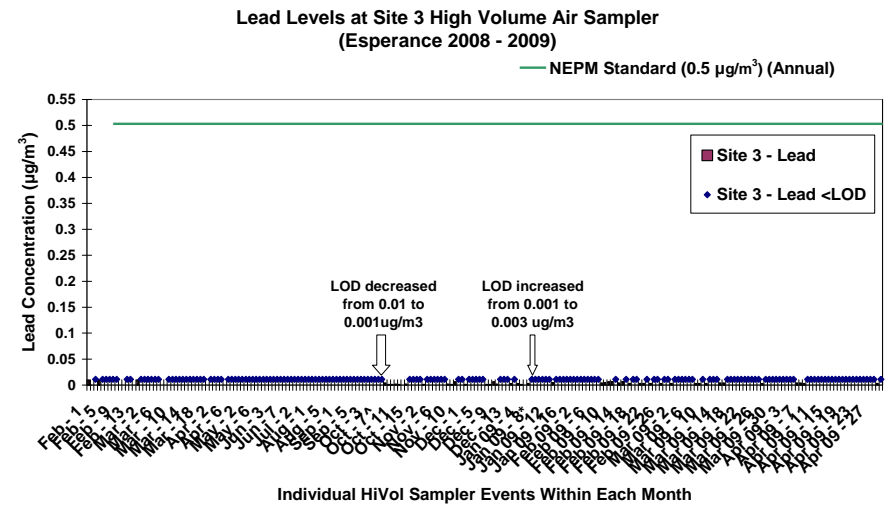
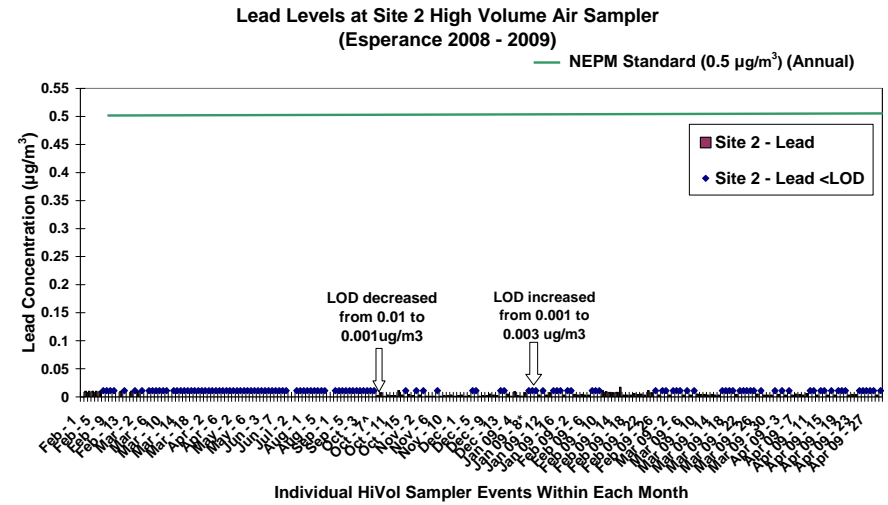
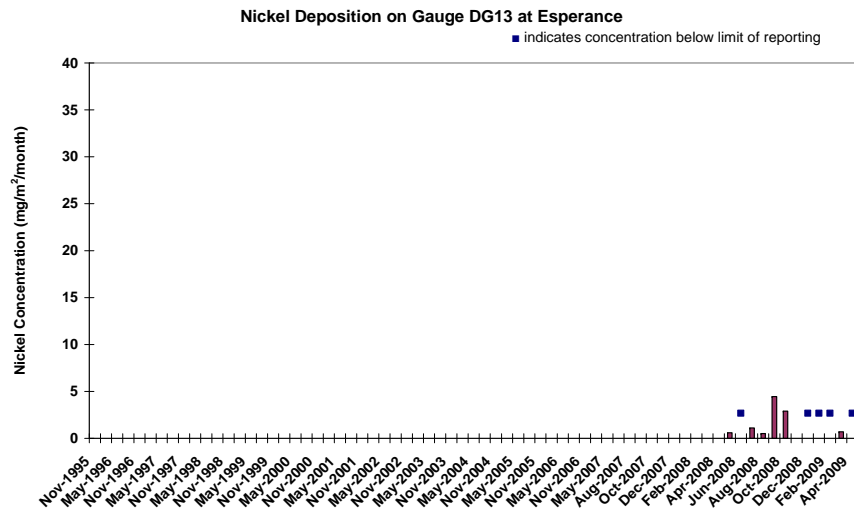
Nickel Deposition on Gauge DG6 at Esperance

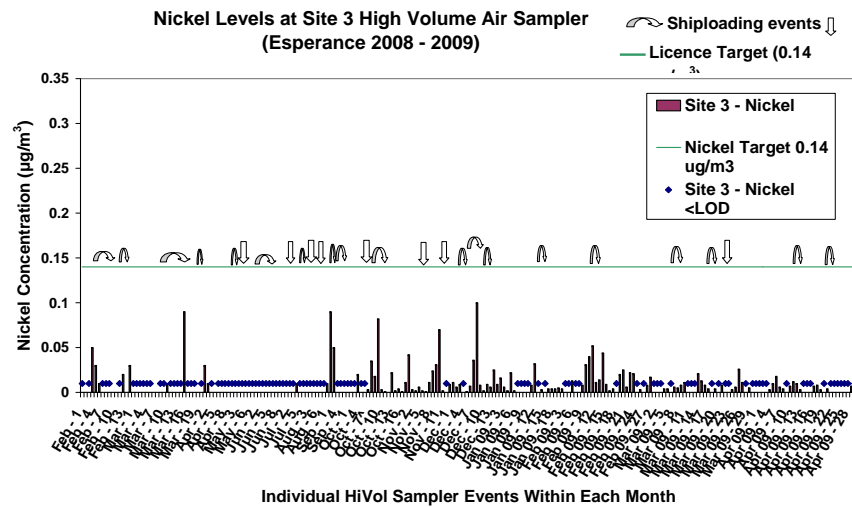
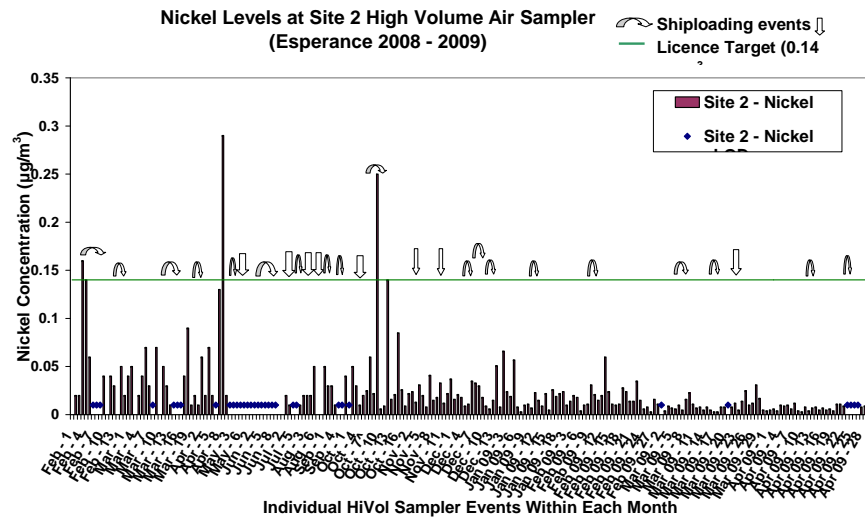


Nickel Deposition on Gauge DG7 at Esperance



2. Hivol Air Samplers





Appendix 3 – House Cleaning Protocol

House Cleaning

House Cleaning of homes where the blood lead level of a child exceeds the guidelines of 10 micrograms per decilitre.

These guidelines have been provided by the Department of Health.

The Contractor will -

Wet wipe all walls and floors starting at the highest point and working down to the floor.
Clean the floor last.

Vacuum and then mop all hard floors in a home. The mopping water will be changed for each room, then each floor will be rinsed using clean water and a clean mop head.

Use the HEPA vacuum to clean floors. These are available free of charge from Arnold Autos/Coates Hire, 65 Norseman Road, Esperance. (The contractor will pay the bond for the hire and will return it after use.)

Wet wipe all hard surfaces, including table tops and chairs, coffee tables, book shelves, windows, window sills, doors, handles and other accessible surfaces. Wet wipe kitchen bench tops.

Use the HEPA vacuum to vacuum carpets and soft furnishings, including lounge chairs.

Wet wipe venetian or vertical blinds to remove accumulated dust.

The Resident will –

Wet wipe all kitchen tops before each meal after the cleaning.

Wash bed linen and blankets if they have not already done so.

Clean hard surfaces at least once a week.

Inspect curtains and blinds monthly and wet wipe accumulated dust.

Relevant to contractor and home owner

When cleaning –

Clean or replace sponges, cloths and mop heads regularly to prevent the spread of dust around the home.

When wet cleaning, pour or spray the cleaning fluid onto a mop, sponge or cloth to prevent contaminating the cleaning fluid.

Wet clean all hard surfaces in the home using a high phosphate detergent or all purpose detergent.

Do not use a dry cloth or feather duster to clean surfaces.

Do not use a broom or dust pan to remove dirt or dust from your floor.

July 23, 2007.



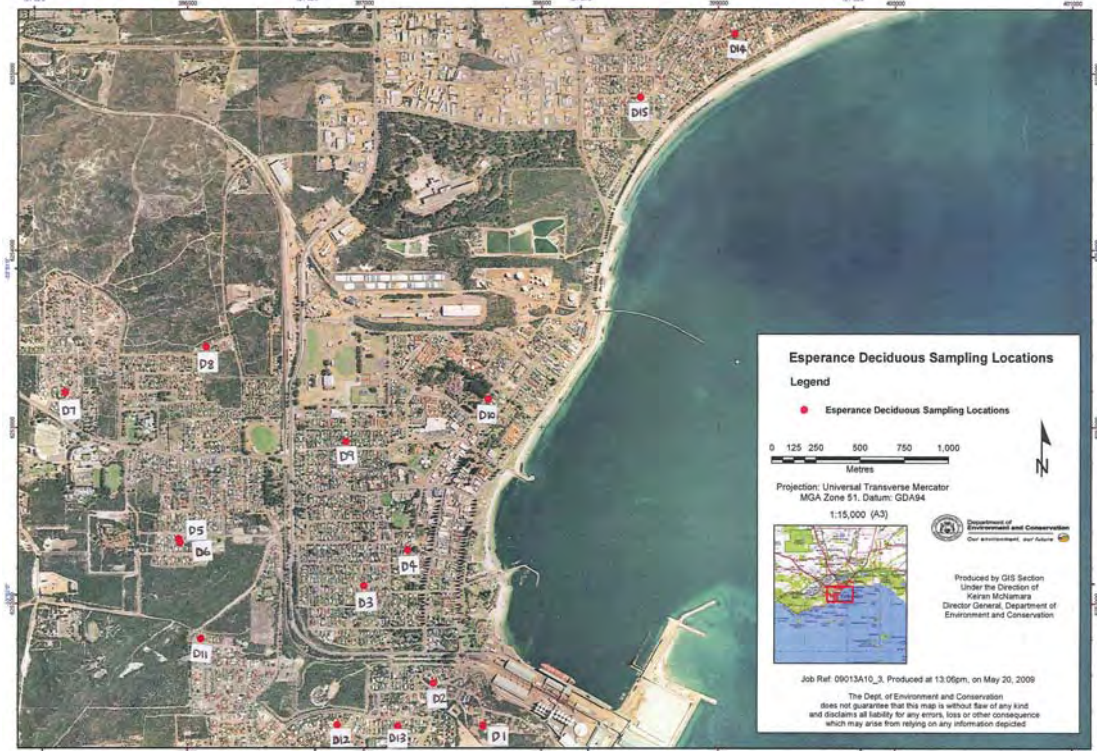
Appendix 4 – Locations of LED samples

Inside Swabs	Outside Swabs	Roof Space Swabs	Roof Swabs
Wood Bookcase Top	Outside Verandah Ledge	Top of Man Hole Cover	Roof
Window Sil Near Door	Gutters Only	Top of Man Hole Cover	Roof
Top Kitchen Shelf	Above Metre Box	Roof Cavity	Roof
Top Kitchen Shelf	Gutters +1m roof on catchment side	Roof Cavity*	Roof
Fridge Top	Clothesline Frame	Roof Cavity/ Man Hole Cover	Roof
Top of Fridge	Front Door Step	Roof Cavity/ Man Hole Cover*	Roof
Top of Fridge	Beam Verandah Ledge	Roof Cavity	Roof
Ledge Above Door	Top of Rainwater Tank	Roof cavity man hole lid	
Bookshelf	Top of Metre Box		
Window Sill front of House	Top of Metre Box		
Low window sil in childs room	Top of Airconditioner Outside		
Low window sil in childs room	Top of Airconditioner Outside	* These two were dry dust samples	
Top of cabinet	Verandah Ledge		
Window sil-low	Top of Metre Box		
Fan Blade	Verandah Ledge Framing		
Bench Top Kitchen	Window Ledge		



Appendix 5 – Sampling of Deciduous Leaves

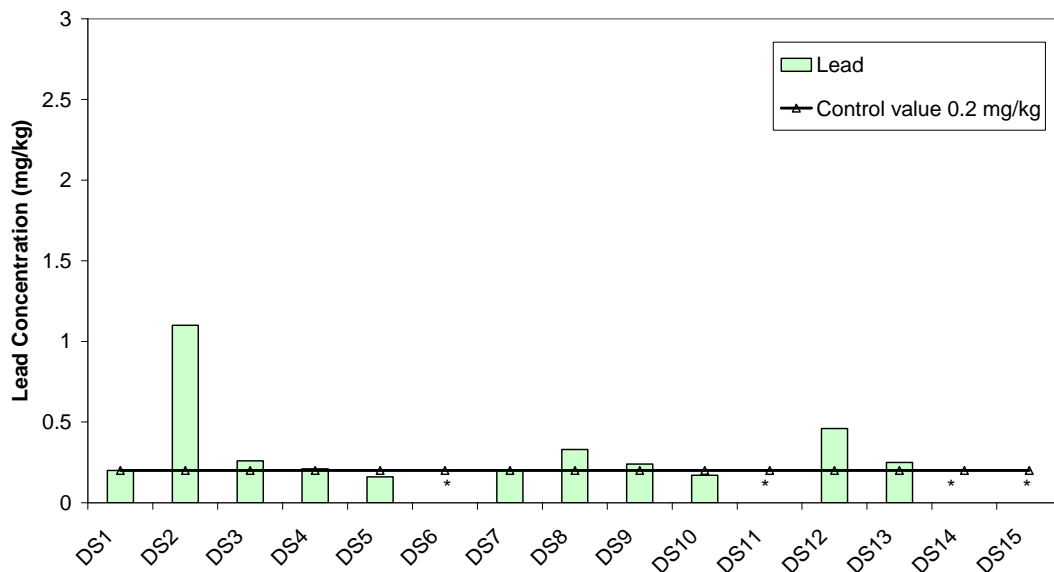
Sampling locations

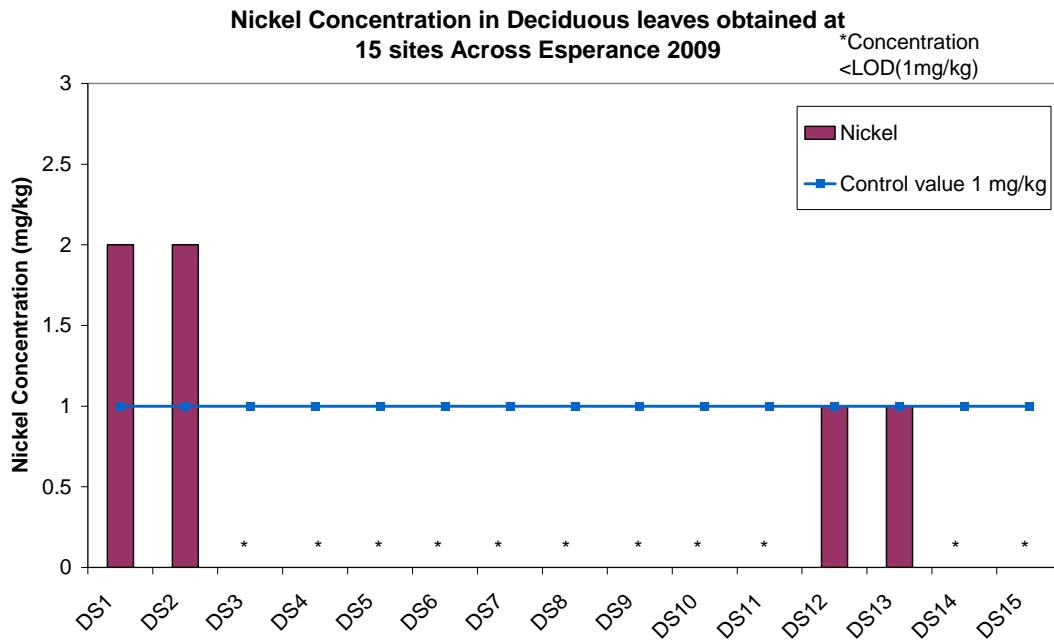


As the aerial photograph indicates, sites DS1, 2, 3, 4, 12 and 13 are the closest sites to the port. Almost all lead levels were near to or below the control value of 0.2 mg/kg and four samples were below the LOD. Sites DS2 and 12 showed the highest lead levels. Levels were generally similar to those for flowers, confirming the finding that lead is not circulating widely in the community.

**Lead Concentration in Deciduous leaves obtained at
 15 sites Across Esperance 2009**

*Concentration <LOD





For nickel all sites were at or below the level of detection except DS1 and 2. These data do not provide evidence of mobilization of nickel in the wider community in 2009, with a low level of nickel detected only at sites closest to the port. Note that the LOD for nickel is five times that for lead due to analytical limitations.

